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THE

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A WEEKLY REVIEW OF CURRENT PROGRESS IN ELECTRICITY AND ITS PRACTICAL APPLICATIONS

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COMPLIMENTS OF THE SEASON.

It gives THE ELECTRICAL WORLD pleasure to cordially wish its readers a Happy New Year and much prosperity during 1895.

OUR SERIAL ARTICLES.

In the present issue, the first of a new volume, we give at the head of the serial articles of Messrs. Houston and Kennelly, A. E. Wiener and Dr. Bell, a synopsis of the parts which have previously appeared. This will enable a new reader to intelligently follow the remainder of the sections, and, at the same time, will serve as a review that will doubtless be appreciated by those who have read the articles from the beginning.

BREAKING THE RECORD AGAIN.

This is the largest number of an electrical journal ever published. The edition printed is also the greatest, 17,250 copies. How previous large editions of THE ELECTRICAL WORLD compared with this as regards advertising will be seen from these figures:

	Pages.	Number of advertisements.	Inches of advertising.
March 7, 1891	42	301	2,099
Feb. 27, 1892	52	357	2,613
March 4, 1893	56	378	2,828
March 3 1894	76	386	3,215
January 5, 1895	88	395	3,781

Surely the business outlook in the electrical and kindred industries must be promising to render such an issue possible.

TECHNICAL SUBJECTS POPULARLY TREATED.

We print elsewhere the first five of a series of technical articles on the practical or industrial side of electrical science, and written so as to be easily understood by those who have not had the time or inclination to become versed in the more special knowledge usually demanded when applying to other sources of information on the same subjects. While the subjects are treated in a popular manner in one sense, they differ from most articles of the kind in being from the pens of technically competent writers, and are technically correct in their information—which, it is scarcely necessary to state, is too often not true of the usual popular article. While we believe that the series will be particularly appreciated by the business man, who, as a rule, has not time to delve into special treatises or to follow consecutively the various developments as announced in the periodical press, and also by the student and general reader, we also feel sure that they will not be found without interest by the technical reader. The authors have avoided dwelling upon matters of special or purely theoretical interest, but as the articles will cover a wide range of electrical applications, many of them will doubtless touch upon subjects that some, though experts in one of the branches treated, have had little or no opportunity to follow closely if at all, and who will be interested in becoming acquainted with their general outlines. In the present issue the manufacture of the incandescent lamps is described by Lieut. M. K. Eyre, every stage of the numerous processes being clearly explained. Mr. B. F. Miles, in the same manner, treats of the manufacture of arc light carbons, which is a subject on which heretofore but little information has been available. A typical central station dynamo is the theme of Lieut. J. B. Cahoon's' article, and Mr. J. Appleton gives a most interesting account of the manufacture of storage batteries, which is particularly apropos at a moment when this industry promises to assume much larger proportions than, owing to unfortunate litigation, it has in the past. The article on the street railway controller in a short space gives the information necessary to understand the various systems of controlling apparatus that are now, or have been, in use; the usual extremely complicated diagrams of connections are omitted, as they ordinarily tend merely to create in the mind of other than street railway electricians the impression that the subject is a difficult one to understand, which a reading of the article will show is far from being correct. In succeeding issues will appear articles on other practical applications, written in pursuance of the plan followed in the present ones.

IS THIS DUE TO THE CHANGE IN FORM?

To print the first issue of THE ELECTRICAL WORLD for 1894, consisting of 15,000 copies of 100 pages, required just 200 reams of paper. The present edition consists of 17,250 copies of 128 pages, and no less than 274 reams of paper, weighing a little over 9 1-7 tons, is used for this single number, an increase in paper amounting to 37 per cent. The first number of 1894 had 40 pages of reading matter. Owing to the smaller type in which the paper is now set, to-day's 40 page issue contains considerably more matter than did the corresponding issue of last year. In volume of advertising this week's paper contains 88 pages, against 60 a year ago, an increase of 32 per cent; 395 advertisements, against 320, an increase of 19 per cent.; and 3,781 inches, against 2,541, an increase of 33 per cent.

THE DIGEST.

Commencing with the present number, the scope of THE ELECTRICAL WOLDR'S Digest of Current Technical Electrical Literature will be extended to include matter published in American as well as in foreign journals. This was the ultimate intention when the Digest department was established two years ago, and as many readers have also urged the change just made, we have reason to feel that the notable increase of labor and expense entailed will be appreciated. One of the prinicipal considerations that led to the extension of the Digest was the recognition of the fact that heretofore many useful articles on electrical subjects have been unavailable to the general electrical public through appearing in periodical to which they do not have access. Among these are the college technical publications, which frequently contain the results of original experimental work of value. The transactions of professional societies other than electrical also occasionally contain a paper on an electrical subject, and the same is true of the various general and special scientific journals, the total assuming considerable proportions. Owing to the prior clims on our space of original matter, of which even only a portion of that submitted having intrinsic value can be utilized, it has been impossible for us to reprint these articles, or even to abstract them in the usual form. Hereafter they will be treated by Mr. Hering in the Digest department, after the system heretofore applied to foreign periodical literature, and in addition, there will be a Digest of the more important articles appearing in American electric journals. It is not intended, however, to make these articles inclusive in character, but rather, following the scheme of the foreign Digest, to briefly indicate the main points brought out, the reader desirous of learning all of the details being referred to the original. We feel that this new feature will greatly enhance the already important character of this department of THE ELECTRICAL WORLD. We may add that the amount of work involved in preparing the weekly instalments is much greater than might be supposed from their extent. When it is considered that scores of journals have weekly to be carefully scanned, and articles, when found worthy of notice, closely studied to be able to give in a few words an intelligent idea of their main points, it will be seen that the labor and attention required is extremely arduous; particularly as many articles read over are found to contain nothing worthy of mention. It is an entirely different matter to condense a long or important article into a minimum number of words than to abstract it in the usual manner without particular reference to the space occupied, and this is particularly true if the aim is to make the digest of the article a conscientious summary of the original.

THE PROMISE OF THE NEW YEAR.

We are not of those who consider that "electricity is only in its infancy," but on the contrary believe that it has arrived at an age of maturity and contains little probability of the startling developments which the lay public thinks it may at any time bring forth. On the other hand, there are promises of great advances in several directions, some of which may even be realized during the year now commencing. Of these by far the most important is the realization of "cold light," or electric lamps in which a considerable portion, instead of perhaps less than one per cent., as at present, of the energy supplied will be converted into luminous, instead of heat, rays. Tesla and Pupin in this country, Lodge in England, and Ebert and others in Germany have been working in this direction, and though the results thus far have been meagre from a practical standpoint, yet the glimpses given of the possibilities lead us to hope that they may eventually be realized. Thus far the researches have been largely gropings in the dark, but with the rapid advances being now made in the knowledge of Hertzian phenomena we may soon have the principles developed from which practical results will follow as mere deductions, as when after Faraday discovered the phenomenon of induction every modern application of electrodynamics could have been at once predicted if the conditions of the problem had been given. The German school of electrochemists also seem to be working along new and promising lines, though thus far the results offered have had little practical value, and some of them, as, for example, the recent hydro-carbon gas battery, described in our columns, seem like familiar sights displayed in a new light and described in new scientific terms. Going from the domain of pure science to that of the engineer, we are on surer ground, for here it is merely a question of fashioning the material at hands in accordance with the conditions which may present themselves. The starting of the Niagara plant during the year will undoubtedly give an impetus to the utilization of other water-powers for electrical purposes, and the transmission of power. The year will also possibly mark a considerable advance in arc light engineering through the employment of larger and direct-connected units, and finally fix the practice of the exclusive use of direct connected machinery for all except the smallest units in all generating stations and larger isolated plants. We may also expect during the year to see the commencement in all cities and larger towns of electrical power distribution by multiphased currents, which may also result eventually in largely affecting the present methods of electric light supply. Whether long-distance electric traction will make any advance is questionable; thus far the propositions to this effect have been purely speculative ones, or made with a view to obtaining franchises really intended for local traffic, and until the subject is studied more from an engineering standpoint than it has been it will be unsafe to hazard an opinion. Urban and shorter inter-urban lines, however, will be enormously increased if we are to judge from the many hundreds of projects that have been announced in our news columns the last several months, and the time does not seem far distant when a horse car will be almost a curiosity. Underground conduit traction schemes will probably await the outcome of the road to be built in New York; this, however, in this light of the success of the similar one at Budapest, does not seem doubtful. Long distance telephony with cheap lines and telegraphing without wires, both await the solution of the scientific problems we have before referred to, the experiments in Europe in regard to the latter revealing no possibilities beyond what might have been experimentally shown years ago if it had been thought worth the while.

Ludwig Boltzmann.

BY M. I. PUPIN.

Few Continental mathematical physicists appeal so strongly to the mode of thinking of the English student as does Boltzmann. His profundity reminds one of Helmholtz; his suggestiveness is very much like that of Maxwell; his mathematical elegance recalls the pleasures which the lover of mathematical physics derives from the reading of the classical writings of Kirchhoff, Neuman and Jacoby; his clearness is that of the English school of mathematical physics, the School of Thomson, Stokes and Airy.

In Boltzmann we have a happy combination of the cold exactness of the North and the warmth of feeling and the vividness of imagination of the South. German science celebrated most of its triumphs in the North, German poetry and German art flourished and flourish to-day principally in the milder regions of the genial South, on the banks of the Danube, the Neckar, and the Rhine.

It is on the banks of the Danube that one would naturally look for the home of Boltzmann, and in no other place than that most charming of continental towns, Vienna, the blessed Austrian metropolis. Blessed indeed, may it well be called, for it was a blessing from Heaven to be a dwelling place of that most noble of European dynasties, the imperial house of Hapsburg. Wiser, more generous, and more enthusiastic patrons than the Hapsburgers of art, literature and science have never been seen.

Here Boltzmann was born in 1844, and here he studied at the famous University, where he received his degree of Ph.D. in 1869. It should be mentioned, however, that Boltzmann studied also at the Universities of Heidelberg and Berlin, and that they share with the University of Vienna the honor of having contributed to the early training of this representative German physicist. In 1869, when only 25 years of age, he was appointed Professor of Mathematical Physics at the University of Graz, where he remained till 1873, when the University of Vienna called him to the chair of mathematics. His friends in Graz knew Boltzmann's love for experimental physics, and they understood full well that an offer of the chair in experimental physics would bring him back again; and so it did. Boltzmann returned to Graz in 1876 and continued his most productive work there as Professor of Experimental Physics until 1889.

LUDWIG BOLTZMANN.

During the earlier part of this period Boltzmann devoted much of his attention to molecular physics, and as the principal results of his epochmaking investigations may be cited his resarches into the kinetic theory of gases and the mechanical basis of the second law of thermodynamics. It is interesting to mention in this connection that while still a student at the university, Boltzmann felt a strong desire to read the works of Maxwell, Thomson, Stokes, Airy, Joule and other English writers. Obtaining one day Maxwell's essays on the kinetic theory of gases the electromagnetic theory of light, he resolved to read them with and the aid of a dictionary, though he did not understand a single wordof English. A few days of strenuous effort carried him through these essays, and so pleased indeed was he with his success that he repeated it, his rather unusual method of mastering the intricacies of the English idiom, and found himself in a very short time perfectly at home in the English scientific literature, though he had never heard a single word of English spoken. This was, undoubtedly, a very fortunate incident in Boltzmann's life for many reasons, as will appear presently. One of these reasons should be mentioned now. Without the co-operation of Boltzmann's inimitable analysis, the kinetic theory of gases, called into existence by the original researches of Kronig, Clausius and Maxwell, would hardly withstand the vigorous assaults of recent scientific thought, especially the inquiry into the constitution of gases as revealed by the constitution of their spectra. It should also be observed here that two of Boltzmann's most prominent pupils, Professors Arrhenius and Nernst, have contributed much suggestive and valuable work to physical science, especially to the domain of physical chemistry, in their vigorous attempts to extend the kinetic theory of gases to dilute salt solutions.

Professor Boltzmann's investigations in electricity can scarcely be over-estimated. He may be very properly called the apostle of the Faraday-Maxwell theory in Germany. As is well known, the three most striking predictions of this theory were:—Electromagnetic disturbance travels through dielectrics as waves; the velocity of propagation of these waves is the same as that of light; in non-magnetisable dielectrics the square of the index of refraction is equal to the dielectric constant in electromagnetic measure. Boltzmann was the first to test experimentally the validity of the last of these three predictions by a careful determination of the specific inductive capacity of a large number of dielectrics whose indices of refraction were known. (Wiener Sitzungsberichte, vol. 66, 1872, and vol. 67, 1873). Soon afterwards he observed the pondero-motive power on dielectrics when in an electrostatic field, and made use of it for new measurements of specific inductive capacities (Wiener Sitz.-Ber., vol. 68, 1873). He found that in the case of paraffines, resinous substances, sulphur and gases, Maxwell's relation between specific inductive capacity and index of refraction is fulfilled, while for other substances it is not. (Wiener Sitz.-Ber., vol. 69, 1874). He also discovered that crystallized sulphur has a different specific inductive capacity in different directions, in perfect accordance with Maxwell's electromagnetic theory of light. He was also the first to point out that in luminous vibrations the direction of electrical displacement is normal, and that of magnetic induction is parallel, to the plane of polarisation.

Boltzmann's conviction in the correctness of the Faraday-Maxwell theory of electromagnetism grew stronger and stronger until it became his firm scientific faith, which he was ready to defend and to propagate with all the vigor and burning enthusiasm of which his strong nature is capable. Numerous are the articles which he has published on this subject, most of them in *Wiedemann's Annalen*. A beautiful account of the view which Boltzmann has formed of the Maxwell theory is given in his treatise:—Vorlesungen über Maxwell's Theorie der Elektricitaet und des Magnetismus. I. Theil: Ableitung der Grundgleichungen für ruhende isotrope Körper, 1891. II. Theil: Verhalten zur Fernwirkungs-Theorie, 1893. Published by Johann A. Barth, Leipzig. This treatise contains by far the best, if not the only correct, commentary and true interpretation of Maxwell's theory of electricity. It is written in a very elementary style, and can be warmly recommended to all students as an easy introduction into Maxwell's treatise.

Professor Boltzmann is a young man still. He has done much for which the scientific world owes him a debt of lasting gratitude. Those who have followed steadily and studied carefully his beautiful researches trust most confidently that under his leadership German physical research will progress as steadily as it did under the leadership of Helmholtz and Hertz.

English Honors for American Work.

It may interest Americans to know that the only paper read before the London Institution of Electrical Engineers during the past year which was awarded the Institution premium was Mr. Wilkinson's for his paper on "Notes on Electric Tramways in the United States and Canada."

The Record of the Year.

The year 1894, although not characterized by remarkable activity in the electrical field, has witnessed a gradual but certain improvement in every direction. The electrical industries, like all others, have but slowly recovered from the effects of the financial depression of the preceding year, but that evil has in many ways proved a blessing, and business is established on more firm and lasting foundations. There is every indication that with the new year, new life and activity will be developed in every quarter.

It is perhaps in the telephone field that the greatest interest has been manifested. The first month of the year saw the expiration of the Bell receiver patent, thus throwing the field open for magneto instruments and leaving the Bell company's claims to the battery transmitter resting entirely on the Berliner patent. The result was the appearance on the market of a large number of magneto telephone outfits and the development of a considerable business in the manufacture and sale of instruments for interior and short distance work. The sensation of the year, however, was the recent decision of Judge Carpenter, at Boston, declaring the Berliner patent to be void, and making public the battery transmitter. It is too early yet to establish the effect of this decision, but as the field is thrown open, it is presumed that at least outside of the large cities considerable competition to the Bell interest will spring up.

The incandescent lamp situation has not attracted the attention it did a year ago. A few decisions were rendered in cases brought by the Edison interests against infringing manufacturers. On Nov. 17 the Edison patent expired by limitation of the Canadian patent, but even this important event created little stir and has resulted as yet in no appreciable change in the situation.

The reversal of Judge Green's remarkable decision in the Edison feeder and main case is another of the important decisions handed down in the courts during the year.

The accumulator has occupied quite a prominent position in the field during the year. The installation of an auxiliary plant in the station of the Edison Electric Illuminating Company of New York marked an important advance in the use of storage batteries of large capacity in this country. After more or less litigation, the Electric Storage Battery Company, of Philadelphia, acquired control of all the patents rights for the United States, thus securing to itself a monopoly of the sale of accumulators. The final settlement of a legal battle, in which the various companies have been engaged for many years, much to the detriment of the industry, will undoubtedly lead to a more general use of storage batteries.

Some important transmissions of power plants have been installed during the year, notably the three-phased stations at Concord, N. H., Portland, Ore., Taftville, Conn., and Columbia, S. C. One of the most interesting points about these plants is the adoption of the three-phased current, showing that multiphased transmission is obtaining a strong foothold here, as well as abroad. Work has been steadily progressing on the great Niagara Falls plant, the generators being practically completed and a number of the turbines already in place.

The subject of electric traction has received considerable attention. The electric propulsion and towing of canal boats has been widely discussed in New York, and some experiments in this direction actually carried out. Electric locomotives have also come somewhat to the fore, and in this country those for the Baltimore tunnel have been practically completed. At the recent election in New York City the proposition for an underground road, which almost certainly means the adoption of electricity as a motive power, was approved by popular vote, and the Metropolitan Traction Company during the year decided to construct on a portion of its lines an underground conduit system, a modification of that which has been in successful operation in Budapest for the past few years.

The adoption of the provisional magnetic units by the American Institute of Electrical Engineers was one of the important incidents of the year and a step which will prove of value to both theoretical and practical men. The legalizing by Congress of the units adopted at the International Congress of Electricians—the ohm, volt, ampere, coulomb, farad, joule, watt and henry—was also very gratifying to the advocates of a standard system of electrical units.

The annual meetings of the various societies and organizations have been fully up to the usual standard. They were led off by the convention of the National Electric Light Association at Washington, in February, at which the sensation was a new system of transformation described in the paper of Mr. C. F. Scott. The Philadelphia meeting of the American Institute of Electrical Engineers in May proved to be a most interesting and instructive one, and the discussions were participated in by an unusually large number of prominent engineers. The annual gathering of the American Association for the Advancement of Science, New York Street Railway Association, Northwestern Electrical Association and the American Street Railway Association were very successful.

The year 1894 will also be remembered by every member of the American Institute of Electrical Engineers as that of the successful establishment of the Chicago local branch. This was an important step and will probably lead in time to the formation of other branches in various sections of the country, and a consequent widening of the field of usefulness of the parent body.

The necrology of the year unfortunately includes the great name of Helmholtz, whose death is an irreparable loss to science. Heinrich Hertz, that brilliant young experimenter of whom so much was predicted and expected, has also joined the great majority. Edmond Julien, the inventor of the type of accumulator which bears his name, and Jablochkoff, who devised the famous Jablochkoff candle, have also died during the year.

In periodical literature the important contributions have been principally to alternating current theory and practice. The most notable of these, without doubt, has been the "Sine Curve Controversy," carried on in the columns of THE ELECTRICAL WORLD and the London *Electrician*, and in which part has been taken by an unusual number of European and American electrical authorities. The discussion on the relative cost of copper with different electrical systems of distribution, Prof. Blondel's study of the inductance of polyphased lines, and the researches of Kennelly, Dunbar and Pupin in electrical transmission by alternating currents with reference to inductance, capacity and resonance all formed valuable additions to important subjects. The contributions of Bell, Steinmetz, Reber, Duncan, Mascart, Scott, Arnold, Ryan and others have added during the year more to the knowledge of multiphased machinery and its theory than all had previously been written. The study by Houston and Kennelly of the problems connected with the transmission of power from Niagara, the extended accounts in our columns of the great electric traction system of Philadelphia, and of the important electrical installations of Switzerland, also deserve notice among the features of the year. The work of Oswalt in electro-chemistry and of Tesla, Ebert and Pupin in the search for "cold light," give promise of further developments in two departments of electrical science, which seem to hold forth so much for the future. The general acceptance during the year of D'Arsonval's views in regard to the possibility of resuscitation from the apparent death sometimes following electric shocks, and the practical rules for resuscitation formulated by Dr. A. H. Goelet, should not be passed by without notice. The discussion during the latter part of the year in our columns on fly-wheels and fly-wheel accidents was exhaustive in its extent, and forms probably the most important contribution ever made to the literature relating to fly-wheels.

The accessions to English electrical book literature have been numerous, and include two works of the highest character—Hertz' "Electric Waves," and Heaviside's "Electromagnetic Theory." Martin's "Inventions, Researches and Writings of Nikola Tesla," supplied a much needed account of the work of one whose fame has become world-wide, and the "Recollections of Werner Siemens is an autobiography that would be creditable to a man of letters, and gives a valuable insight of the growth of the great science which has given the latter part of this century the name of "The Electrical Age." Coerper's "Central Stations of Cologne and Amsterdam," Merrill's "Reference Book for Electric Street Railway Engineers," and Foster's "Central Station Book-keeping," are three notable additions to the strictly technical side of electrical engineering, while Emmett's "Alternating Wiring and Distribution," Fleming's and "Electric Lamps and Electric Lighting," supplied two useful works to the expository side. Other works to be noted are Lodge's "The Work of Hertz and Some of His Successors," Palaz' "Photometry," Houston's "Electricity One Hundred Years Ago and To-day," and Parkhurst's "Dynamo and Motor Building for Amateurs." New editions of some standard works have appeared so largely rewritten as to almost rank them among the new publications of the year. Among these are Kapp's "Electrical Transmission of Power," Salomon's "Electric Light Installations," Houston's "Dictionary of Electrical Words, Terms and Phrases," Crocker and Wheeler's "Practical Management of Dynamos and Motors," and Davis' "Standard Wiring Tables."

The Yesterday and Tomorrow of Technical Journalism.

> "There is nothing so truly dead as the newspaper of yesterday, nothing so much to be dreaded (by competitors or charletans) as the newspaper of to-morrow."
>
> HENRY J. RAYMOND.

That THE ELECTRICAL WORLD, in its third decade, should continue to advance with rapid strides, both in subscriptions and advertising, while other periodicals in the same line, despite their utmost efforts, keep slipping and sliding back, has not failed to attract attention from readers, advertisers and contemporary journals.

The explanation of this condition of affairs is simply this:

THE ELECTRICAL WORLD is the pioneer in its line. It was published many years before any of the other and younger journals made their appearance upon the scene. It has always aimed to secure the largest circulation possible in its field, and spends between $25,000 and $30,000 a year in doing it, because it believes this to be the only way to permanently retain the greatest circulation and largest volume of advertising business.

In the year 1881, an employe in a telephone office, without previous journalistic experience, established a paper to contest the field with THE ELECTRICAL WORLD, as he had a perfect right to do.

In his first issue he publicly expressed his acknowledgments to the proprietor of an established newspaper for "pointers" in regard to a business of which he confessed he knew but little.

Since then other journals have come forward from time to time, under the direction as a general thing of men neither journalists nor electrical engineers, and most of them presently found a congenial corner in the electrical field and proceeded to cultivate it.

There were even those who left the WORLD'S employ, as was their privilege, to link their fortunes with other electrical journals.

It is related that some of these, after gazing at the building in which for years they had contentedly worked, sat down on a bench in the City Hall Park and wept to think that THE ELECTRICAL WORLD should so soon thereafter go to pieces.

They believed themselves impervious to any ordinary temptation, but it was so easy a matter in this case for them to do as they intended doing; chance of failure there was none, and they had so much to gain that they soon overcame their own scruples.

While THE ELECTRICAL WORLD was a good paper—too good, if anything—it was notoriously extravagant in its expenditures. There was no possible necessity for spending the money it did on mere subscriptions—on which there was a loss instead of profit.

"What would advertisers have to say about that?"

Oh! bother advertisers! How many of them know or care what circulation a paper has? "What fools these advertisers be!"

Reading notices, the publication of his portrait, complimentary mention, the offer of an editor's personal "influence" when he may hear of an order to be placed that the customer is in doubt what to do with—these are what appeal to the average advertiser, dear, good-natured, never-put-all-your-eggs-in-one-basket old soul.

What was that remark? Not good technical journalism? No, perhaps not; but it's good business. Newspapers are not published wholly to enrich advertisers. Two years from to-day you'll see where THE ELECTRICAL WORLD will be and where our paper will be.

The electrical business was new; few of the men in it were acquainted with any of the papers, and being busy and profits being large, until they got their bearings most of them in placing advertising considered it the part of wisdom to treat all the journals alike.

From this class, at that time, neither circulation nor returns received any particular attention. "Sometime" the question of advertising would be taken up, discussed, settled, but not just then.

THE ELECTRICAL WORLD continued to build up its circulation, knowing that money invested in that way would be returned to it with interest by and by. Other papers thought that they could reach the goal by a considerably shorter route.

The financial depression brought a change in the manner of placed advertising. Instead of taking space in a dozen or so different papers going to the same readers, most of the electrical companies began to inquire whether practically the same benefit might not be gained from one as from a larger number of journals reaching the same probable customers.

Such companies naturally decided upon THE WORLD, because it reaches all connected with electricity and street railways in the United States and Canada whose attention can be gained through a newspaper advertisement, while its advertising rates, circulation considered, are but 1-5 those of the average journal of its class, and, owing to the larger editions printed, the expense it incurs in inserting an advertisement is 4 1-2 times what the same space would cost on the average other periodicals in the same field.

Not a few of the companies which concentrated their advertising in its columns also took an increased space in the WORLD.

It was, of course, to be expected that the other journals would not like this, and would say that it was extremely reprehensible and more or less selfish on the part of THE ELECTRICAL WORLD not to insist upon advertisers giving to each of the smaller papers the same amount of business they gave it, irrespective of age, experience, reputation, circulation, or the returns that would probably come from the investment in the other papers.

The intelligent reader, however, will see that if advertisers pursued such a policy they would not be encouraging the spending of large amounts in securing subscriptions, each of which must be filled at a loss, or showing a proper appreciation of the efforts of a periodical that conscientiously endeavored to keep a manufacturer's name and specialties prominently before every one who can be reached by such a journal.

Therefore, although a few papers may not approve the change, the electrical business and technical journalism are the gainers, and the paper most inclined to find fault is probably the one least likely to make much effort in the direction of better service.

No reform or improvement was ever inaugurated without opposition from those affected by the change, however beneficial such change seemed to others.

This is but the third decade of THE ELECTRICAL WORLD'S existence in which it has been continuously under the same management, and it is too modest to claim to know as much about the electrical or street railway business or technical journalism as those who have entered the field later.

It and those connected with it, however, are anxious to learn and grateful for the advice and suggestions of contemporary journals. If it does not follow all the advice it receives from them, it hopes they will not feel offended.

THE ELECTRICAL WORLD regrets exceedingly if any of its younger contemporaries find it in their way.

They have never interfered in the slightest degree with its business; the effect of their presence has been altogether in the other direction, for the larger their number the more advertising and the more subscribers have come to it.

Grateful for their generous assistance and co-operation, it asks them to suggest the manner in which it will be most agreeable to them that it should demonstrate its appreciation.

They can hardly ask it to go out of business, or even to suspend publication in their behalf. If they did, some one might be flippant enough and uncharitable enough to remind them of that famous definition of the old philosopher: "A bore is a man who persists in talking about *himself* when you want to talk about *yourself*."

To be less energetic than it is, less aggressive, less inclined to give subscribers and advertisers full value and more than value for their money—then it should cease to be THE ELECTRICAL WORLD.

Anything else it will cheerfully do for its brethren of the electrical press, to all of whom in the meantime it extends, at this holiday season, the assurances of its most distinguished consideration.

The Berliner Telephone Decision.

The following opinions on the Berliner Telephone decision were received too late for insertion in last week's issue:

William H. McKinlock, president of the Gilliland Telephone Company, Chicago: "The Berliner decision does not affect us directly, as we are operating upon decidedly different lines, and with apparatus that does not interfere with the Bell Company's system in the least. We cannot help but feel, however, that the decision will act as a boomerang to the opposition companies, and that it will serve to unsettle the telephone situation for some time to come. There is something more in the telephone business than a single patent, and however much the Berliner patent seemed to have held the key of the situation, investors may find that they have only been let into the vestibule, and that it will require experience, capital and time before they can be admitted to the storehouse within. While the removal of the patent in a sense throws the field open, the elements as mentioned above will be found to be paramount in the successful embarking in the telephone business, and these the American Bell Telephone Company possesses almost a monopoly of. It is a well-known fact that the telephone business is not, in a sense, a commercial business, inasmuch as the elements of competition do not enter into it. It is impossible for two separate exchanges to be operated in the same town or city, and as the Bell Company has the field pretty thoroughly covered, it will only be necessary for them to reduce their rates to meet the views of the opposition companies, and they will be able to hold a very large share of their present business.

Dr. D'Unger of the D'Unger Long Distance Telephone Company says: "Whilst I consider it important that this Berliner bugaboo has been laid low, telephony will not be furnished at half the rates now charged by the Bell people, much less at one-quarter. Good telephones—that is, reliable ones—cost money, and it takes money to operate them. As much money as ever will be needed to construct the lines, this voidation of the Berliner patent not reducing the price of wire, poles, conduits or labor. 'Hello,' girls, too, will come about as high as ever. The question as to who can now build telepehones should be clearly understood by the people, for the public is woefully ignorant upon this matter. There is no patent now on the Berliner claims, it is true, but it would matter but little if there was one, for an instrument constructed according to the specifications as laid down in the vacated patent would be about as serviceable, for telephone purposes, as one of our lake foghorns. The annulment of the Berliner patent does not, as many suppose, give the use of the microphone to everybody. The appeal to the U. S. Circuit Court of Appeals, whilst cutting the Bell people off from a trial before the Supreme Court (unless the latter court itself orders up the case for review) will be of no avail. The evidence against the patent is so overwhelming that no reversal of the decision will ever come."

The First Year's Experience With the New Form.

It is a year since the change in the form of THE ELECTRICAL WORLD from the larger to the smaller page, and therefore an appropriate time to consider the effects of so radical a departure.

So far as the paper itself is concerned the result has been a considerable increase in the cost of mechanical production.

A statement covering the first five months of 1894 shows an average increase in this department of 33 per cent. as compared with the corresponding issues of the preceding year.

Record for Three Years, Showing Volume of Advertising in Four Leading Electrical Journals.

"Comparison gives definiteness and clearness to the thought. We cannot understand anything well but by comparing it with something else." The following figures show the advertising published in their first issues, respectively, for three years by four leading electrical journals, arranged chronologically according to their ages.

Journal.	Section.	Color.	1893.		1894.		1895.		Net changes since 1893.	
			Advts.	Inches.	Advts.	Inches.	Advts.	Inches.	Advts.	Inches.
THE ELECTRICAL WORLD.	Eastern.	Tea Green.	320	1.783	320 no change.	2,549 increase 43 p. c.	395 increase 23 p. c.	3,781 increase 49 p. c.	increase. 23 p. c.	increase. 112 p. c.
No. 2.	do.	Yellow.	116	843	92 decrease 26 p. c.	737 decrease 13 p. c.	104 increase 13 p. c.	805 increase 9 p. c.	decrease. 10 p. c.	decrease. 5 p. c.
" 3.	do.	Terra Cotta.	207	1,255	145 decrease 30 p. c.	855 decrease 32 p. c.	145 no change.	789 decrease 8 p. c.	decrease. 30 p. c.	decrease. 37 p. c.
" 4.	Western.	Blue.	122	1,078	109 decrease 11 p. c.	1,078 no change.	129 increase 19 p. c.	987 decrease 8 p. c.	increase. 6 p. c.	decrease. 8 p. c.

Leaving out of consideration all the editorial expenses, cost of correspondence, contributed articles or illustrations; the expenses of the business department—rent, salaries, maintenance of branch offices, correspondence, etc—also the cost of setting up the type, it was found that after the "forms" were on the press the cost of each copy printed was 7.6-10 cents in 1894, as compared with 5.7-10 cents for the corresponding issues of 1893.

As under the most favorable circumstances the amount received from a subscriber is but 5 10-13 cents, there is thus on each subscription a direct loss of at least 21 per cent. on the actual cost, even reckoning only the white paper, press work, binding, mailing and postage, and exclusive of all the other by no means inconsiderable expenses.

It need hardly be pointed out that under these conditions the larger the subscription list the greater the loss in this department.

On the other hand, however, the more subscribers a paper has, the more advertising it will get, and in this way the subscription deficit is balanced and more than balanced by the profits from advertising.

In the first issue of 1894, when the change in form took place, the editors took occasion to review the progress made by the paper up to that date. The paragraph ended with these words:

> "We do not take this backward glance in the spirit of one so satisfied with his achievements as to feel contented to rest upon them. On the contrary, we hope to make the change to a new form a marking point from which to advance to new conquests, so that in years to come we may look back and note the same steady advance that has characterized the period just passed."

Let us see how far this hope has been realized during the year.

The net gain in circulation has assuredly been most gratifying.

The first issue of January, 1894, consisted of 15,000 copies; the first issue of March, 15,500; May, 16,000; July, 16,000; September, 16,000; November, 16,000.

As to advertising, THE ELECTRICAL WORLD once more broke its own high record in its issue of March 3rd, 1894, in which it printed 386 different advertisements, aggregating 3,215 inches. Throughout the year its advertising business continued to be unusually large and to increase in volume, although other papers in every line showed the effects of the financial disturbance.

The paper begins 1895 by again smashing all records.

This issue consists of 128 pages and 17,250 copies, the largest number and the most extensive edition of an electrical journal that has ever been published anywhere since the world began.

In advertising, too, the present number is far in advance of anything even THE ELECTRICAL WORLD has before accomplished in that direction, as will be seen by the figures in another column.

Nowhere perhaps is the principle of co-operation more strikingly exemplified than in technical journalism.

Manufacturers whose advertisements render it possible for an electrical worker at a cost of 5 10-13 cents a week to share in all the benefits accruing from an expenditure on the part of THE ELECTRICAL WORLD amounting to more than $100,000 a year, themselves find the amount paid for advertising in its columns a profitable investment.

For example, to mail 17,250 circulars, 4 by 5½ inches in size (even if one had a list of purchasers of electrical, steam engineering and mechanical supplies all ready and corrected up to date), would cost at the very least $269.55. The items in detail are as follows:

To set up the type, $2.00; paper, $4.50; press work, at 75 cents per 1,000, $12.93; envelopes printed, $34.50; addressing envelopes at $1.50 per 1,000, $25.87; folding, mailing and stamping circulars at $1 per 1.000, $17.25; postage at 1 cent, $172.50; total $269.55.

THE ELECTRICAL WORLD'S rate for a quarter page advertisement, 4 by 5½ inches, in the present issue, of which 17,250 copies are printed, would be but $14., with a reduction from even this were the advertisement continued for more than four insertions.

Thus it will be seen that even at the single insertion rate to send out the same number of circulars would cost the manufacturer nineteen times what he has to pay THE ELECTRICAL WORLD.

While it is pleasant to know that one is thus of some little service to two very worthy classes of the community, and while there is much satisfaction in being connected with as a part of the largest and widest circulated journal of its class in the world, the reader must not think that these considerations alone would induce a paper to continue year after year to pay out so large sums of money unless the financial returns from advertising warranted the outlay.

A technical journal is but a commercial enterprise, and, although we would not on the one hand wish to deceive a confiding reader by undertaking to convince him that THE ELECTRICAL WORLD closes its eyes to the question of material prosperity, we on the other hand hope he will give it credit for sufficient financial independence to refuse to insert advertisements when it feels it cannot conscientiously recommend what is advertised. Fortunately, however, notwithstanding this and notwithstanding that its loss on subscriptions amounts to between $25,000 and $30,000 a year, the paper can be published at a profit. In this fact lies the best assurance that the outlay and the supervision of advertising will continue.

ELECTRICAL APPLIANCES AND THEIR MANUFACTURE.

PRACTICALLY TREATED BY PROMINENT EXPERTS.

Arc Light Carbons.

BY B. F. MILES.

ARC light carbons are to the electric arc lamp as the wick is to the oil lamp, or the burner to the gas jet. The best arc lamp cannot send out its piercing light without a good carbon, while the best carbon in a poor lamp can only emit a feeble glow. One often has to bear the odium due to the faults of the other, but in both perfect combination are necessary before the dark places of the earth can be made bright as noonday.

To the casual observer, an arc light carbon is a very uninteresting object. It is usually a cylinder, varying from three-sixteenths of an inch to an inch in diameter, and from six to fourteen inches in length. Its color is a deep bluish gray or black. Oftentimes they are coated very thinly with copper, nickel or zinc, which completely changes their appearance. In most cities in this country the copper-coated variety is the one usually noticed in street arc lights, while in Europe the black, uncoated variety is almost wholly burned.

These unpretentious little cylinders, however, have a long history, and the process by which they are made is an extremely interesting one. About 1810 Sir Humphrey Davy, in his researches in electricity, discovered that small cubical sticks of carbon, whose points were separated from each other about the sixteenth of an inch, would emit a brilliant flash of light when a current of electricity was passed through them. These carbons were composed of powdered wood charcoal, mixed with a little syrup of tar, moulded into shape under a pressure of about a hundred pounds to the square inch, and baked in a crucible in a very hot fire. During the next seventy years numberless experiments were made in Europe and in this country to produce carbons from a variety of mixtures. The electric dynamo and arc lamp, not having been perfected until the closing years ot the decade, 1870-80, the demand for carbon electrodes was very limited, their principal use being in scientific research; consequently they were only made by hand in two or three Continental laboratories on the smallest scale, and at a very high cost. In 1876, the principal French maker sold his product at thirty-five to forty cents each, a price that was practically prohibitive.

With the birth of the wonderful Brush dynamo and arc lamp, a large commercial demand was quickly created, and how to supply carbons of high quality and at a low cost became a problem for electricians, second only in importance to the invention of the arc lamp.

The first step in this problem was to find suitable raw materials. Search had been made on both Continents with comparative failure. Of the many sources of supply suggested, carbon produced in gas retorts seemed the most feasible, but the varying impurities and refractory nature of this material had made it at best a makeshift. Till the fall of 1878, however, it was the principal source of supply, and carbons were still made in rectangular cubical form with blunt ends.

The first American carbon manufacturer and his factory deserves a mention here. This was David Thompson, of Newark, N. J., who died recently at a good old age. The writer remembers well calling on him nearly six years ago, and walking from his unpretentious little wooden house through his grape arbor to his small two-story work-shop. It was only about twenty feet broad by thirty feet long. A hand mortar, a rude brick oven and mixing pan, a hand bolting and grinding outfit, with a few iron and steel molds, comprised his entire "plant." He still kept the small rectangular blunt iron moulds, with which he made the first arc light carbons produced in this country, and spoke sadly of the business as having far outgrown his little means.

The present high position of the American carbon industry is due to two men, the celebrated inventor, Charles F. Brush, and Washington H. Lawrence, one of the founders with Mr. Brush of the Brush Electric Company, and now president of the National Carbon Company, Cleveland, Ohio. While engaged in the invention of his arc dynamo, Mr. Brush had been investigating the nature of carbons and planning for their manufacture. In 1877, with Mr. Lawrence, he began a series of experiments on petroleum coke. After others had searched over two continents, it seems almost ridiculous that Mr. Brush found the desired supply of commercial carbon in its raw state within a mile of the Brush Electric Company's works; yet such is the fact. The Standard Oil Company for years had been burning up the last product of the distillation of crude oil, formed at the bottom of its paraffine stills. Shoveled from the stills in great lumps like the largest anthracite coal, it also resembles the latter at a little distance in its shiny, black appearance. It was this refuse product that was to help in giving the world its most brilliant light.

At first, Mr. Brush was puzzled over some properties of the new material. While it is pure carbon, it is, also, like the purest anthracite coal, a non-conductor of electricity when in a raw state. After having heated the coke in a little crucible held in a forge fire, he found the non-conductor changed into a conductor, and the main result was gained. The balance of the experiments were conducted principally to ascertain the grain best adapted for burning in the electric current.

These results attained, it was decided that the best adhesive material to bind the particles of carbon together was coal tar pitch. This is the practice to-day, varied by such other slight additions as the experience of manufacturers have found to be advisable. These admixtures are kept as trade secrets, and as the carbon, after moulding, is baked at a very high temperature, it is very difficult to discover exactly what has been used.

The first large carbon works built still exist. It is the plant connected with the factory of the Brush Electric Company at Cleveland. From this plant many other factories have started. The writer believes all in this country have adhered closely to the materials which Mr. Brush determined as best for the business, and have followed closely the processes designed by himself and Mr. Lawrence.

These processes of manufacture may be summarized as follows: The petroleum coke is crushed and carried into retorts, heated to a high temperature, where it remains from ten to fifty hours, according to the result desired to be produced, thereby the moisture is driven out and the quality of conductivity imparted. Next the carbon is carried to mills in which it is ground to a fine flour, next bolted and carried to a pan in which it is to be mixed with the "binding" material. All this seems very simple, but when one remembers that petroleum, coke and diamonds are carbon, and that fine petroleum coke is nearly as hard as diamond dust, it is seen that the process requires exact machinery of great power, and that much care must be exercised in each of the subdivisions of the process. When in this stage, the carbon has the physical characteristics of the ordinary wheat flour of commerce, save that it is black.

In combining the carbon flour with the pitch, the latter is first broken up in an ordinary crusher, then transferred to mixing kettles or pans. The proportions of carbon flour, pitch, and its associate mixtures vary according to the "softness" or "hardness" of the carbon desired. These mixing kettles and pans are kept warm, and the entire mixture is constantly agitated by hoes, or other devices, from fifteen minutes to an hour. This heat causes the particles of pitch to attach themselves to particles of the carbon flour, and at the completion of the process the mixture has the appearance of black pebbles of various sizes mixed with coarse black sand. After this mixture has cooled, it is again crushed, ground and bolted so that a flour of uniform grain is produced. The machinery employed for this purpose is somewhat different from that used in wheat flour mills, but the modifications would not interest an untechnical reader.

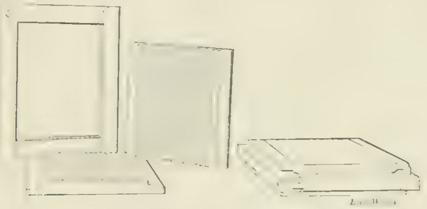
Thus far the process has not been of much interest to the ordinary observer. From now on the work becomes quite interesting. The material takes one of two courses, according as it is to be made up into "moulded" or "forced" carbons.

If the first, the material is brought to men working at benches, who are called moulders. They are provided with steel moulds, split in half, grooved according to the length and diameter of the carbon cylinders to be made. The steel of which these moulds is composed is of the finest quality, else it will not retain its shape under the tremendous pressure employed.

The moulder weighs the flour in a scale, distributes it evenly over the entire surface of the mould and upon it places the proper steel cap. The mould is then very slowly heated, which causes the particles of combined pitch and carbon flour to take a form resembling thick paste. When the proper degree of heat has been obtained, the mould is taken from the furnace and placed under a hydraulic press, the pressures employed varying between 100 and 400 tons. From the presses the moulds are taken back to the bench, the cover and sides removed and the card of carbons very carefully lifted off. When these cards of carbons become cool, each carbon is separated and the little fin that has held it to its neighbor is scraped off each side, so that the carbon is left a perfect cylinder.

As mentioned above, the first carbons made were rectangular in cross-section with blunt ends. The modern practice is to make them cylindrical, with points more or less like the ends of a sharpened pencil. This change was suggested by Mr. Brush from his observations upon the shape which carbons acquired when burning in an arc lamp. He noticed that carbons whose cross-section is a circle cast much less shadow upon the surfaces to be illuminated than those whose cross section is a square; also that all carbons burning in the electric arc tend to shape themselves like pencils, and do not form a quiet arc until they have assumed that outline.

The former observation could not be made the basis of a patent. The latter combines points of utility, both in cost of manufacture and in the initial half-hour of burning, and is the subject matter of one of the Brush, also one of the Lawrence, patents which are still in force.



Mould for 7-16 inch Carbons.

The majority of the carbons consumed in this country, being burned in lamps fed by a constant current, are made by the moulded process, to which they seem best adapted. In Europe, on the other hand, the majority of arc lamps are on constant potential or alternating currents, and require a carbon whose particles are arranged differently from those in the moulded process, and also in many instances a core of less dense material to insure steadiness of light.

The flour for carbons to be made by this process is treated somewhat differently than that of the moulded variety. It is usually shaped into cylindrical "plugs," about 6 in. in length and from 2 to 6 in. in diameter. These are placed in front of the plunger of an hydraulic press of horizontal action and are forced through its jaws, taking any desired cross-section from the outline of the die at the mouth. As fast as the carbons leave the die they are received upon a table and cut to desired lengths. Should the carbons be "cored," a "core" or hollow about an eighth of an inch in diameter is left in the centre of the carbon as it passes through the die, by the action of a "tongue." This all can be readily understood by imagining the action of the human tongue and breath when ejecting a stream of water. The water corresponds to the carbon "plug"; the lips to the die at the mouth of the press; the breath to the press plunger forcing out the carbon, and the tongue tends to produce a hollow or core in the liquid stream.

There are various combinations for the mixture that is used to fill the core, and the secret of its composition is usually guarded by manufacturers with much care.

We have now reached what is called the "green carbon" stage of the process. The carbons appear a shiny black in color, are quite heavy, break easily, and, when held by the fingers and tapped together, give forth only a dull sound.

Both moulded and forced carbons are next taken to the furnace room, where the volatile matter contained in them is driven off. This is a process requiring great delicacy in handling, combined with absolute thoroughness. If they are baked too rapidly, they warp and so are unfit for trimming. If they are not baked sufficiently, they are too low in conductivity and give a very poor light.

In the early days of the art, baking was accomplished by placing each carbon in a mould or crucible and heating many crucibles in a large retort. This very expensive process was soon superseded by baking in fire-clay pots or seggars, many of which can be baked together in a furnace resembling a pottery kiln. This is the process followed by many foreign manufacturers. In this country, the almost universal practice is laying the carbons in a large rectangular furnace, layer upon layer, each separated, in a bed of sand; the entire mass, protected by a covering several inches in thickness, over which the heat plays until every carbon has reached a high temperature. Just what temperature this is, measured in degrees, has never been accurately ascertained. It is supposed to be between 2,000° and 3,000° Fahrenheit. Few realize the time required in baking alone. It seldom happens that large furnaces are "turned" within two weeks.

There are several methods of applying heat, both to calcining retorts and baking furnaces. The simplest construction consists of a fire-box in which coal or natural gas is burned and the heat carried over the mass of carbons in a single direction.

Mr. Lawrence has invented a modification of the Siemens-Martin reverbratory process for steel making which gives the highest results. Bituminous coal, rich in gaseous products, is converted into fuel gas. This is conveyed hot into the furnace itself through fire-brick flues, first by one end, next by the other, where, mixed with air, it burns with an intense flame. During the two or three days of highest combustion, the interior of the furnace glows like the face of the sun at noon, but at the same time the heat is under most perfect control.

From the furnace the carbons are carried to the sorting tables, where, rolled on steel plates of true face, the straight are separated from the crooked. The former are taken into the plating room, where they are given a thin coating (usually) of copper, which increases their conductivity and prolongs their life. The latter are sorted into various grades; some are sold as seconds, others are cut into short lengths, others are rejected. It is a very interesting sight to see the packing boys wrapping the carbons in paper for shipment. Few machines surpass their agile fingers in rapidity of movement, as they roll single carbons into blocks of five, and blocks of five into packages of twenty-five. The latter they place closely together in wooden boxes, of a thousand capacity, and when the nails of the lid are driven down, the carbons are ready to be carried by rail or water to any part of the civilized world.

There remain two or three points of interest to students of social science and statisticians.

At the beginning of the modern carbon industry in 1878 nearly every one of its thirty to forty processes was accomplished by unaided hand labor. In sixteen years this condition has been completely reversed. Hand labor now exists only in four processes, and in the coming year these will be greatly assisted or accomplished wholly by labor-saving devices.

Such economies are only possible where the business is carried along on the largest scale. In such a concern the responsibilities thrown upon its management are great. The workman whose employment fails should be provided for. This can seldom be done in these days of fierce competition, save by increase in quantity, consequent upon the highest quality. It is greatly to the credit of Mr. Lawrence that this is his invariable aim, and that, with his many improvements in processes and machinery, he has been able so to extend the operations of the company of which he is head that it has retained in its service all its worthy employees.

Few industries exemplify better the tendency of our age to concentration. During the past fifteen years nearly seventy-five factories have started in this country and Europe to compete for the production of the two hundred million carbons annually consumed. Their combined capacity has probably reached five to six hundred millions per year. At no time has available active factory capacity decreased below three hundred millions annually. Over half of these factories have died natural deaths. Of the remaining, many have amalgamated with competitors to reduce costs. At present about twenty-five factories are in operation, with a capacity of three hundred and fifty to four hundred millions. Of these, over one-half are unable to find sufficient trade to justify an output of one per cent. of the world's consumption. Of the remaining dozen, less than one-half produce nearly 90 per cent. of the grand total.

The Incandescent Lamp.

BY. MANNING. K. EYRE.

To describe at short notice for the non-technical reader and in a limited space the manufacture of incandescent lamps is not as simple a task as may appear, and I therefore beg the forbearance of the reader if the result proves, as I fear it may, uninteresting and incomplete.

The manufacture of incandescent lamps consists in the manufacture, manipulation and final assembling of the five distinct parts which constitute a finished lamp. The total number of operations necessary in the construction of the lamp is in the neighborhood of sixty-five. It is needless to add that in the space of this paper it is not only impossible to fully describe any process, but many of them can only be indicated.

The five parts of the lamp above referred to are, *a*, the filament; *b*, the inside part; *c*, the leading-in wires; *d*, the bulb, and *e*, the base. These appear in Fig. 1, and are there indicated as *a-b-c-d-e* in the order named.

The filament, or as it is commonly called, the carbon, is that part of the lamp which in offering a resistance to the passage of the electrical current is thereby rendered incandescent, and emits heat, which is waste, and light, which is useful.

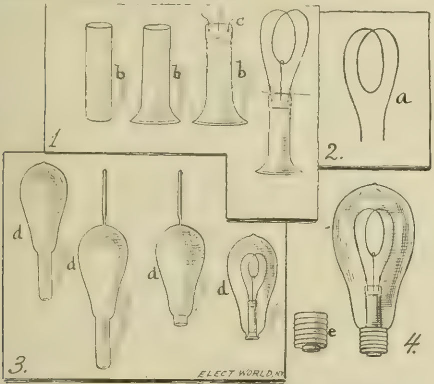


FIG. 1.—PART OF AN INCANDESCENT LAMP—1. Showing Steps in Manufacture of "Inside Part."—2. Filament.—3. SHOWING STEPS IN THE MANUFACTURE OF BULB.—4. Base and Finished Lamp.

The history of the development of this insignificant looking thread is the history of some of the best years of such men as Gaudoin, Swan, Sawyer and Edison, and a host of others.

The first filaments used with any success were made of platinum, but as this fused at a temperature a trifle above white heat it was exceedingly unreliable. Below white heat it gave insufficient light, and above this point it soon melted. It was evident that some substance was required that could stand considerable variation of temperature without danger of fusion. Carbon possessed this quality, and various vegetable substances, containing a high percentage of carbon, were tried with more or less success, such as silk threads, cotton, jute, sugar, paper and bamboo. The latter is probably the best natural product for the construction of a filament, and when carbonized and treated properly, results in a highly satisfactory and efficient lamp.

To obtain uniformity of structure and a homogeneous product, manufacturers have experimented with liquid compounds, eliminating air gaps. The mixtures used are numerous, being the combination of some vegetable fibre with an acid or a salt, as for instance, the combination of cotton, wood pulp, or silk, with sulphuric acid or chloride of zinc.

The base and acid are placed in a vessel and thoroughly stirred by means of a rotating spindle provided with paddles, until the base is thoroughly mixed. It is next placed in bottles, the liquid being about the consistency of thick molasses, and forced out of the lower ends of the jars through small dies of various sizes, representing the cross-section necessary to make filaments for the different candle powers and voltages.

After the squirting process the fibre is solid, and after being thoroughly washed and purified is wound on drums, shown in Fig. 1*a*. This is the first step in the operation of drying the filament. Only one layer is reeled on the drum, the drum as it rotates moving horizontally, so that the successive turns cannot fall one on the other. When removed from the drums it is wound in a loose coil and the two ends of the coil measured with a micrometer. This measurement serves to indicate the particular class of the lamp the fibre is destined for, and consequently which particular form of mandrel it shall be shaped upon.

Another method of attaining the same object consists in using two drums, winding the fibre from one drum to the other. In this case the fibre passes through guides, placed between the drums, which lead the fibre through an acid while in transit.

At the lamp works of the General Electric Company three forms are used for shaping filaments. The oval, for all high volt low economy lamps, the spiral, for high volt 16 candle-power high economy lamps, and the horse-shoe, or loop, for low volt lamps. The low volt low candle-power lamps require too short a filament to admit of the use of a spiral or oval.

The coil taken from the drum is then wound on the proper form, sometimes called a mandrel, to shape it for the style of lamp desired. The oval and spiral forms are shown in Fig. 1*a*, the operator being shown in the act of winding the fibre on the oval form, which consists of two vertical rods, the cross section of one being an ellipse, the other circular. The fibre is wound with one complete turn around the elliptical and half a turn around the cylindrical rod.

The next step in the process of manufacture is the carbonization of the fibre. A moderately complete description of this process as, carried out by some manufacturers, may be found in Mr. Gilbert S. Ram's work, entitled, "The Incandescent Lamp, and its Manufacture." Briefly stated it amounts to this.

The fibre is wound on carbon blocks of the desired shape, but in order to allow for the shrinkage of the fibre, which is very great, the two carbon sections of the form are connected by means of wooden sticks. As the process of carbonization proceeds the sticks shrink with the fibres, so that at the end of the process the two carbon blocks are in contact.

These blocks are packed in a carbon box, about ten in a box, leaving enough space for the blocks to move freely in the shrinking process. Between each block is a thin partition of carbon, which slides loosely in the box. The carbon box, containing the forms, is then placed in a plumbago crucible, leaving some clearance all round, which is filled up with powdered charcoal.

The heat of the furnace into which the crucibles are packed, should be very gradually raised, eight hours being about the time required for the first heat (about 600 degrees Centigrade). About five or six hours more brings the temperature to a bright red, and an additional three or four hours to a white heat.

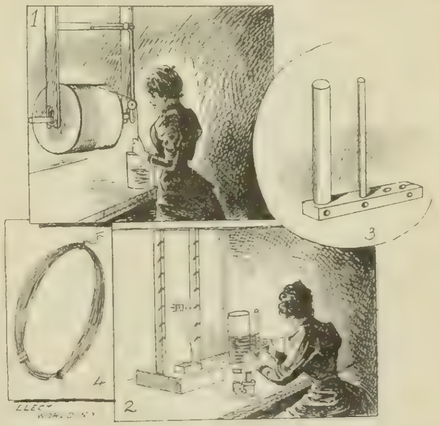


FIG. 1 A.—MANUFACTURE OF THE FILAMENT.—Winding Filament.—2. Shaping Oval Filament.—3. Spiral Form.—Coil of Filament.

Whatever the process, we will suppose the fibre carbonized and cut into proper lengths, each length representing a filament as it appears in the finished lamp. Measurements are again taken with a micrometer of each individual filament, which are then sorted out into proper boxes for transfer to the treating room. If the two ends of the filament do not measure alike the carbons are rejected.

It is to be regretted that there is no space for details, as in a great measure it is the details which would convey to the reader some of the real difficulties of lamp manufacture. For instance in the handling of the fibre the greatest care must be taken to regulate the shrinkage. A filament squirted with a diameter of 22 mils, may, after drying, be reduced to 10 mils, and again after carbonization to 5 mils, a total difference of 17 mils. Now bearing in mind that with two finished filaments of the same length, a difference in cross-section of 1 mil makes all the difference between a 16 c. p. and a 20 c. p. lamp, some of the trials and tribulations of manufacturers may be understood.

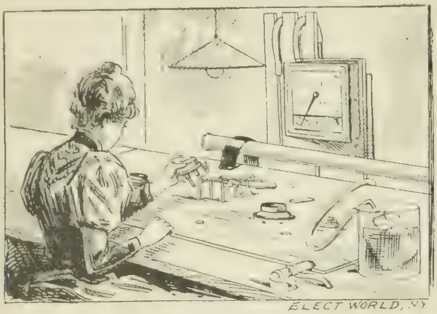


Fig. 2.—Treating Process.

The object of the next process, treating the filament, is briefly to give it a uniform and homogeneous surface. Up to this point, no matter what the process adopted and in spite of every care and precaution, the filament is still in a more or less crude state. In all the early filaments the fibrous structure was porous and irregular. The effect of this can be readily conjectured. Each filament consists of an infinite number of small fibres, unsymmetrically arranged, and the electrical current, finding no continuous path, is compelled to jump from fibre to fibre. This forms a succession of infinitely small electric sparks, which (though we may not see them) tend to disintegrate the filament and make a short lived lamp.

The use of a liquid instead of a solid, the quality of the mixture, and, in general, the superior methods of manufacture now employed, render the filament as it now arrives at the treating stage more uniform, and with its porosity and irregularities reduced to a minimum. Nevertheless, it would be far from satisfactory without this treatment. Years ago filaments were manufactured stamped out of paper, carbonized between sheets of paper in moulds, and then treated with a carbon gas. Gasoline vapor has been very usually employed, or any hydro-carbon gas.

The treating apparatus consists in brief of two jars provided with tight stoppers, a galvanometer, rheostats and circuit breaker.

Fig. 2 shows an operator holding in her hand the stopper of one of the jars, the necks of which only are visible. The two projections on the stopper are holders for the carbons. The carbons having been placed in the holders the necks of the jars are closed and the circuit is made. The gas in the jar deposits the liberated carbon on the filaments, making a surface of uniform resistance. Since this deposit adds to the surface of the filament, it must add to its diameter, causing a considerable reduction in the resistance. The specific resistance of the deposit is also considerably less than that of the filament. It is evident then that there is a limit to the amount of treatment to which a fibre can be subjected, since the filament of the lamp must have a given resistance for a certain candle-power, voltage and efficiency. In practice the amount of treatment reduces the resistance considerably. Knowing the resistance required in the finished filament it is only necessary to treat until this resistance has been attained. By the side of the ammeter in Fig. 2 are shown the mercury gauges for indicating the pressure in the treating jar. It was long ago found that to treat under atmospheric pressure did not give satisfactory results, the operation being performed too quickly, and the deposit consequently rough and soft; a pump is therefore connected with the jar to exhaust it When the gauges show sufficient vacuum the carbon vapor is admitted. The deposit under these circumstances is much more uniform and hard. The time required to treat each set of filaments is for heavy carbons as much as 50 to 60 seconds, and less for the lower candle-powers. In this as in all the other processes of manufacture, there are numerous uninteresting details requiring the greatest possible care and attention. Were the resistance of carbon constant at all temperatures the process would be greatly simplified. As the temperature rises, however, the resistance diminishes, which is contrary to the law followed by metals, whose resistance increases with an increased temperature. Therefore if we are treating two filaments to a given resistance, and treat one at a different temperature from the other, the results will not be the same, though the final resistances are. If the two filaments are now tested at the same voltage, it will be found that they differ in candle-power. This and other difficulties that might be cited can only be overcome by years of experience, skilled labor, and the best quality of apparatus.

The user of lamps can perhaps now understand why, if a number of lamps are run through the factory, say for 16-c.p. 106 volts, only a portion of these lamps can be furnished of that particular voltage, the balance varying in voltage from about 100 to 102. I have been occasonally asked by central station people why lamp manufacturers did not endeavor to have all plants installed at three or four voltages. It is evident that if this plan were adopted a large part of the product of the lamp factory would be unsalable, there being no market for lamps unavoidably manufactured of other than the three or four voltages installed. Of course the immediate effect would be increased cost, and the user would have to pay for the unsalable product.

The filament being now completed and ready for assembling we can turn our attention to the glass work.

In Fig. 1 the "inside part" and bulb are shown in various st ges of manufacture. The inside part, *b* Fig. 1, is first a small cylindrical glass tube. Sketch 1, Fig. 3, shows the process known as "flaring," which consists of widening out one end. In the meantime other labor is busy getting the wires ready.

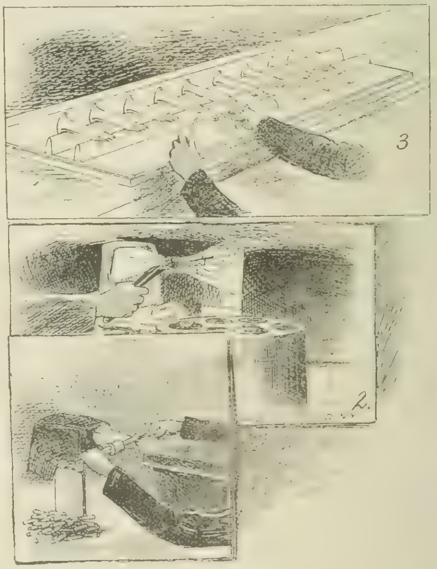


Fig. 3.—Manufacture of Inside Part.—1. Flaring.—2. Sealing in Wires.—3. Clamping.

Each leading-in wire is composed of two metals, copper and platinum, the former metal being satisfactory for that part of the wire which does not enter the vacuum of the lamp, platinum being necessary for this purpose. Were the wire made entirely of copper on heating the junction of the copper and glass, the difference of expansion of the two substances would cause the glass to crack, resulting in a leaky lamp. Platinum having very nearly the same cöefficient of expansion as glass obviates this trouble, and in addition possesses the advantage of being able to stand the high temperature of the blow-pipe. The copper and platinum are joined by fusion; only a short length of the latter is necessary.

Sketch 2, Fig. 3., shows the next step in the process of assembling the parts. The two wires are inserted in the "inside part," the blow-pipe flame heating the inner end of the tube, and when the glass is sufficiently soft the operator, with a pair of flat pincers, seals the glass tightly together over the junction of the copper and platinum. This completes the "inside part," see *b* Fig. 1. Care must be taken in this operation to prevent cracking the seal, carelessness in this respect being a prolific source of leaky lamps, which are readily detected in the pump room, where lamps are exhausted. To prevent this as far as possible, the glass is gradually cooled in an annealer, shown in 2, Fig. 3, after being subjected to the high heat of the blow pipe.

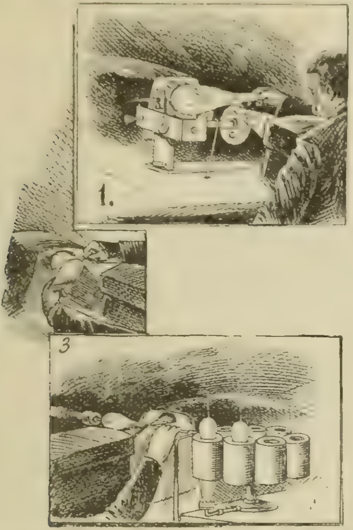


FIG. 4.—MANUFACTURE OF BULB.—Blowing off Bulb.—2. Tubulating.—3. Sealing in.

The inside part is now ready to receive the treated filament, the joining of the two together being a comparatively simple operation, commonly called "clamping," shown in 3, Fig. 3. The junction of the filament and the platinum wires may be made by means of a carbon paste, only the two legs of the filament being held in position until they adhere, or a more difficult operation may be employed, using a deposited clamp. The latter is made by heating the junction of the filament and leading-in wires in hydrocarbon gas, being much the same in principle as the treating process. Other methods have been and still are used, as for instance the socket joint, where the filament fits into a sleeve of carbon, carbon paste being used to make the junction firm. In another department the bulbs are being prepared for the reception of the inside part and filaments. As bulbs are now very generally moulded, it will not be necessary to describe the operation of blowing the bulbs. These arrive at the factory from the glass works as shown in the first sketch, *d*, Fig. 1.

The first step in handling the bulb is known as "tubulating," which consists in attaching to the large end of the bulb a small tube, through which the lamp is later exhausted.

This may be accomplished either by heating the rounded end of the bulb in the blow-pipe, and at once working the small tube on the softened glass, or by first perforating the grounded end. In the latter operation the worker holds the bulb in one hand, and the small exhaust tube in the other, and after heating with the blow-pipe, works them together, the tube fitting over the orifice previously made.

The second operation is blowing off a part of the long neck to make the bulb of proper length. This process can be seen in Fig. 4, Sketch 1. The bulb is laid on revolving rollers, *c*, causing the bulb to revolve while the flame from the pipe heats the neck at the point where it is to be blown off. When sufficiently hot the bulb is lifted off the rollers and the neck pulled off by hand, leaving a ragged edge. The operator then blows into the exhaust tube, and the ragged edge is blown out, (presenting the same appearance as a soap bubble), until so thin that it can be rubbed off with the finger, leaving a clean, well defined end, see Fig. 1.

The bulb is now ready for the inside part and filament, which are sent over from the clamp room, after being carefully inspected. The process of assembling the bulb and inside part is called sealing-in, and can be seen rather crudely indicated in 3, Fig. 4. The blow-pipe flame is, as usual, the means employed. The inside part, with carbon clamped to it, is taken in a holder and inserted in the bulb. The two are then placed in a frame which is slung into the flame. When the glass is softened the frame is swung clear of the frame and the holder inserted in the lower end of the inside part, the operator straitening the inside part and filament until they are in their proper position, as seen in the finished lamp. The bulb is then again lowered into the flame and kept rotating. The glass around the neck of the bulb gradually softens until by its own weight it falls around the flare of the inside part, forming an air tight seal. To prevent sudden cooling the bulb is then placed in an annealer.

The sealing-in having been completed, the next step is the exhaustion. This is perhaps the most interesting and important process in the manufacture. Too much care cannot be devoted to it, for the quality of the lamps depends on the issue of this operation. It is, of course understood that a vacuum is necessary to preserve the life of the filament, but perhaps every one does not know how perfect the vacuum must be; the presence of only a little air oxidizing the carbon, burning the filament and shortening the life of the lamp It was here that the early lamps failed almost entirely, the vacuum obtained by means of a mechanical air pump being utterly insufficient. All the pumps now in use are mercury pumps, generally Geissler or Sprengel pumps. The process of thorough exhaustion is so expensive that many means have been tried to make only a partial exhaustion answer the purpose. Mr. Gilbert S. Ram, A. I. E. E., has expressed the whole matter so clearly in his work on the manufacture of the incandescent lamp that I think it would be interesting to the reader to quote him.

"It has, at various times, been proposed to fill the bulb with nitrogen gas, and then to only partially exhaust. In this way a residual atmosphere of nitrogen could be left behind, which would be incapable of burning the filament. Another advantage of this method would be that the exhaustion, not requiring to be carried to a very high state, could be done very quickly with a mechanical air pump.

"There are, however, several reasons why this method cannot be successfully used. The combustion of the filament with the oxygen in the case of a residual atmosphere of air is not the only action to be considered. In a lamp containing a residual atmosphere of air, nitrogen, or any gas, there are convection currents set up in the gas within the bulb, which consequently becomes very hot. The gas is heated by contact with the white hot filament, and a continual circulation is kept up from the filament to the bulb, and back again." . . .

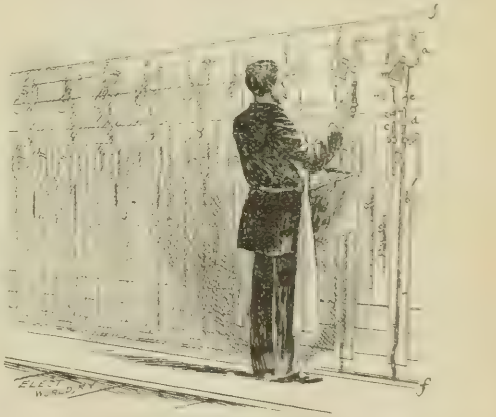


FIG. 5.—EXHAUSTING LAMPS.

"One of the most cherished attributes of the incandescent lamp is that it gives off very little heat, and is perfectly safe, and can be handled with impunity when lighted, and may be placed with safety anywhere, even with very inflammable material in close proximity. All these advantages are lost when the vacuum is not perfect. No residual gas can be allowed in the bulb."

Enough has been said to show the absolute necessity of a good vacuum, or at least as perfect as we can make it, so we can at once proceed to the description of the process of exhaustion.

Fig. 5 is a rough sketch of one of the aisles in the pump room.

In the sketch, *f*, are two large pipes, the upper one feeding the mercury to the pumps, the lower one carrying it off to the reservoir. The mercury is kept in circulation by means of a rotatory screw pump, keeping the Sprengel pumps fed as long as there is a demand for the mercury. The lamp, *a*, after leaving the glass-room, is rubbered. That is, a small rubber cap is placed on the end of the small exhaust tube, which, when the lamp is placed on the pump, fits into the cup, *e*, forming an air-tight joint. As the process for exhaustion continues the internal pressure being removed, the external pressure forces the lamp and tube more and more into the cup, *e*, making a tighter joint where a tight joint is most necessary. Below the joint is a small receptacle, *d*, in which is kept a little phosphoric anhydride to absorb any moisture. Below this again, is the main tube, *b*, through which the mercury and air fall. This tube must be a few inches longer than an ordinary barometer tube, 30 inches. The action of the pump is very simple. The lamp having been placed on the pump, the mercury carried over in the upper pipe, *f*, falls in a fine stream through the small tube, *c*, and connecting tube, *g*, and at this point forces air down the long tube, *b*. The mercury in falling acts exactly as though it were a succession of small pistons, following each other rapidly, and each one forcing a bubble of air down and out through the long tube, and circulating pipe, *f*. The consequence of this is for the first few minutes that the lamp is on the pump, the column of mercury in the tube, *b*, is full of falling bubbles, and as the process continues the bulbs get smaller and smaller, and fewer in number, giving a very good ocular demonstration of the progress of the exhaustion. Very soon the tube will appear solid, that is, with no bubbles, indicating that no more air can be forced out under the existing circumstances. The vacuum is, however, far from complete, there still being a considerable quantity of air clinging to the glass and to the filament. In addition to this the filament itself and the clamps contain gases which must be driven out before the vacuum is complete. Up to this point no current has been allowed to traverse the filament, the lamp being consequently cold.

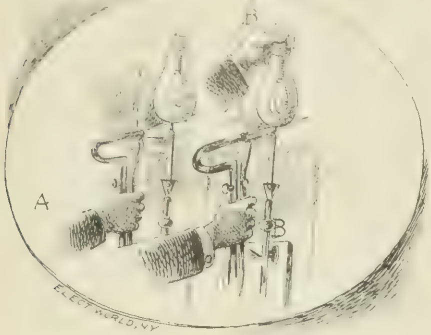


Fig. 6.—Sealing-Off.

Resistances are placed in series with each lamp, and by means of a small plug, *s*, *s*, Fig 5, can be thrown in or out, regulating the amount of current passing through the filament. The lamp is now allowed to burn at a dull red for several minutes. This heats the lamp, and some of the air clinging to the glass is forced out and caught by the falling mercury. The column of mercury, which had previously become solid, now becomes filled once more with bubbles, though much smaller than before. Some of the gases are also driven out of the filament and clamps. When the bubbles have nearly ceased again, the lamp is flashed, and then allowed to burn, driving more air and gases out. This process is repeated until the lamps are all burning at something above normal candle-power, and when the mercury tube once more appears solid and free from bubbles, the vacuum may be considered attained.

The next operation is known as "sealing-off," and consists in taking the lamps off the pumps without losing the vacuum. This process is indicated in Fig. 6, the dull flame being for the purpose of gradually heating the glass and the hot pointed flame doing the work. The operator holds the blow-pipe in the left hand, and with his right lifts the lamp off as the glass melts.

The lamp is now ready for basing, though as a rule this is not the next step which it undergoes. The natural order would at first sight seem to be to base the lamp and then to test it, but commercial considerations render this impossible. Lamps are manufactured with so many different bases, the Edison, Thomson-Houston, Westinghouse, Mather, Hawkeye, Brush, Swan, etc., that it would require a stock of millions of lamps to supply only a moderate demand at short notice. By carrying them in "wire-stock," however, this difficulty is overcome in a great measure, the lamps being based to order.

As the method of testing, however, is the same whether the lamp is based or unbased (wire-lamp), it will be best to finish the manufacture first and describe the testing after.

Fig. 7 shows the various stages of socketing. 1 is the frame consisting of a long bench, perforated with circular holes which receive the mould, 2. The mould is made in two sections to admit of the lamp being more easily removed.

The Edison base consists of two parts, the button and the shell. These having been placed in the mould, the lamp is laid on the frame as shown in sketch 4, Fig. 7. The wires are so arranged that one is in contact with the button, the other with the outer shell. Plaster is then poured in the mould, filling the base. The lamps are then raised to a vertical position, and forced by hand into the plaster, and a small vertical hollow rod pushed down over the small projection on the end of the bulb. This serves to keep it straight and steady it while the plaster hardens. See 5, Fig. 7.

The lamps are then placed in a drier, as damp plaster causes short circuiting, moisture being a fair conductor.

The lamps are now ready for the photometer test. A great deal of mystery seems to surround this test in the minds of many people, though it is exceedingly simple in principle. Nevertheless too much care cannot be taken with this test, and it is necessary to employ the best of labor. Although I have stated that the *principle* is simple, I do not by any means wish to be understood to imply that a successful photometer test can be made by any one. On the contrary, an unexperienced person would be very apt to find his readings differing by several candles, when there should be, and probably is, no practical difference.

The photometer is shown in Fig. 8, and consists of a long bar, to the centre of which is attached a screen, shown in 2, and is simply a rectangular frame, holding a disk of paper, in the middle of which is a grease spot, *A*. On either side of this disk are fixed small mirrors, *B*, *B*, at an angle, so that an observer looking at *A* on edge, sees two reflections of the grease spot in the mirrors, *B*, *B*.

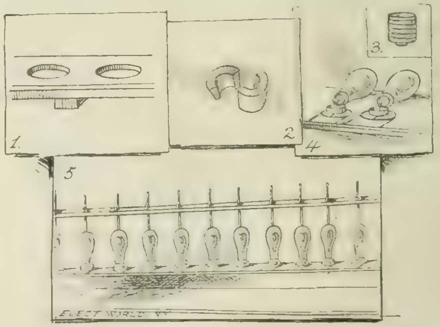


Fig. 7. Socketing.—1. Frame.—2. Mould.—3. Shell.—4. Lamps Ready for Plaster.—5. In Plaster, Hardening.

On top of the photometer is the galvanometer for keeping the voltage constant, and on the photometer bench can be seen the ammeter (under the screen,) and the voltmeter, near the lamp to be tested. At the opposite end of the photometer bar is shown the standard lamp.

In many factories only a comparatively small percentage of the total product is tested on the photometer, the balance of the lamps being placed on racks with some of those tested, and sorted out by means of the eye. This method is however, unsatisfactory, though it gives much closer results than is apt to be supposed. Much better results can be secured by testing each individual lamp, which method, though expensive, is thoroughly reliable.

The standard of candle power varies, and is different in the United States and in Europe, and in fact were the same lamp sent to different laboratories throughout this country, quite a variety of results might be expected. The orginal standard, or unit of light, may be the flame of a candle, or a portion of the flame of an Argand burner. In comparing standards with the original unit of light, the Methven screen is used, which allows only a small portion of the centre of the flame to shine on the grease spot of the photometer, this part of the flame remaining more nearly constant.

In the factory, however, standard lamps of different candle-power are manufactured, and kept constantly checked up, new ones being made up from time to time.

In order to test a lamp a standard lamp, say, of 16-c.p. is placed at one end of the photometer bar, the voltage of this standard being kept absolutely constant. The lamp to be tested is mounted at the other end of the photometer, the screen and mirrors being in the middle, and equidistant from the lamps. In shunt with the lamp to be tested is a voltmeter, and in series with it an ammeter, the latter being used only where the efficiency is to be tested, or when the lamp is destined for series work.

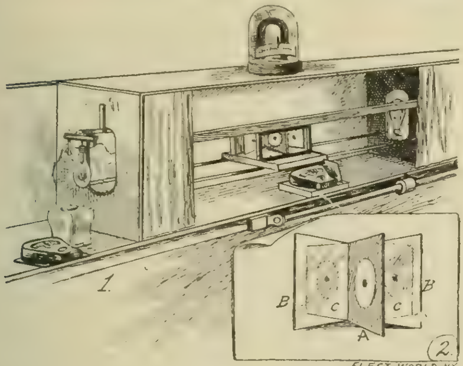


FIG. 8.—1. PHOTOMETER.—2. Disc and Mirrors.

One operator sits directly in front of the screen, and by moving a slider changes a resistance in series with the lamp to be tested. This alters the amount of current passing through the lamp, and consequently the amount of light given out by it. This operator, at the same time, is watching the reflections of the grease spot in the mirrors. As long as the intensity of light on the two sides of the spot is unequal, the reflections will be quite different in appearance, one being dark, the other light. When the intensity of the lamp to be tested is exactly equal to that of the standard 16-c. p. lamp at the other end of the photometer, the images of the grease spot become exactly alike in appearance, and in fact almost entirely disappear. The other operator reads the voltage as indicated by the voltmeter, and the lamp is so marked.

Care must be taken that the standard is mounted in its socket at the exact angle at which it was originally standardized, as the intensity of light varies with the angle which the plane of the filament presents to the photometer bar. For the sake of uniformity all lamps are tested with the filaments in the same relative position to the photometer, otherwise it would be impossible to compare results, or check the test.

This is so important a subject, and so many practical points are involved in it affecting the user of lamps, that I regret more space can not be devoted to it, especially as at the present time many large consumers of lamps are fitting up photometers, with the idea in view of testing the product of factories. This is undoubtedly a very sensible plan; nevertheless, there is trouble in store for all of us until the use of the photometer is thoroughly understood.

At the lamp works of the General Electric Company, every lamp is tested on the photometer, and before shipment, an additional test, known as the rack-test, is applied. This briefly consists in placing the lamps in a long horizontal rack, and passing a low current through them, bringing them all to a dull red. In this position it is very easy to pick out any lamps showing defective filaments, such as spotted carbons. These are weeded out and the voltage raised until the lamps are all burning at about normal candle-power. The percentage of lamps thus weeded out is very small, because after every process in the factory expert inspection is made of the product, making about 70 inspections in all. Another source of possible error is at once detected on the racks, namely, mixing lamps of different candle-powers, caused by errors in making. It seems rather a curious fact that if two lamps, one of 16-c.p., the other of 20-c.p., *but both of the same efficiency*, were placed side by side, it would be extremely doubtful whether the difference would be noticed by any but the most experienced eye; on the other hand place two 16-c p. lamps together, *of different efficiencies* and the disparity can be readily detected, though they are of the same candle-power.

On the rack test nearly all errors are apt to be discovered, because since the lamps are all at the same voltage, any error appears at once at a difference *in efficiency*, except in the case of two lamps of the same efficiency, same voltage, and different candle-power. This is so improbable an error that its occurrence need not be considered. To explain what is meant, let us suppose two filaments, one very small and fine, giving ten candles of light, and consuming 30 watts, or 3 watts per candle, the other, very large and coarse, giving 20 candles, consuming 200 watts, or 10 watts per candle. The small filament would burn very white and would apparently be giving much more light than the coarse filament, which would burn very dull. The surface of the latter filament being so much greater, it is really giving out twice as much light.

The lamps which are not kept barreled up, are carried in the factory in racks each containing a certain number of lamps, and are of great assistance in counting. A miscount in shipment is very rare.

The lamps have now only to be cleaned, labeled and wrapped, and they are ready for barreling up.

It is sometimes disheartening, after all the care taken in the manufacture of the lamps, to hear the complaints made by owners of plants, which, in nine cases in ten (and this is not in the least an exaggeration) are due to some misuse of the lamps. To begin with, a lamp should be fitted to a plant's pressure, just as much as a shoe to give satisfaction should be fitted to a man's foot, and after the lamp is so adjusted to the requirements, the regulation should be kept constant. In no other way can lamps, no matter of what manufacture, give satisfaction.

Good regulation means running the plant within one volt either side of the marked voltage of the lamps. This can be appreciated when it is understood that to run a lamp 4 volts above its voltage shortens its life to exactly one half; 8 volts high reduces the life to one quarter. In other words a 100 volt lamp whose normal life is 1,000 hours, if burned at 104 volts will live 500 hours, and if subjected to 108 volts will only burn 250 hours.

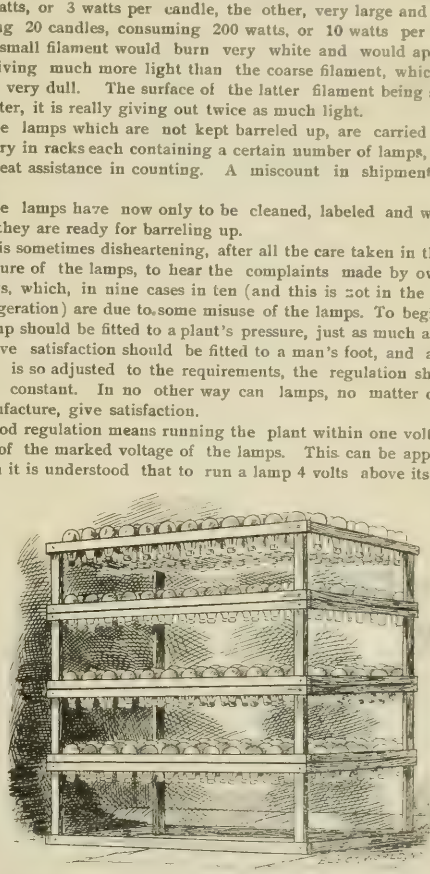


FIG. 9.—LAMPS IN RACK READY FOR BARRELLING.

I have tested plants supposed to be running at 104 volts, which showed on test to be really 120 volts. Imagine the effect on the lamps! It is not at all an uncommon thing for plants to vary the regulation 10 or 15 volts; in fact the only uncommon thing in the business is to find good regulation, outside of the very large illuminating companies, and even there it is by no means perfect. It being the season of the year when good resolutions are in order, let us resolve,

"TO KEEP OUR REGULATION PERFECT."

Storage Batteries.

BY J. APPLETON.

THE principle on which storage batteries are constructed is that of the decomposition of water by the passage of an electric current. For example:

If two conductors are immersed in water so that they do not touch (see Fig. 1), and a current is passed, flowing from one conductor through the water to the other conductor, the water is decomposed, or split up into its component gases, oxygen and hydrogen, the oxygen being given off at the positive pole (marked +) or the conductor which conveys the current into the water, and hydrogen at the other or negative pole (marked —).

Now, if two lead plates are substituted for the foregoing conductors, and a little sulphuric acid is added to the water, a further action will be noticed on the positive plate. Where the oxygen is given off, a dark brown coating will be observed, and if the current is allowed to pass for a sufficient length of time to form a fairly thick coating, it will be found that the lead plates themselves will give out a current when the external circuit is made.

The principle or theory of the storage battery may be briefly described as follows: The passage of an electric current through a combination of lead plates immersed in dilute sulphuric acid performs a certain chemical action, which changes the condition of the plates. In performing this change, the current stores up a certain amount of energy, which becomes available again in the form of an electric current when the plates are connected through an external circuit, being thus restored to practically their former state.

The amount of electrical energy which can be stored up in a battery is proportional to the amount of peroxide of lead formed, and the larger the surface of the lead exposed to the action of the current the greater the amount of energy stored, as the oxidizing action will not readily penetrate deeply into the plates. The portion of the plates which undergoes this chemical action is termed the "active material."

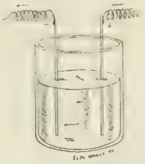
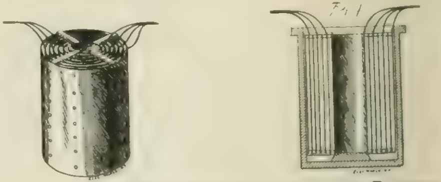


FIG. 1.—VOLTAIC CELL.

The first storage battery was made by Gustave Planté, and consisted of a number of lead plates placed in dilute sulphuric acid, the alternate plates being connected together, thus forming two sets, viz., positive and negative. The plates were kept from touching each other by means of insulating material placed in between them. In order to obtain a greater amount of active material, and consequently a greater capacity for storing up energy, he found that the surface of the plates should be porous, and to accomplish this he reversed the direction of the current every alternate charge, making the positive plate negative, and *vice-versa.* By continuing this for some time the plates became porous and more readily took up the chemical action. This treatment is called "forming." Fig. 2 shows a practical form of the early type of Planté battery, which was designed and manufactured by The Elwell Parker Company, of England. It consists of sheets of 2 lb. lead about nine inches wide, perforated with small holes, and rolled into cylindrical form of such size that they fit one inside the other, being separated at the top and bottom by insulating pieces. The alternate cylinders are connected by lead lugs burnt on to them, thus forming the positive and negative plates.

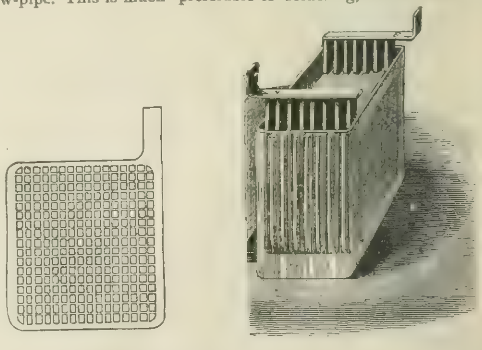
The cylinders, when connected up, are placed in an earthenware jar, as shown in Fig. 3, a solution of dilute sulphuric acid being added. Before being charged with an electric current the plates are pickled in a bath containing a mixture of nitric and sulphuric acid for 24 to 30 hours. This makes the surface of the lead plates more easily acted on by the current. Before attaining their full capacity these plates must be charged and reversed at least thirty times.

About 1881, Faure, a Frenchman, found that by applying mechanically a coating of oxide of lead to a lead plate or conductor, he obtained the same or better results without the lengthy operation of forming, and although Planté may be considered the first to discover the practical storage battery, yet Faure and others so modified and improved his methods as to produce a commercial battery. The early Faure storage batteries were composed of lead plates to which was applied a coating of oxide of lead, either in a dry or paste form, held in contact with the lead plate by an envelope of felt, or other suitable material. The difficulty with these batteries was to keep the active material in permanent connection with the lead plates. The next improvement was to make the lead plates perforated, or cellular in form, the apertures being filled up with a paste of oxide of lead. Besides Faure, many others were working in this direction, the principal patents being in the names of Brush, Swan, Sellon-Volckmar, Julien and others. The most practical storage battery of this type is constructed as follows: A lead grid is cast in an iron or steel mould, Fig. 4 showing a plan of the grid. After being cleaned up, these grids are filled with paste. The positive plates are filled with a paste made of minium or red lead, mixed to a proper consistency with very dilute sulphuric acid. The paste is pressed into the apertures of the grid with a trowel, the superfluous material being scraped off level with the surface. The paste for the negative plate is made with litharge (a lower oxide of lead) instead of minium. The section of the grid is such that the pellets of paste or active material tend to key themselves firmly into the holes, thus preventing disintegration of the plate when in work. When the plates are dry after being pasted, they are placed in a tank containing dilute sulphuric acid, where they are partially formed with an electric current; this process being called "hardening."



FIGS. 2 AND 3.—ELWELL-PARKER PLATES AND BATTERY.

After hardening, the plates are removed from the tank and assembled in groups or sections in the following manner: The lugs of all the positive plates are connected together by a lead strap which is burned on, the plates being spaced about one inch apart; the negative plates are treated in the same manner, and then the positive and negative sections are interleaved to form a complete cell, the sections being kept from touching by strips of insulating material; Fig. 5 shows a cell mounted complete. There is always one more negative plate than positive, so that each end of a group or section terminates with a negative; this is done because the action on the positive plates is more severe, and it is necessary to equalize this as much as possible by having a negative on each side of it. It will be noticed that the connecting strips are burned on to the lugs, not soldered; lead burning is practically welding or fusing the lead parts together by means of a hydrogen flame and blow-pipe. This is much preferable to soldering, the reason being that the tin in the solder is attacked by the chemical action, whereas a lead burnt joint contains no foreign metal. A hydrogen flame is essential in lead burning to prevent the surfaces to be joined from being oxidized, and thus preventing fusion.

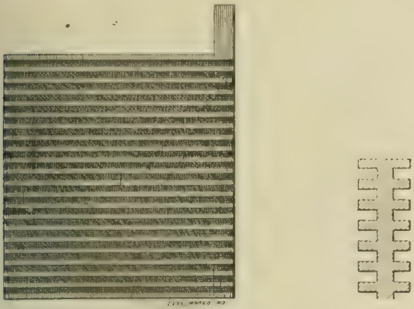


FIGS. 4 AND 5.—PLAN AND SECTION OF LEAD GRID.

The modifications and forms of the pasted type of storage battery are many, but the same principle is embodied in them all, the modifications being chiefly to overcome patents and cheapen the cost of manufacture.

Some good modifications of the Planté type have been introduced, notably, the Crompton-Howell and Epstein batteries, both of which are made in England.

The Crompton-Howell battery is made in the following manner: A block of lead is cast by an ingenious method, whereby it becomes very porous; this is sawn up into plates about 8 inches square, and ¼ to ⅜ inch thick; a lead lug is burnt on to the edge, and the plates are then assembled in the usual manner. The porosity of these plates enables the forming to be done in a much shorter time than with the plain lead plates, and enables them to give a much greater capacity.



FIGS. 6 AND 7.—PLAN AND SECTION OF EPSTEIN PLATE.

The Epstein plates are cast as shown in Figs. 6 and 7, the idea being to present as much surface as possible to the chemical action; before being formed with an electric current they are pickled in a boiling solution of nitric acid and water.

The Tudor storage battery, which is very largely used in Germany, is a modification of both the Planté and Faure types.

The lead plates are cast with fine corrugations, or projecting ribs on the surface (somewhat like the Epstein plates, but with thinner ribs); these are filled up flush with a paste of oxide of lead, which eventually becomes loosened and falls off, the capacity being then obtained from the active material on the plates themselves. The object of using the paste is to give capacity immediately the cells are put in use.

The latest form of this battery consists of several small plates about six inches square, made as described, and then mounted up in a lead frame containing openings for six or more of these plates, which are attached by one lug at the top, thus allowing perfect freedom to expand and contract. These large compound plates, as they may be called (see Fig. 8), are assembled and mounted as before described.

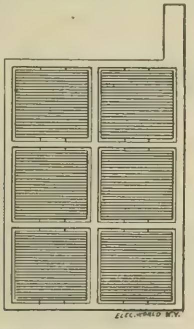


FIG. 8.—TUDOR PLATE.

The latest, and from all accounts the most successful, type of storage battery yet introduced, is the chloride accumulator, in which the basis of the material that eventually becomes active is chloride of lead, this being found far more satisfactory than the oxides. The chloride of lead is mixed with a certain proportion of chloride of zinc, and then melted in furnaces; when brought to the proper temperature the molten metal is poured into moulds, in which are cast the pastelles, which, after further treatment, become the active material in the plates.

These pastelles are placed in another mould called the framing mould, and a frame of alloy (lead and antimony, the antimony being added to harden it,) is cast around them under great pressure. This method of casting under pressure is an extremely ingenious and valuable process, and entirely removes many of the defects inherent in other types of batteries.

After casting the plates in this manner they go through a chemical action for reducing the chloride of lead. This is accomplished by placing the plates in connection with a plate of zinc in a bath of chloride of zinc. This takes out all the chlorine, leaving the pastelles in the form of crystalline lead, the molecular constitution of which is eminently suited for storage battery plates, being very porous, but yet of great mechanical strength.

After being reduced in this manner the plates are washed and then put in tanks of dilute sulphuric acid to form in the ordinary way, the crystalline lead being peroxidized in the positive plates; the negative plates do not require further treatment after the reducing process. Figs. 9 and 10 show one of these plates and a complete cell.

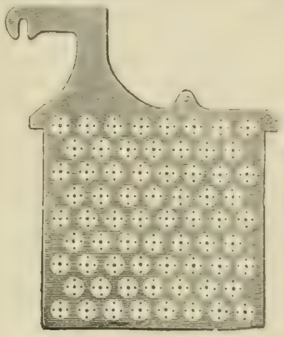


FIG. 9.—CHLORIDE PLATE.

Other metals besides lead have been tried for storage batteries, but with only partial success; oxide of copper and zinc are used in one type, but so far the battery has not attained the same commercial success as the lead batteries.

The solution or electrolyte used in lead storage batteries is dilute sulphuric acid, the specific gravity varying from 1.2 to 1.3 in the various types.

During discharge the specific gravity decreases, and arises again during the charge; by this means a fairly accurate indication of the amount of energy contained in a battery can be obtained.

The jars or boxes in which the plates and electrolyte are placed are usually glass, hard rubber, or wood lined with lead, according to the purpose for which the battery is used.

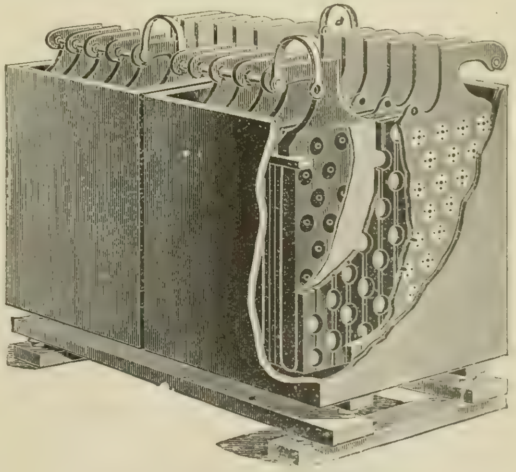


FIG. 10.—CHLORIDE CELL COMPLETE.

This subject, the manufacture of storage batteries, can only be treated fully in a long series of articles, and our present aim has only been to give a general idea of the methods employed, whereby readers may become better acquainted with this branch of electrical engineering which is daily becoming more valuable and indispensable to the trade.

A Central Station Dynamo.

BY J. B. CAHOON.

THE many changes that have been going on in the electrical field incident to the development of electric lighting has included the remodelling of lighting stations in the larger cities, and the substitution of large direct driven generators for the old bi-polar belt-driven type. As such a change involves a large expense, we naturally are led to believe that the direct driven unit must possess commercial as well as technical advantages over the old style machine. The very high speeds that have been common with bi-polar generators have given rise to serious losses of energy in belts, to expense in belt maintenance, to trouble with bearings, and other additional features tending to cause the cost of maintenance and operation to assume a relatively large figure. In addition to this, the belt driven generator takes up a great deal of room, and in large cities space is exceedingly valuable. In many cases where the plant is already established, the purchase of additional land to keep pace with the growth of the plant is practically out of the question, on account of the excessive cost involved. The direct driven unit occupies comparatively little space when coupled to engines of the vertical type, as will be seen by reference to Fig. 2, which shows this style of generator. Another advantage is, that by the introduction of the direct driven generator, larger units may be employed, and a consequent lessening of the number of dynamo tenders. The general rule governing the size of the unit is, that they should be as large as possible, and so divided that the stopping of any one of them will not prevent the balance from giving the normal output of the station. The general practice in the use of these large units is to couple a generator on each end of the shaft of a vertical triple expansion engine, which is driven at a speed varying from 172 revolutions for the 100 kilowatt to 90 revolutions for the 800 kilowatt generator. The number of poles in the generator varies from eight in the smaller size to sixteen in the larger size.

Fig. 2 shows a 400 kilowatt generator, which has twelve poles and runs at a speed of 120 revolutions per minute; by reference to this figure a fair idea of the size of this generator may be obtained. This being of medium size is the favorite unit with many of the managers of large central stations. An average sized engine for driving two of these generators, one on each end of the shaft, is about 1,300 indicated horsepower, this leaving a small surplus power over what is actually required to drive the generators at full load.

The general features of construction followed in all sizes of this style machine are:

First. The frames and pole pieces are cast from a special grade of soft steel, possessing the highest magnetic permeability.

Second. The armatures are so constructed that currents of air constantly circulate through core and windings, providing thorough ventilation for the purpose of keeping down the temperature and the armature to as low a point as possible; the machines in general being designed for a very small rise in temperature when operated at full load, the limit on standard machines being 40° C. rise above the surrounding air after a continuous run of ten hours.

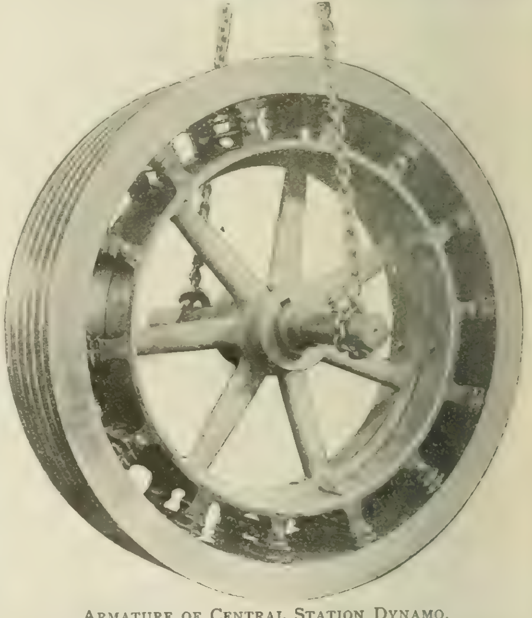
Third. The winding of the armatures consist of straight copper bars connected directly to the commutator bars, which are situated on the two ends of the armature. In other words, a portion of the winding itself is used for the commutator.

Fig. 1 shows an armature of one of these generators removed from its frame, and a reference to it will show the great care which is taken in the construction of the armature to provide for ample ventilation, and it also shows the method of supporting the sheet iron discs of which the armature is composed.

In order that the general reader may get a fair idea of this type of machine, we give a more detailed description of the 400 kilowatt machine, as follows:

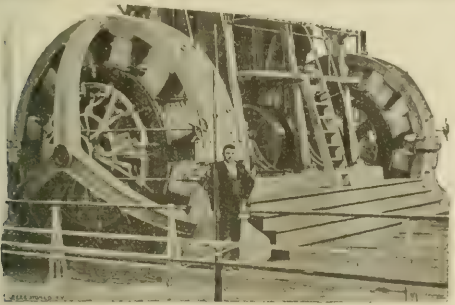
The Frame. This is made of a special grade of cast steel, and for convenience in handling is cast in halves; on the lower half are cast projecting lugs or feet for supporting the frame on the foundation.

The pole pieces, twelve in number, are cast separately from the frame, and both they and the latter are carefully faced where they are to be bolted together, so as to insure as nearly a perfect contact as possible. A reference to fig. 2 will show that the face of the pole piece is larger than the body. This answers two purposes, one for a better distribution of the lines of force, and the other for supporting the field winding. This winding is variously designated as the field spool, field winding or simply fields. These field spools are made up separately from the pole pieces, being wound on a shell in much the same manner as thread is wound on a spool, and is slipped over the pole piece before the latter is bolted on to the frame. After being placed in position, these windings are all connected together in such a manner as to cause the pole pieces to become alternately north and south poles. All these machines for central station work are what are known as shunt machines, no attempt being made to make them self-regulating, as it has been found in actual practice that managers of central stations prefer to have the machines so that they can only be regulated by hand; as one station manager very aptly put it, "The regulation of the machines must be exceedingly close in order that our customers may be satisfied with their lights, and that the lifetime of the lamps may be a maximum; and even with large compound wound machines we should have to have a man to watch the regulation, and we find that if the machines are compounded or made self-regulating approximately, that the man relies too much on this; therefore, we would rather have the plain shunt machine and depend on the man entirely to see that proper regulation is obtained." It will be noticed by reference to the cuts that there are as many sets of brushes as there are pole pieces. These are carried by a large yoke, which is supported, in the 400 kilowatt machine, by lugs fastened on the frame, and proper mechanism is attached so that the yoke may be rotated to permit of simultaneously adjusting the brushes at the neutral points. When assembled in position the floor space occupied is 37 inches lengthwise by 181 inches in width, the diameter of the frame itself being 154 inches and the height above the floor line 107 inches, and its approximate weight is 54,400 pounds, while its output is 2,960 amperes at 135 volts. The diameter of the engine shaft, where it carries the armature, is 14 inches. The armature is forced on to the shaft, the core of the armature being just enough smaller to make a good forcing fit, and after it is home in place it is keyed up so as to practically become an integral part of the shaft.



ARMATURE OF CENTRAL STATION DYNAMO.

The Armature. The hub of the armature is made of a fine quality of cast iron, on the exterior periphery of which is mounted the spider proper of the armature, which is made of non-magnetic metal and has twelve arms which dovetail into the core, this latter being made up of thin sheet iron discs carefully insulated one from another, and separated every three or four inches by an air space of about half an inch, for the purpose of permitting the air to circulate through the windings and core for keeping down the temperature. The armature in motion acts something like a centrifugal fan, causing the air to be forced from the interior towards the exterior through these ventilating ducts. Were it not for this feature the output of the armature would necessarily be considerably reduced, owing to the rise in temperature. The windings are made up of heavy copper bars, which are increased in depth on the ends of the armature to form what are known as face commutators, and are spaced about one-eighth of an inch apart by means of wooden spacing blocks, so as to admit of a circulation of air, while the bars forming the commutator are carefuly insulated from each other by mica. The body of the armature is very carefully insulated with alternate layers of mica and tough paper to a thickness of about one-eighth of an inch, and the bars themselves are very carefully insulated before being placed in position, so that double insulation is provided throughout. An infinite amount of pains and care is taken with this particular feature of the armature, even though the potential is comparatively low, so that under no circumstances except downright mechanical injury can there be a possibility of short circuit occurring in the armature. After the winding of the armature is completed, it is then carefully bound with heavy German silver wire so as to hold the windings in position; then the commutator faces are turned off true and smooth and the armature is ready to be tested. The test through which one of these large machines has to go is very elaborate. Careful note is taken of the temperature of fields and armature during and after a ten hours' run, and again after a 24 hours' run, and readings taken of the voltage and ampere output of the machine every few minutes, as also readings of the amount of current it takes to excite the fields. It is very rare that faults are discovered in these large machines, so careful is the workmanship throughout; but should any fault develop during the test, the machine is stopped, and the fault remedied and the test started all over again, and is continued until it is clearly shown that the machine meets the specifications in every particular. The manufacturers of electrical apparatus are continually striving to perfect their methods of manufacture so as to produce a machine which shall be free from both mechanical and electrical defects, and one in which the purchaser can put the utmost confidence. Particularly is this the case with large units, because, if anything should happen to one of these while running in a large central station, it would be known to many and would do much to injure the reputation of the manufacturer.



400-K. W. Central Station Dynamo.

Last, though not least, of what may be said in favor of the use of these large units, is the much better appearance which a station has that is equipped with these over one having a multitude of small machines running from a counter shaft with the attendant noise and confusion incident to such a system. We have not entered, to any extent, on technical reasons for the adoption of these large units, mainly because technicalities only appeal to the engineer. The question as to whether or not a station should adopt such units comes down largely to a matter of dollars and common sense, and as both of these are on the side of the large direct-driven unit, we may feel fairly safe in assuming that now that their introduction has begun, and they have found favor with the public, it is only a question of time when all of our large stations will adopt them.

An Historic Dynamo Sold.

The dynamo which furnished current to the first electric lights ever used for tower illumination was recently sold by the Wabash (Ind.) City Council to the Rose Electric Light Company of St. Louis. It was a Brush machine, and was connected with the Court House tower in Wabash in March, 1880. The trial run was witnessed by hundreds of visitors from all over the country. The outfit continued to run until 1886, when the four 2,000-c.p. lights were taken down, and, with the dynamo, stored away in the City Hall. The dynamo and lamps cost $18,000, and were sold for $30.

The Electric Street Railway Car Controller.

SYSTEMS of controlling apparatus for electric cars may be divided, according to the methods used for securing regulation of speed, into three classes:

First. Those making several combinations of different sections of the motor field coils or "commutating" the fields.

Second. Those introducing a resistance in series with the motors (the two latter being in parallel at all times) in order to reduce the starting current and to prevent an unpleasant and dangerous jerk when starting. The resistance is divided into comparatively few or many parts, according to the particular system used. To increase the speed, more and more of these sections are short-circuited, until at full speed the motors are left in multiple, but with no outside resistance in the circuit. With some types of controlling apparatus a further increase in speed is effected by short-circuiting or cutting out a portion of the field winding, thus weakening the field strength and increasing the speed.

Third. Those making combinations of the two motors, starting with them in series, then throwing them in multiple. During the process of changing the connections, one motor is short-circuited on itself, then open-circuited, then thrown into multiple arc with the other motor. A resistance in one or two sections is used in series with the two motors when starting, and this same resistance is used again during the operation of changing the motors from series to multiple, in order to prevent the acceleration in speed from being so rapid as to cause the car to jump suddenly forward.

On account of the greater economy in power consumption which is effected by the use of series-multiple controllers, this type of controlling apparatus is rapidly being adopted for all cars equipped with two motors (from its very nature it will be seen that it is not adapted to single motor cars), to the exclusion of the two types mentioned previously. As a matter of fact, the first or commutated field type of controller has long been discarded by manufacturers, and is rapidly being replaced with the series multiple type.

It may be of interest to give you a more detailed description of a series-multiple controller, but in such general terms as will apply to any controller type.

Controllers operating on the series-multiple principle are usually provided with two handles, one being for turning the controller cylinder or drum, the other for operating the reversing switch.

In order to reverse the direction of rotation of a series-wound motor, it is necessary to reverse the direction of the current in *either* the field coils or armature; reversing the current in both field coils and armature will leave the direction of rotation the same. Therefore, it is necessary to bring to each controller four wires from each of the motors, in addition to the ground and trolley wires, and the wires from the resistance coils. Of the four motor wires, two connect with the two brushes, and two with the two ends of the field windings. The operation of the reversing switch is usually entirely independent of the movement of the controller cylinder, although in one well-known type of series-multiple controller there is an interlocking device which prevents the reversing switch from being operated, except when the controller handle is at the "off" position. The advantage of this is that the controller is less liable to be injured in use. The great objection to the use of such a device is that it requires three distinct movements for the motorman to reverse the car, first, to cut off current, second, to throw reversing switch, third, to throw on current again; and as the occasions when the reversing switch is called into service are usually those demanding the most rapid stopping of the car, if destruction of life or damage to property are to be avoided, it will be seen that all unnecessary and time-consuming movements should be avoided.

The different positions of the main controller handle are usually designated by marks on the top of the controlling stand, and in the best types of controllers the positions are distinguished by notches in a wheel or disc, revolving with the drum and engaging with a pawl. The different positions are then distinguished by the sense of touch, and the motorman may keep his eyes to the front at all times.

Series-multiple controllers have two positions of most economical operation, one being when the motors are in series with each other, and with no external resistance in circuit, the other when the two motors are in multiple with no external resistance in circuit. On the former position, the speed of the car is somewhat less than half of the speed on the latter position, and this series position is consequently much used when cars are running through crowded streets, around curves, over crossings, etc. As the two motors are started in series, the starting current is only about 50 per cent. of what is, if the motors are started in multiple, required to start the same car with the same quickness, for the torque, or turning effort, of the motors depends only upon the number of amperes flowing through them, and in the former case, as the same current flows through both motors, the torque developed is twice as great with a given flow of current to the car, as if the same current is divided, half going through one motor and half through the other. Conversely, if the car is started with the same acceleration in each case, the current required to start with the motors in series is only half of that required if they are in multiple. This means that a car equipped with series-multiple controllers will not show the same wide variations in current consumed, and with even comparatively small systems of electric roads this is a most important point, as the maximums of the current variations in the power house will be much lower and the strains on the generating machinery will be less severe.

About the only objection which can be raised to the use of series-multiple controllers is, that when the motors are being thrown from series to multiple, one of them is cut out entirely, while the other is still doing work; but as the positions of controller, while the connections are arranged in this way, are not intended to be used as running points, but are to be passed over quickly, and with one movement of the handle, this unequal division of the work is but momentary, and in practice does not last for a sufficient length of time to cause any perceptible increase in temperature of one motor over the other.

Electrical Power Transmission—VII.

BY LOUIS BELL, Ph. D.

[*Synopsis of Preceding Sections.*—The former sections have dealt with the elementary principles underlying the development of electrical energy, and the theory of continuous current dynamos and motors, the subjects being considered under the heads "Concerning Electrical Energy" and "Power Transmission by Continuous Currents," the section in this issue being included under the latter. The practical portion of the subject was commenced with a classification of continuous current motors under four heads: Case I. Series wound motors at constant potential; Case II. Series wound motors at constant voltage; Case III. Series wound motors with independent current and voltage; Case IV. Shunt wound motors at constant voltage. In regard to the motors under Case I., it is stated that they are now comparatively little used and hence of not great practical importance. They necessitate a regulating device, usually worked by a centrifugal governor, and on account of danger from the high voltage, which their use implies, and mechanical and other difficulties, they have come to be looked upon as a last resort, only to be employed when nothing else is available. Motors comprised in Case II. are of great importance on account of their employment in street railway practice; aside, however, from their use for this purpose, for hoisting and a few other applications, series wound motors, while possessing some valuable properties, are limited in their usefulness by their tendency to vary widely in speed when the load changes; hence they are employed chiefly in cases where the speed is varied deliberately. They have the advantage on constant potential circuits of being able to give on occasion very great torques. Their disadvantage of non-regulation on such a circuit is largely overcome in street railway practice by the combination, through the means of a controller, of the two motors of a car in series or parallel, though a rheostat comes into play at intermediate speeds. The motors under Class III. are used occasionally with some success, but not extensively, owing to mechanical and other difficulties. By working a specially designed generator and motor of this system together, the pair will act almost as if connected by a belt, and the motor will run at a nearly uniform speed. Case IV. is taken up below.]

Power Transmission by Continuous Currents.

33. Case IV—Shunt wound motors are invariably worked on constant potential circuits, to which they are particularly well suited They form by far the largest class of motors in general use and owe this advantage mainly to their beautiful self-regulating properties.

The shunt motor is in construction practically the same as a shunt wound dynamo. Let us look into the action of such a machine when supplied from a source of constant voltage. If the design be reasonably efficient, the armature will have a very low resistance and the shunt circuit, which includes the field coils, a resistance several hundred times greater. When such a machine is supplied with current of constant voltage at its brushes and is running at any given speed and load, the current through the armature is practically determined by the counter E. M. F. developed, the armature resistance being almost negligible. The shunt is of high resistance and takes a certain small amount of current, determined by the voltage across the brushes. Now let the load increase; the field is, aside from loss of voltage on the line, practically constant and the first effect of the added load is, as in a series motor, to reduce the speed. But this lowers the counter E. M. F., and consequently the armaturre current rises and the torque is increased, thereby enabling the motor to operate under the larger load. The torque necessary to enable the motor to maintain an increased load varies directly as the load and is also directly proportional to the current. But since the current is directly proportional to the difference between the impressed and counter E. M. F.'s, it is possible to design a machine so as to run at almost exactly constant speed.

The constancy depends really on the armature resistance, small as it is. For example, a motor is designed to run at 100 volts. Running light the counter E. M. F. is 99.9 volts and with an armature resistance of 0.01 ohm the current will be 10 amperes. The work done is say 1-h. p. Now let a full load, say 20-h.p., be thrown on. The torque will have to be increased 20 times, requiring 200 amperes. But this will flow through the armature under an effective pressure of 2 volts. Hence the counter E. M. F. will only have to fall to 98 volts to provide current enough to meet the new condition. As the counter E. M. F. varies directly as the speed a fall in speed of less than 2 per cent will follow the increase of load. This computation neglects all questions of armature reaction as well as the effect of this minute fall in speed on the output, but fairly represents a case that might actually be met with in the best modern practice. In fact, shunt motors have been so designed as to vary no more than 1½ per cent. in speed from no load to full load. A variation of 5 or 6 per cent. is, however, more usual.

When supplied from an over compounded generator so that the impressed voltage will increase with the load, a shunt motor can be operated even more closely to constant speed than indicated above, since there is no longer need for a fall in speed to continue the requisite difference between the impressed and counter E. M F's. In such case any tendency to fall in speed is at once corrected by the rise in voltage on the line. This device is seldom used, however, since it is ill fitted for simultaneously operating a number of motors at varying loads, and for single units has no particular advantages over the series wound pair previously noted, or a very simple arrangement of alternating apparatus.

Not only can the shunt motor be worked at nearly constant speed, but it also has the advantage of permitting a considerable range of speed variation without sacrificing much in the matter of efficiency. We have already seen that a change in field strength involves a change of speed, since it necessarily alters the counterl E. M. F., which in turn modifies the current.

In a shunt motor the immediate effect of a decrease of field strength is to lower the counter E. M. F., letting more current through the armature and increasing the torque. Hence the speed rises until the current and torque adjust themselves to the requirements of the load. On the other hand, if the field be strengthened, the current necessary to carry the load cannot be obtained without a fall in speed. It is clear that the changes of speed thus obtained may be quite considerable, for in a motor such as that just described a variation of 10 per cent. in the field would produce an immense variation of current, which would have to be compensated by a change in speed as great as in the field. Inasmuch as these field changes can be produced by varying the field current, which is already small, through a rheostat in the circuit, this change of field strength can be accomplished with but a trifling waste of energy. If the field magnets are comparatively unsaturated, it is not difficult to obtain perhaps 50 per cent. variation in speed. A motor designed for such work is, however, necessarily bulky, as it must be possible to get torque enough to handle the full load with a field much below its normal strength.

It should be noted that even when running at a considerably modified speed, the motor must still be nearly self-regulating, for changes in load for the conditions that govern self regulation are within moderate limits unaffected by the particular strength of field employed. Only when the armature reaction has been greatly modified will the regulation be sensibly disturbed.

A device sometimes used to improve the regulation of motors essentially shunt wound is the so called differential winding. This consists of an additional field winding in series with the armature, but around which the current flows in such a direction as to de-magnetize the field. The total field strength is then due to the difference between the magnetizing power of the shunt and of this regulating coil. When the load on the motor increases, the additional current due to a minute change of speed will weaken the field and thence cause the motor to run faster until the counter E. M. F. adjusts the current to the new speed and output. Differential winding obviously requires an extra expenditure of energy in the field since the shunt and series turns act against each other. It is now used much less than formerly since it has been found that a well designed pure shunt motor will regulate very nearly as well and more efficiently. Fig. 21 shows the Sprague motor wound on this differential plan, now only of historical interest, but which through its good qualities did much to popularize the electric motor in America.

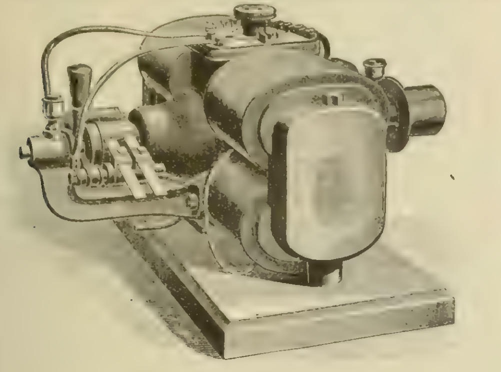


FIG. 21.

Various modifications of shunt and series wound motors have from time to time appeared devised for particular adaptation to special purposes or sometimes merely for the sake of novelty. None of them, however, are of sufficient general importance to find a place here.

(To be continued.)

Electrodynamic Machinery—XXI.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

[*Synopsis of Preceding Sections.*—The term electrodynamic machinery includes not only the apparatus by which mechanical energy is converted into electrical energy, but also the translating apparatus, the transmission circuits, and the apparatus required for the measurement of electrical energy.

In any dynamo electric generator, E. M. F.'s are produced in conductors by causing them to cut magnetic flux paths. The value of this E. M. F. may be increased by increasing the rate of cutting magnetic flux, as for example, by increasing the speed of revolution, of the magnetic flux, or the number of turns of the conductor.

The electrical capability of a machine is equal to $\frac{E^2}{r}$ where E is the E. M. F. of the machine taken at its brushes, and r is the internal resistance of the machine. In any machine of given dimensions the electric capability is nearly constant, whatever may be the winding of the machine or the size of the wire employed.

The commercial efficiency of a generator is the ratio of its output to its intake, *i. e.*, the ratio of its electrical activity in watts at its terminals, divided by the mechanical activity it absorbs in watts.

Dynamo electric generators are either constant potential or constant current generators. Constant potential generators are:—

(1). Magneto-electric, (2). Separately excited or, (3). Self excited.

Self-excited generators may be:—(1). Series wound, (2). Shunt wound, (3). Compound wound.

Dynamo electric generators may be divided according to the number of field poles, into bipolar and multipolar. They may be divided according to their magnetic circuit into (1.) Those having simple magnetic circuits formed by a single coil or winding.

(2). Those having consequent poles. Dynamos may also be divided, according to the shape of their armature, into ring, cylinder, disc, smooth core and toothed core armature, machines.

Alternating current generators may be divided, according to the number of separate alternating currents they furnish, into uniphase, dipthase, or triphase generators.

A machine capable of producing two or more separate alternating currents is sometimes called a multiphase generator.

By convention, magnetic flux is assumed to [illegible] north seeking pole, and to enter it at its south seeking pole.

The force producing a magnetic [illegible] force and is generally contracted M. M. F.

Magnetic flux may vary in (1) direction (2) intensity (3) distribution.

Similarly directed magnetic fluxes repel each other. Oppositely directed magnetic fluxes attract each other.

As regards its direction, magnetic flux may be (1) uniform, (2) convergent, (3) divergent.

The intensity of uniform flux is unvarying. The intensity of convergent flux increases along its path; that of divergent flux decreases along its path.

The intensity of magnetic flux is measured in units called gausses. The gauss is the unit of magnetic intensity, and is such an intensity as is represented by one C. G. S. unit of flux (one weber) per sq. cm of normal area.

A M. M. F. may be produced (1). By the passage of an electric current. (2) As a property inherent in the molecules or ultimate particles of certain kinds of magnetic matter.

The passage of an electric current through a rectilinear conductor towards an observer will produce a magnetic flux that is directed counter-clockwise around the conductor.

A conducting turn carrying one ampere is called an ampere-turn. When a current passes through a coil of wire, the strength of the magnetic flux produced by a single turn carrying two amperes will be twice as great as the turn carrying one ampere.

The M. M. F. of a current, therefore, depends on the number of ampere turns.

The unit of magneto motive force is called the gilbert. A gilbert is a M. M. F. produced by $\frac{10}{4}$ ampere-turn, or approximately 0.7958 ampere turn. If, therefore, the number of ampere-turns on a coil be multiplied by 1.257 or $\frac{1}{0.7958}$, the product will give the M. M. F. of the coil in gilberts.

The magnetic flux produced in a circuit by a given M. M. F. will depend on the nature and dimensions of the circuit, and on its reluctance *i. e.*, on its resistance to magnetic flux.

The unit of reluctance is called the oersted, or the reluctance of a cubic centimetre of air pump vacuum measured between opposite faces.

The unit of magnetic flux is called the weber. The weber is equal to the flux produced by one gilbert acting through a reluctance of one oersted.

Ohm's law for continuous current circuits may be expressed as follows, namely:

$$\text{amperes} = \frac{\text{volts}}{\text{ohms}}, \quad \text{or}$$

$$\text{current strength} = \frac{\text{electromotive force}}{\text{resistance}}$$

A modification of this law applicable to magnetic circuits is,

$$\text{webers} = \frac{\text{gilberts}}{\text{oersteds}}, \text{ or magnetic flux} = \frac{\text{magnetomotive force}}{\text{reluctance}}$$

Magnetic circuits may be (1). Non-ferric, or those containing no iron, (2). Ferric, or those composed entirely of iron, and (3). Aeroferric, or those containing both air and iron.

The reluctance of a non-ferric circuit is equal to the length of the circuit in centimetres, divided by its cross-section in square centimetres, and this can only be directly applied when the cross-section is uniform.

Magnetizing force is the space rate at which the magnetic potential descends in a magnetic circuit. The total fall of magnetic potential in a magnetic circuit is equal to its M. M. F., just as the total "drop" of electric potential in an electric circuit is equal to its E. M. F.

When a magnetizing current is passed through a coil surrounding a core of iron, the magnetic flux produced is usually enormously greater than if the coil was provided with a core of air or other non-magnetic material. This increase in the M. M. F. is not strictly speaking to be regarded as due to a decrease in the reluctance of the circuit, but rather to an increase in the M. M. F., due to the magneto motive force inherently possessed by the iron.

The magnetic flux produced by a current passing through a coil of wire surrounding iron is produced as follows:

(1.) By the prime M. M. F., or that produced by the magnetizing current.

(2.) By the induced aligned or structural M. M. F. of the iron.

Practically, however, it is convenient to consider that iron is devoid of M. M. F., but that its reluctance varies with the flux in the circuit.

In a magnetic circuit, when a magnetic flux of Φ webers passes through a circuit with a reluctance of $\mathcal{R}$ oersteds, there is produced a counter M. M. F. of Φ$\mathcal{R}$ gilberts.

The reluctivity of a substance is its reluctance of unit volume, measured between parallel faces. The reluctivity of air-pump vacuum, air, wood, glass, etc., are practically the same, and do not vary with the flux density. The reluctivity of iron may be as low as 0.0005 and varies with the flux density.

A linear relation exists between magnetizing force and reluctivity in iron between the limits of flux density at which iron is practically worked, so that equal increments of magnetizing force add equal increments of ferric reluctivity.

Iron becomes practically magnetically saturated when [illegible], the intensity, is 7 kilogausses in cast iron, and 17 kilogausses in wrought iron and soft steel, since the reluctance rises very rapidly after these intensities have been reached.

The effect of an air-gap in a magnetic circuit is:

(1.) To increase the reluctance in that circuit.

(2.) To cause a leakage or shunt path in the air surrounding the gap. After due allowance has been made for the reluctance of leakage paths, Ohm's law applies to the magnetic circuit for the determination of the flux at any point.

Electrodynamic induction is the induction of the E. M. F. in a conductor moving relatively to a magnetic flux. The E. M. F. induced by electrodynamic induction depends on the density of the flux, the velocity and direction of the motion and the length of the conductor. The direction of the E. M. F. induced, depends on the direction of the motion and on the direction of the flux.

When a conducting loop is rotated about its axis, in a magnetic field, the value of the electro motive force induced in it will depend on the rate with which it is emptied or filled with the flux, and the direction of the E. M. F. on the direction with which this flux threads or passes through it.

The E. M. F. induced in a coil maintains the same direction, so long as the flux threading through the coil continues to increase or decrease.

The E. M. F. induced in a rotating coil has the same direction as the motion of the hands of a watch; *i. e.*, clock-wise, when the flux entering the loop has the same direction as the light which passes from the face of the watch to the eye of the observer. When the flux enters the loop in the opposite direction, it will induce an E. M. F. in the loop in the opposite direction to the hands of a watch; *i.e.*, counter-clock wise.

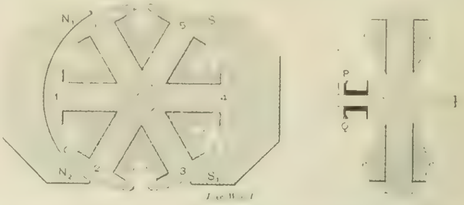
The effectiveness of a dynamo for generating E.M.F. is not necessarily to be gauged by the amount of the so-called idle-wire, or wire which at any instant is not covered by a polar face.

Magneto-electric generators are employed in telephony and for firing electric fuses in mines.

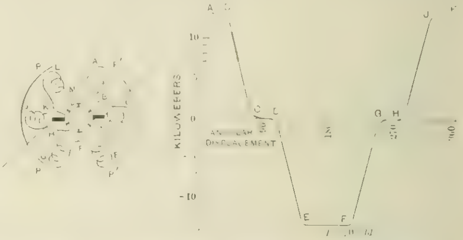
The first step necessary for determining the E. M. F. produced by a generator is to determine the magnetic flux linked with the armature conductors in the various stages of revolution, and from the rate of change in this linkage, together with the number of turns to deduce the E. M. F. at each instant.

104. A form of armature, which stands next in order of complexity to the shuttle-wound armature last described, is the radial or pole armature, represented in Figs. 87 and 88. Here the armature coils *C*, *C*, are wrapped, usually by band, around radially extending laminated pole-pieces, formed from sheet iron punchings laid side by side. This type of machine is rarely found in generators, but is sometimes adopted in very small motors. The winding of an armature is carried out as represented in Fig. 89, where the pole-pieces are shown at *P*, *P*, and *P*, *P*. Starting the winding at the point *M*, the coil *A* is wound from *A* to *B*, as shown; the coil *C* is then wound from *B*, through *C* to *D*; the coil *E* from *D*, through *E* to *F*; the coil *G* from *F*, through *G* to *H*; the coil *J* from *H*, through *J* to *K*; the coil *L* from *K*, through *L* to *M*, finally connecting the last end of the coil *M* to the first end of the coil *A*, thus making the closed-coil winding shown in the figure. The connections of this winding to the six-part commutator will be seen from an inspection of the figure. The points *M*, *B*, *D*, *F*, *H* and *K*, are brushes connected to the separate insulating segments of the commutator, being provided in the position shown on a line connecting the centres of the pole pieces. This commutator is shown in cross section at *P*, Fig. 88. It will be seen that, owing to the conical boundaries of each armature coil, the winding is difficult to arrange. This type of generator is always operated by an electromagnetic field.

105. Since the dimensions of machines with pole or radial armature are always small, the reluctance of the circuit is practically wholly resident in the air spaces between the poles and armature projections provided care be taken that the iron in the armature is not worked at an intensity above 10 kilogausses, or above 7 kilogausses in the field magnet, if the latter be of cast iron. If *A* be the area in square centimetres of the polar face of a radial armature projection, and *d*, be the clearance or *intrefer* in cms, then *d* will be the reluctance of the *intrefer* over each armature projection. Since there are four such air gaps in multiple series the total reluctance of the circuit provided in the case represented by Fig. 87, will be $\frac{d}{A}$ oersteds, provided we neglect the reluctance existing in the iron.

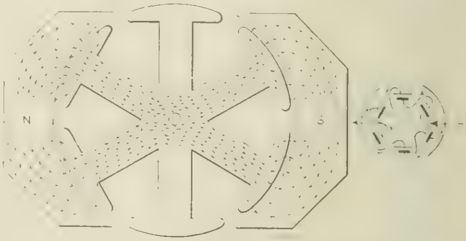


Figs. 87 and 88.—Radial or Pole Armature. Sections at Right Angles to Axis and Through Axis.



Figs. 89 and 90.—Diagrams Showing Connections of Coil with Commutator and Flux Passing Through One Armature Projection During a Complete Rotation.

106. The distribution of the flux through the armature is diagrammatically represented in Fig. 91. If the cross section of each polar extremity be *a*, square centimeters, then at no time there will be less than two radial projections carrying the total flux, and if 10 kilogausses be the limit permitted by the reluctance of the air gap, the total flux to be forced through the armature will be 2 $a\times$ 10,000=20,000 *a*, webers. The M. M. F. necessary on the field magnets will be 20,000 $a\times\frac{d}{A}$ gilberts. For example, if a=1.3 sq. cms, d=0.2 cms, a=10 sq. cms, the M. M. F. required will be 26,000×0.02=520 gilberts=416 ampere-turns, and this must be the excitation included on both limbs of the electro-magnet.



Figs. 91 and 92.—Distribution of Flux and E. M. F. at Position Shown.

(To be continued).

Laboratory of Houston & Kennelly, Philadelphia.

Practical Notes on Dynamo Calculation.

BY ALFRED E. WIENER.

Synopsis of Preceding Sections.—Before commencing Part III. we will, for the benefit of new subscribers, briefly review the contents of Part I. and II. of this serial. In the first part, which is commenced in the issue of May 19, 1894 (Vol. XXIII., p. 675), the author has deduced a numerical value for the unit of electromagnetic induction, and, based upon this "unit armature-induction," has given a set of practical formulæ for calculating the dimensions and the winding of the armature. This object is treated in 30 chapters, as follows:

Part I.—Calculation of Armature.

Chapter 1. Unit Armature Induction.—Chapter 2. Specific Armature Induction.—Chapter 3. Conductor Velocity.—Chapter 4. Field Density.—Chapter 5. Length of Active Armature Conductor.—Chapter 6. Size of Armature Conductor.—Chapter 7. Diameter of Armature Core.—Chapter 8. Dimensions of Toothed and Perforated Armatures; (*a*) Toothed Armatures; (*b*) Perforated Armatures.—Chapter 9. Length of Armature Core; (*a*) Number of Wires per Layer; (*b*) Height of Winding Space, Number of Layers; (*c*) Total number of Conductors, Length of Armature Core.—Chapter 10. Armature Insulations; (*a*) Number of Commutator Divisions; (*b*) Number of Convolutions per Commutator Division; (*c*) Number of Armature Divisions.—Chapter 12. Radial Depth of Armature Core, Density of Magnetic Lines in Armature Body.—Chapter 13. Total Length of Armature Conductor; (*a*) Drum Armatures; (*b*) Ring Armatures; (*c*) Drum Wound Ring Armatures.—Chapter 14. Weight of Armature Winding.—Chapter 15. Armature Resistance.—Chapter 16. Energy—Losses in Armature; (*a*) Energy Dissipated in Armature Winding; (*b*) Energy Dissipated by Hysteresis; (*c*) Energy Dissipated by Eddy Currents; (*d*) Total Energy, Loss in Armature.—Chapter 17. Radiating Surface of Armature; (*a*) Radiating Surface of Drum Armatures; (*b*) Radiating Surface of Ring Armatures.—Chapter 18. Specific Energy Loss. Rise of Armature Temperature. Empirical Formula for Heating of Drum Armatures.—Chapter 19. Circumferential Current; Density of Armature.—Chapter 20. Load Limit and Maximum Safe Output of Armature.—Chapter 21. Running Value of Armature.—Chapter 22. Armature Torque—Chapter 23. Peripheral Force of Armature Conductors.—Chapter 24. Armature Thrust.—Chapter 25. Types of Armature Winding; (*a*) Closed Coil Winding and Open Coil Winding; (*b*) Spiral Winding, Lap Winding and Wave Winding.—Chapter 26. Grouping of Armature Coils. Formula for Connecting; (*a*) Parallel Grouping; (*b*) Series Grouping; (*c*) Series Parallel Grouping.—Chapter 27. Application of Connecting Formula to Special Cases; (*a*) Bipolar Armatures; (*b*) Multipolar Armatures, with Parallel Grouping; (*c*) Multipolar Armatures, with Series Grouping.—Chapter 28. Dimensioning of Commutator; (*a*) Diameter and Length of Brush Surface; (*q*) Commutator Insulations.—Chapter 29. Brushes and Current Leads; (*b*) Brushes; (*b*) Current Leads.—Chapter 30. Mechanical Calculations about Armature; (a) Shaft; (*b*) Driving Spokes; (*c*) Bearing; (*d*) Pulley and Belt.

In Part I. are contained Formulas (1) to (88), and Tables I. to XLIV., derived from the data of nearly two hundred of the best modern dynamos.

The second part deals with the magnetic flux, and embraces ten chapters, arranged in two subdivisions.

Part II.—Calculation of Magnetic Flux.

1. Useful and Total Magnetic Flux.

Chapter 31. Magnetic Field. Lines of Magnetic Force. Magnetic Flux. Field Intensity.—Chapter 32. Useful Flux of Dynamo.—Chapter 33. Actual Field Density of Dynamo; (*a*) Smooth Armatures; (*b*) Toothed and Perforated Armatures.—Chapter 34. Percentage of Polar Arc; (*a*) Distance between Pole Corners; (*b*) Bore of Pole Pieces; (*c*) Polar Embrace.—Chapter 35. Relative Efficiency of Magnetic Field.—Chapter 36. Total Flux to be Generated in Machine.

2. Calculation of Leakage Coefficient.

Chapter 37. Formula for Probable Leakage Factor; (*a*) Smooth Armature; (*b*) Toothed and Perforated Armatures.—Chapter 38. General Formulæ for Relative Permeances; (*a*) Two Plane Surfase inclined to each other; (*b*) Two Parallel Plane Surfaces Facing Each other; (*c*) Two Equal Rectangular Surfaces Lying in One Plane; (*d*) Two equal rectangles at right angles to each other; (*e*) Two parallel cylinders; (*f*) Two Parallel Cylinder Halves.—Chapter 39. Relative Permeances in Dynamo Electric Machines; (*a*) Principle of Magnetic Potential; (*b*) Relative Permeance of the Air Gaps; (*c*) Relative Average Permeance Across the Magnet Cores; (*d*) Relative Permeance Across Pole Pieces; (*e*) Relative Permeance Between Pole Pieces and Yoke.—Chapter 40. Actual Leakage Factor of Machine.

Part II., is commenced in the issue of Nov. 10, 1894 (Vol. XXIV., p. 497), and comprises formulæ (89) to (134), and Tables XLV. to LII.

In the following parts the dimensioning of the field magnet frame, the calculation of the magnetomotive forces, the calculation of the magnet winding, and practical examples of dynamo-calculation will be taken up.

(Part III. will be continued in our next issue.)

A Definition of Reactance.

To the Editor of The Electrical World:

Sir:—I am much obliged to you for the interesting discussion which you have opened in your columns concerning the meaning of the word "reactance," and I hope that the article which you kindly reprinted in your issue of the 20th of October may have been understood by all your readers as fully as it was by Messrs. Houston and Kennelly, with whom I am pleased to find myself in perfect accord.

Unfortunately Messrs. Steinmetz and Bedell, who appear to maintain some ill feeling towards me for having claimed for the "Société Internationale des Electriciens" a greater share of credit than was accorded by the opening sentence of their article, "The term reactance which has been employed *by us and others*," and attributed to me in their recent communication a "position" markedly different from that which I intended to assume.

I do not at all assert that the definition

$$I = \frac{E}{\sqrt{R^2 + K^2}}$$

is *preferable* to that of the American Institute, for the good reason that, with Messrs. Houston and Kennelly, I believe these definitions to be absolutely identical, if the circuit is limited to the inclusion of inductance and capacity, as I have stipulated.

Moreover, I have never declared that reactance was constant. What I have stated is that it was a "*constant of the circuit*," which is an entirely different matter. With us a "*constant of a body*," or a "*constant of a circuit*," is any characteristic property of a body or of a circuit even though it be more or less variable, as resistance, or permeance. I am very much surprised that such an objection should have been raised, an objection which would attribute to me an incredible degree of ignorance.

The only position I have wished to take is as follows: (1) It is an abuse of the word "reactance" to apply it without qualification to other cases than those arising from reactions by E. M. F.'s. generated from the inductance and capacity of the circuit considered. In all other cases the terms *apparent* reactance* (or equivalent reactance) should be expressly employed.

The definition of reactance should be supplemented by that of

$$\textit{apparent resistance},\ R = \frac{\text{Power}}{\text{current}}.$$

Messrs. Houston and Kennelly, and Steinmetz and Bedell have doubtless appreciated the justice of my criticisms, since they have

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*The necessity for this distinction, although extremely important, may escape notice, and even Professor Macfarlane has absolutely opposed it. It is, however, a sufficient reply to this objection to consider a particular case, for example the equation which expresses the current strength I of a synchronous motor. This may be written from the point of view I advocate

$$I = \frac{E - E'}{\sqrt{R^2 + K^2}}$$

where E is the E. M. F. of supply, E' the C. E. M. F. of the motor, R the resistance, and K the reactance of the armature. On the other hand, if we consider only the apparent values R_1 and K_1 as preferred by Professor Macfarlane, we should write

$$I = \frac{E}{\sqrt{\overline{R_1}^2 + \overline{K_1}^2}}$$

The former notation is preferable (taking mean values for K and R w dealing with the theory of operation of such motors.

The latter notation, *i. e.* the employment of the equivalent resistance and reactance, will, on the other hand, be more suitable for the practical study of the effect of the current, and of a motor, upon the line conductors.

It is desirable, in my opinion, to retain both systems of notation, and it will, therefore, be evident why I protested against the suppression, by Messrs. Bedell and Steinmetz, of the first in favor of the second.

not offered any objections upon these points, with the single exception that they prefer the word "equivalent" to "apparent." This is a matter of taste, and I cheerfully accept the word "equivalent" if they so prefer.

Admitting the preceding, I am unable to understand the objections raised by Messrs. Steinmetz and Bedell, in regard to the effect of hsyteresis in circuits containing iron cores, in the absence of external E. M. F.'s. In fact, where hysteresis exists, it suffices to designate by R the equivalent resistance (the sum of the ohmic resistance r and the hysteretic loss, divided by the current) in order to write

$$1 \qquad I = \frac{E}{\sqrt{R^2 + K^2}}, \text{ where } K \text{ stands}$$

for the same reactance as that which Messrs. Bedell and Steinmetz specify when they say

$$K = \omega L - \frac{1}{C\omega}$$

There is, therefore, not a shadow of contradiction between the two formulæ, and our definition evidently offers no difficulties to application in the case of hysteresis.

I can moreover affirm that the committee of "The Société Internationale" which included electricians as distinguished as Professors Mascart, Potier, Hospitalier and others, never regarded this question otherwise than Messrs. Steinmetz and Bedell. Even though it formulated equator (1), it was because it considered KI as being the second side of a *right angled* triangle, of which E is the hypothenuse, and of which the first side has a direction coincident with I. As there can only be one way of defining this triangle, there can only be one definition of reactance, as has been appreciated from the outset by Messrs. Houston and Kennelly.

I regret that this statement dispels the illusion of Messrs. Steinmetz and Bedell, who appear to believe that they have derived a new definition, when they have only given a different enunciation of the same definition, but if the Société Internationale, which had carefully studied the proposals of the American Institute, had been consulted in its turn by Messrs. Steinmetz and Bedell, it would have doubtless given them the exact meaning above indicated. It would, however, have refrained from compounding the true reactance in a circuit with its equivalent reactance, in the presence of an external E. M. F., as has been done by Messrs. Steinmetz and Bedell.

As soon as Messrs. Steinmetz and Bedell abstain from this abuse of the word "reactance," the only point to which I have taken exception, I shall be happy to come into accord with them, on the basis indicated by Messrs. Houston and Kennelly, by accepting the definition adopted by the American Institute for the definition of reactance, as equivalent to our own *within these clearly defined limits*, and declaring the same preferable, both because it is simpler and more elegant.

Finally, I embrace the opportunity to supplement the definition of reactance in giving the name *reactance factor* to the ratio K of the reactance K in a circuit to its equivalent resistance R. R

This ratio is similar to the impedance factor of Mr. Kennelly, and it is often very convenient. It defines the tangent of the angle of the lag of the current with reference to the E. M. F. producing it.

Having completed this perhaps too lengthy letter, I suppose I ought to sign myself by the mysterious and amusing title which Messrs. Steinmetz and Bedell persistently gave me, *i. e.*, "The French author referred to." A. BLONDEL.

Ecole des Ponts et Chaussées, Paris, France.

To the Editor of The Electrical World:

Sir:—In sending you the present communication concerning the term reactance, my purpose is not to cause controversy or to enter into personal discussion. I desire, however, that this matter may be freed from any misunderstanding, feeling as I do that there is no occasion for misunderstanding, either in regard to the technical points involved or in regard to the personal views which have been expressed concerning reactance, its meaning and its history. If I have been in part the cause of any misunderstanding, I regret it and trust that such may not continue. Through your kindness I have seen, on the day that this issue of the ELECTRICAL WORLD goes to press, the letter from Professor Blondel which you are about to publish and which is the occasion of my writing. Time has not allowed me to first learn the views of Mr. Steinmetz.

Concerning the history of the term reactance, it has been far from any intention of mine, Mr. Steinmetz, the American Institute of Electrical Engineers, or, as far as I am aware, of any of its members, to pose as the originator of the term or as the original advocate of its use. This has been clearly understood from the beginning by engineers in this country. I may here quote verbatim from the article entitled "Reactance," by Mr. Steinmetz and myself in the Transactions of the American Institute of Electrical Engineers (see Transactions, p. 768). "This term was first suggested by M. Hospitalier (see "L' Industrie Electrique," May 10, 1893), and was proposed officially (see Bulletin, June, 1893), by the committee appointed by the Société Internationale des Electriciens to consider the Congress proposals of this Institute. (See Transactions, vol. x., p. 413.) We take pleasure in expressing our appreciation of the praiseworthy efforts of Prof. Hospitalier and the Société Internationale in their advocacy of this and other conventions of nomenclature." This statement appeared at the bottom of the first page of the article in the Transactions; it did not appear in the article as first given in some of the technical papers. This statement is clear and explicit. In a supplementary article, "Reactance and its Definition," by Mr. Steinmetz and myself, the following statement is made, which has appeared in the Transactions and the technical press. (See ELECTRICAL WORLD, Dec. 1, 1894.) "In a note to our original paper, we have called attention to the first suggestion of the term reactance by M. Hospitalier in May, 1893, and the recommendation of the committee appointed by the Société Internationale des Electriciens to consider the programme for the Chicago Congress, 1893. The term is a happy one; it is international, and uniformity in its use is to be desired."

For a year and a half I have been an ardent advocate of the use of the term reactance, but desire no further honor, being first made acquainted with the word by M. Hospitalier himself in a conversation on the subject of units and symbols, which I had the pleasure of holding with him in the early summer of 1893. I confess that the expression "advocated by us and others" was bad form, although correct.

Concerning the meaning of the term there is practically unanimity of opinion. The same thing may be approached from slightly different standpoints and differently expressed; the idea is the same. Mr. Steinmetz and I willingly restricted "reactance" to the effects of self-induction and capacity, using equivalent (or apparent) reactance where external reactive E. M. F.'s are involved. Reactance primarily signifies a quantity involving no expenditure of energy, a consideration which Mr. Steinmetz and I have considered paramount, and upon which we have laid particular stress.

In the treatment of the synchronous motor, the reactance (due to self-induction and capacity alone) and the equivalent reactance are each useful. It is, of course, to be understood that, where E. M. F's are added, they are added as vectors and not as algebraic quantities. Where equivalent resistance and reactance are used, we may employ the term equivalent impedance for their vector sum. Thus: the current flowing in the armature of a synchronous motor is equal to the vector sum of the impressed and counter E. M. F's, divided by the impedance; or it is equal to the impressed E. M. F. divided by the equivalent impedance. This usage has been followed by Professor Ryan and myself in a paper on the synchronous motor now in press.

The term *apparent resistance* is a good one and needed. It might be well to distinguish between "equivalent" and "apparent" as follows: *Equivalent* resistance and reactance might indicate the presence of external E. M. F.'s, as that produced by mutual induction; *apparent* resistance could then be reserved as a power co-efficient for a simple circuit, combining the effects of ohmic resistance and hysteretic loss.

A means for designating the tangent of the angle of lag or advance by some term, as *reactance factor*, will prove a convenience.

We agree throughout, although I did in part misunderstand Professor Blondel. That there is any "ill feeling" on my part is far from true. Any correction or criticism, given in the proper spirit, is to be looked upon as a favor rather than otherwise.

May I add in closing that the designation "two American writers" [no names given] is even more indefinite than "the French author referred to" [with name given]; and further, that the latter expression was employed by Mr. Steinmetz and myself, because we have naturally believed that Professor Blondel, having used a similar form, would so prefer and could take no offence ?

There has been a tempest in a teapot, whereby "Reactance" has involved an expenditure of energy contrary to its definition. Let us allow "Reactance" to go about its duties, without permitting it, however, to do work.

FREDERICK BEDELL.

New York, N. Y.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

Note. Beginning with the present issue the following important changes will be made in this department. Instead of being confined to foreign electrical literature the scope of the Digest will hereafter be extended to include the most important electrical literature published in this country. It will not be confined to the purely electrical journals, but will include, as far as possible, articles on electrical subjects published in non-electrical journals if they are of a technical character. Abstracts of articles appearing in journals which are readily accessible to American readers will, in general, be noticed more briefly than those in the less accessible journals. For the convenience of the readers the abstracts of American articles will be separated from those of foreign origin by a dash. More space will be devoted to the abstracts as distinguished from the references, and the former will be limited to the most important technical articles of the previous week, excluding of course, those appearing in THE ELECTRICAL WORLD. In general, abstracts will contain briefly the nature of the article, its object the most important data and the conclusions, as far as the limited space will admit. Articles of the following kind, and references to them, will hereafter be omitted; those of comparatively little interest or importance, or which appear to contain nothing new or technical, or belonging more particularly to other branches of engineering science, or are mere descriptions of apparatus, installations, etc., unless of special interest. Reference will be given as heretofore to English translations of important articles originally appearing in a foreign language, provided such translations, when abstracts, contain appreciably more than was included in the Digest abstract. Reference will also be given to important articles which do not admit of being abstracted. A change will also be made in the grouping of the divisions.

Abstracts made by authors, editors or publishers will be inserted if received at least as early as the journal in which the original article appears, provided such abstracts are not longer than the importance of the subject warrants, and that they comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French or German languages.

It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

All communications to this department should be addressed to THE ELECTRICAL WORLD, Digest Department, 927 Chestnut street, Philadelphia, Pa.

DYNAMOS, MOTORS AND TRANSFORMERS.

Open Circuit Loss in Transformers.—The Lond. "Elec.," Dec. 14, contains several replies to Mr. Partridge's short article which was abstracted in the Digest last week. Dr. Fleming states that it should not be inferred that such a time increase in the iron loss of a transformer is a general phenomenon or one which is a universal defect in transformers now used; he has given the subject attention for a long time past, and has also made a series of extended tests which have shown two causes of variation of these losses, which render it absolutely necessary to state, in connection with any such measurements, the temperature of the core and the form of the curve of the voltage at the terminals of the primary circuit, before the results can be compared; he also states that his experiments have shown that in certain transformers, especially tested for that purpose, no time increase in the iron loss takes place, the experiments having been extended over a period of four months; two 30-kilowatt transformers were tested with a single Mordey alternator; as they became heated, a steady decrease in the hysteresis losses were found, which fell steadily during 24 hours, after which it became stationary; after four months there was no evidence whatever of any sensible time increase; the iron losses may vary from 5 to 15 per cent. or more, according to the curve of the E. M. F. at the primary; the temperature rise may make a difference of 10 to 12 per cent.; for comparative tests the temperature should therefore be the same, and the tests should be made with the same load on that alternator; he finds that the loss when worked off groups of alternators in parallel is not the same as when the individual machines are used separately. Opinions must be held in suspense, and the problem now is to find out when this increase occurs and how it may be prevented; he adds that there is an indication that relatively very small hysteresis losses are not so permanent as larger ones. Mr. Roger Smith states that for several months he has been experimenting in this direction, and in one sample of iron he has found a considerable increase, but thinks it necessary to test several samples before arriving at any definite conclusions; he intends to publish the results soon. Mr. Blathy, of Buda-Pesth, states that manufacturers of transformers have been aware of this increase with time, provided the transformer is in circuit, and also that it is not due to dampness; the increase which he has noticed is generally from 20 to 25 per cent. of the original value; artificial heating for several hours to a temperature of about 150° C. will have the same effect, the iron loss being permanently raised thereby about 25 per cent.

Transformer Losses.—In the Lond. "Elec. Eng.," Dec. 14, Mr. Whitcher describes a system devised by himself to [illegible] for small loads.

Unipolar Dynamos.—The system described in the Digest last week is criticised and discussed in "Cosmos," Dec. 8 and Dec. 15.

Motor and Dynamo Design.—Mr. Dunn's lecture is continued in the "Elec. Eng.," Dec. 19. He discusses sparking, compounding and armature reaction; the former, if due to ridges on the commutator or to brushes which are too small, can easily be remedied; the chief cause is the self-induction of the coils, and in that case one remedy is to increase the resistance of the toe of the brushes, thus forcing the current through the coil which has been short-circuited by the brush; carbon brushes are not always suitable, and in some cases copper brushes, made with many laminæ, are used; he believes that this resistance of the brushes ought to increase with the square of the voltage. The second way of killing the spark is by inducing an electromotive force in that coil at the moment when its current is to be changed and thus help to change it (the compiler suggests that this E. M. F. should be just sufficient to cause a current to circulate in this short circuit coil which is exactly equal and in the same direction as that half of the armature current, for in that case no change will be produced in this coil at the moment when it leaves the brushes); the effect of this E. M. F. was shown by an interesting experiment; it is important in that case to provide means that the magnetism shall not be driven away by the armature reaction, which he showed by an experiment. Regarding compound winding, he shows that it is desirable to use the machine near the bend of the saturation curve, but as this is curved the increase of voltage would not be proportional to the current output; to obtain a straight line proportion he suggests over-compounding and then shunting the series coils, not with a German silver resistance, as is customary, but with a small iron wire which has a large temperature co-efficient, such that in heating it changes its resistance, thus producing a curve whose convexity is upward, which, together with the saturation curves of opposite curvature, will result in a straight line; this will take a little time, as the coil must get hot, but this can be hastened by placing it in a vacuum.

A discussion of the paper is published in the "West. El.," Dec. 22. Dr. Emery called attention to a common mistake made in testing large engine dynamos, due to the fact that the armature drag increases materially as the load rises; the proper way to make the tests is "by separate excitation, or by putting on more shunt field, without using the series field, to make a series of progressive tests and bring up the voltage by the increased field and find the losses when the armature circuit is open for each of these progressive loads, and then these subtracted from the full load, or added together and compared with the external output, really gives the efficiency"; the efficiency of such machines is lowered by this method. Mr Dunn spoke of a brush made up of copper leaves separated by paraffine paper and laminæ of some high resistance material. He described the action of the Dobrowolski device, in which the armature is entirely surrounded by a hollow iron cylinder which, therefore, bridges over the air space between the ends of both pieces; he states that it does not cause much leakage, and that it produces a gentle distribution of the magnetic fringe across the space between the ends of the pole pieces.

Principles of Dynamo Design.—A serial by Mr. Harrison under this heading is continued in the "El. Age," Dec. 22. He discusses the field frames of dynamos and leakage.

Electrical Machinist Practice.—In the 14th paper of this series by Mr. Hobert in the "Elec. Eng.," Dec. 19, he gives a few hints in handling armatures. In the 15th article, in the issue of Dec. 26, he discusses lubrication, babbitting and the balance of armatures, and in each case suggests improved methods, in the latter case, calling attention to the difference between the standing balance and the running balance; the latter will be discussed in the next paper.

LIGHTS AND LIGHTING.

Lighting of Work-shops.—"L'Elec.," Dec. 8, abstracts at some length from a recent paper of Mr. Ziezer. Lighting by incandescent lights he finds is about 32 per cent. less expensive in first cost than lighting with the inverted arc, and about 25 per cent. less expensive than with the direct arc; the operating expenses are about 36 per cent. less if there is a special engine and about 25 per cent. if there is no special engine; inverted arcs cost originally about 8.6 per cent. more than the ordinary arcs, and the operating cost is 18.9 per cent. greater; from this he concludes that the cheapest method of electric lighting for silk spinning factories, and in general for the textile industries, is the incandescent light, but when the shadows cast interfere materially with the work, as in weaving machines, it is best to use the inverted arc, which produces no shadows. Detailed estimates are given for comparing lighting by gas with that by electricity, and they show that the first cost is considerably greater for the electric installations (on the assumption, however, that the gas for gas lighting is obtained from the street main), but the cost per hour is much less. The system with inverted arcs has been in use for some time in the works of Messrs. Dobson, Barlow & Co., of Bolton, and the results have been very satisfactory; these lamps are more expensive, but the cost of the lighting per hour is much less than that of all other systems, in which a few bright lights, as distinguished from many smaller ones, are used.

Mill Lighting.—According to the Lond. "Elec. Eng.," Dec. 14, a new system has been introduced in an India cotton mill, in which all of the artificial lighting is done from the outside with 50-cp. lamps in special zinc fittings, placed outside of each window; the system has proved itself to be a complete success and saves the extra premium for fire insurance.

Artificial Lighting from a Hygienic Standpoint.—A short article by Mr. Gentsch is published in the "Zeit. f. Beleucht.," Nov. 24. He states that a normal person develops 92 units of heat per hour, a stearine candle 94, and 17 of these 1,584, a petroleum flame of 17-cp. 634, a gas flame 795, according to Pettenkofer, and 988 according to Renk; according to the latter the Welsbach light gives only half as much as an Argand burner of the same candle power; according to Dieke the heat per candle, for a gas flame, is 50, for an Argand burner 44, for a Siemens' regenerative burner of medium size 23, and for the Welsbach light 10.6; an incandescent lamp of 17 candles develops only 46 units of heat per hour, and the arc light practically none at all. Pettenkofer gives one per cent. as the upper limit of the amount of carbonic acid gas that air may contain; a person develops 44 grains of carbonic acid gas per hour, a stearine candle 28, a petroleum lamp 289, and gas flame 150 (candle power not given), and at 17 candles 214; according to Renk the Welsbach burner gives only 42 per cent. of the carbonic acid gas given off by an Argand burner of the same candle power; the electric incandescent lamp, of course, develops none at all. Rietschel suggests that the heat generated should be considered, and not the carbonic acid gas, as the former has great value in carrying the products of combustion to the upper part of a room. Regarding the poisonous carbonic oxide gas, it is stated that it is the concentration and not the duration during which one breathes this gas, which determines its poisonous effects; according to Gruber, 0.5 per cent. in the air is absolutely injurious, at 0.7 per cent. it begins to be so, while at 4 per cent. it becomes fatal.

Light and Energy Consumption.—An article on this subject is concluded in the "Zeit. f. Beleucht.," Nov. 17 (the first part of which was not received). He gives Langley's table for the light effects for equal amounts of energy, taking that of the spectrum line *A* as unity; for green it is 100,000, for yellow 28,000, and for red 1,200. Another table gives the required energy in horse power for generating an amount of light which is just discernible by the eye; for red it is 34,000,000, for green 75, and for violet 1,800, all of the figures being multiplied by 10 to the minus 20 power; according to this, green light is the cheapest, and it is this light which the fire-fly develops. He gives a table of efficiencies which give the light rays in percentage of the total rays; for the candle it is 0.29 per cent., for gas 0.32, for the incandescent light 6.00, for the arc light 10.00, for the magnesium light 13.70, for Geissler tubes 33.00, and for the Welsbach light 1.60 per cent. A table is given for comparing the incandescent light with the Welsbach for each wave length; for the extreme red the ratio of the former, divided by the latter, is 4.04, for the green light it is a minimum, 0.81, and for the extreme violet 1.74, which shows that the electric light has more red rays, and the other more green rays.

Dioptric Glass Shades.—In an article by Mr. Trotter in the Lond. "Elec. Rev.," Dec. 14, the illustrations of the article abstracted in the Digest, Nov. 10, are reproduced, but without a description; he relates his own experience in this direction (these globes are made with the object of diffusing the light uniformly over a definite area); he questions whether there is really any want for such a uniformly distributed light and believes that the distribution in the ordinary street lighting is sufficiently uniform for all practical purposes; if the superfluous light were taken away from the brilliant parts and spread over the dark parts, he believes that the general effect would not be as useful as at present; as the superfluous light is spread over a small area and the dimly lighted space is large, an even distribution would increase the light on the dimly lighted space only very little. One great objection to the use of such globes is the difficulty of cleaning them, on account of the ridges on the inside surface.

Lamp Shades.—A new form described and illustrated in "Elek. Anz.," Dec. 13, consists of glass beads having facets ground on them, threaded on wires, forming a sort of net which is placed around the bulb of an incandescent lamp, surrounding it completely, and secured at the base.

Continuous and Alternating Current Arcs.—Prof. Fleming's paper abstracted in the Digest, Nov. 17, Dec. 8 and 22, is reprinted without the discussion or the diagram in "El. Power," for December.

POWER AND HEAT.

Cost of Electric Transmission of Power.—A lecture by Mr. A. Siemens is very briefly abstracted in the Lond. "Elec. Eng.," Dec. 14. Regarding the repairs of electric motors, he states that his firm has had motors on tramways which have run 60,000 miles without any repairs whatsoever. Although the advisability of making a change from a mechanical to an electric transmission system must be decided in each case by local circumstances, he states that in general the colliery owner would save sufficient to repay the outlay in 10 years, or in other words, the cost of erecting the plant for the year would be less than the present cost by an amount equal to 20 per cent. of the outlay.

Polyphase Transmission Plan.—In a paper abstracted in "L'Elec.," Dec. 10, Mr. Bucherot describes a di-phase installation which has been installed at the factory of Weyher & Richmond, and states his reasons why this system was preferred (presumably as compared with the single-phase system and not with the three-phase system); he claims that the efficiency of the generators is greater than that of simple alternators, the starting of motors becomes simple, and the system can be used simultaneously for lighting and power.

Electric Heating.—A description of the exhibit of the Lagrange & Hobo process at the Antwerp exhibition is given by Mr. Maze in "Cosmos," Nov. 24. The system has been described before in these columns, but the following additional information may be of interest. It is preferable to have a battery of accumulators in parallel with the dynamo; a volt meter should be used; the nature of the liquids depends on the metals to be heated; carbonate of potassium dissolved in water in the proportion of about 1 to 4 or 5 by weight, was used in this case; the temperature of the bath exercises a very great influence, 50° to 70° C is about the best; for tempering it is preferable to have the liquid cold; for the passive electrode a sheet of lead answers very well; the E. M. F. ought to be greater the lower the conductivity of the liquid; in the above mentioned liquid, 100 volts is sufficient for small iron and steel bodies; the E. M. F. is proportional to the extent of the surface immersed, and depends in a certain degree on the nature of the metal, but the current strength is approximately the same for all metals, and is about five amperes per square centimeter of surface to be heated (about 32 amperes per square inch); the time required is proportional to the temperature, to the mass to be heated, and to its surface. The method can be used for welding metals which cannot be welded in the forge; steel is welded as easily as iron; the process is specially well adapted for superficial tempering.

Electric Furnace.—According to the "Electro. Chem. Zeit," for December, Mr. Moissan has obtained, in his electric furnace, a chemical combination of three atoms of carbon with four of aluminum; also one of two atoms of carbon and three of chromium; he has also obtained chemical power chromium.

Generating Electricity by Wind-mills.—The "Eng. Mag." for December contains an article by Lieut. Lewis, in which he discusses the subject in general and describes his own system. He states that there are over 1,000,000 windmills in operation in the United States, and that 100,000 mills are sold each year. He describes an installation in France, and another at the house of Mr. Brush, in Cleveland, both of which were installed in 1887; regarding the latter he states that it has been in constant operation for the past six years and it was found that the attention to keep it in working condition amounts to practically nothing, and that of the 408 cells of accumulators in constant use not one has shown serious signs of failure. In a table he gives the useful horse power developed by wind-mills of different sizes, the results of his own experiments made with wooden wheels driving dynamos; for the best steel mills the figures should be increased 20 per cent.; for a 16-ft. wheel, for instance, 1.5-hp will be developed for a 16-mile wind and for a 20-ft. wheel 4.5 hp, the horse power being that actually applied to the shaft of the armature, "allowing 500 watts per horse power." He has found that the most satisfactory regulation is obtained by a compound wound dynamo with the series coil reversed; it can be made to regulate between wide limits of speed, but it is advisable on account of the efficiency not to make these limits too great; the maximum speed should never be more than double the actual working speed; there is no necessity for moving the brushes, but an automatic cut-out is necessary; a wind velocity of at least six miles per hour is necessary to drive a wind-mill; in general a storage of 3 to 5 days' supply should be counted upon. He gives the figures for a plant in which a wind-mill replaced a steam plant; the cost of the steam plant, including battery, was $1,000, while that of the mill plant was $1,800; the total yearly cost, including interest and depreciation, was $4.33 per lamp per year for the steam plant, for 75 lights, while for the mill plant for 127 lights it was $2 per lamp per year.

Electricity in the Iron and Steel Industries.—A paper of Mr. Selby-Bigge, abstracted in the Digest, June 23, is abstracted more fully in the "Eng. Mag." for December. It will be remembered that in this paper a plant is described in which a saving of 30 tons of coal per week was effected after the adoption of an electric system of power distribution. In an editorial note accompanying the article it is stated that the application of the electric motor to rolling mills is about to be tried in this country; a 30-kw. motor is to be connected directly to the rolls and shall be capable of reversing at full load every 10 seconds; it is believed that this can be accomplished by the Leonard system. Regarding electric welding it is stated that 2.7 million welds are made per annum in this country with steel and iron wire, and about 3.78 million with the copper and brass wires, representing together about 4,000 hp.

Electric Plow.—A translation of the description mentioned in the Digest, Oct. 13, is reprinted with illustrations in the "Elec. Eng.," Dec. 26.

TRACTION.

Accumulator Traction.—A paper by Mr. Gibbings is reprinted in the Lond. "Elec. Eng.," Dec. 14. He discusses it from the standpoint of a municipal undertaking, and argues in favor of refuse destruction, supplying electric power for tramways during the day and for lighting during the night, the machinery being designed so that it always works at full load; some estimates are included. The paper is also published in the Lond. "Elec. Rev.," and discussed unfavorably in an editorial, in which it is stated that the proposal is an old one and that it is well known that storage batteries do not meet the requirements, and that, as the system is impracticable, it is not worth discussing; in the editorial discussion which follows, battery traction is admitted to be the ideal system if a suitable battery existed.

Light Railways.—A report of the Board of Trade conference on this subject is published in the Lond. "Elec.," Dec. 14. Lond. "Engineering," Dec. 14, devotes a long editorial to this subject. An editorial is also contained in Lond. "Ind. and Iron," Dec. 14. A report is also published in the Lond. "Elec. Rev.," Dec. 14.

Electric Carriages.—In the continuation of Mr. Reyval's article in "L'Eclairage Elec.," Dec. 1, he describes and illustrates a number of electric carriages, and gives the conditions for the next competitive test of the "Petit Journal," a Parisian daily paper, which is to be held in July.

Monorail System.—According to "L'Eclairage Elec.," Dec. 1, Mr. C. E. L. Brown, of Switzerland, has recently declared himself in favor of the monorail electric railway system; in his opinion it has special advantages for accumulator traction; by special arrangements (not described) he believes an economy of 25 per cent. can be obtained over the ordinary system.

Electric Railways in France.—Some tabular data giving the first and the running cost of four railways in France is published in "L'Ind. Elec.," Dec. 10.

Street Railways of St. Louis.—The "Eng. Mag." for December contains a well-illustrated article on this subject by Mr. Bryan. He claims that this city has more miles of electric railway than any city in the world, and that it also has a cable line of the most improved and modern construction; there are 215.36 miles of lines of electric railways, 42.61 miles of cable road and 12.35 miles of horse lines, referring in all cases to single track; the horse lines are soon to be changed to electric lines; the city has a population of 600,000; several cable roads which were unsatisfactory were changed to electric lines and at once became satisfactory. He makes a comparison between the best and most recently built electric road, with the best and latest cable road, the conditions for both being favorable for a fair comparison; if anything they are more favorable for the cable line, on account of the shorter length and fewer curves; on the cable line 35 two-car trains run 107 miles daily each with a gross hp. per train of 18.32, and net, exclusive of cable, 6.28 hp.; the coal consumption per train mile was 11.18 pounds and that per hp. hour was 5.18; the average total load was 413 hp., the average friction load of the cable alone was 2.69 hp. (evidently this is intended to be 269) or 65 per cent. On the electric line there were 69 motor cars running 125 miles per day, and 26 trailers averaging 62 miles; the average hp. per motor car was 15.52; coal consumption per motor mile was 7.76 pounds, per train mile 8.15 pounds, and per hp.hour 4.22 pounds; 4 trailers were assumed to be equivalent to one motor car; the results are based on the records for the month of March, 1894. On account of the friction load being constant, additional trains on the cable line would require over 50 per cent. less hp. on the electric line, but, on the other hand, the electric system covers a mileage three times as great as that of the cable; he concludes that the cable is preferable where the traffic is sufficiently large to justify numerous and close spaces on a comparatively short line, while if the length of the line is great and the traffic per mile less, the advantage is in favor of electricity; the closing of the slot in cold weather has caused great annoyance and expense; in general it may be said that for roads operating more than 20 cars, the first cost of the electric plant is about two-thirds of that of a cable plant. An extension has just been completed in which all the rail joints are welded together, and thus far less than 1 per cent. have broken. In conclusion he states that there are extensive coal fields within eight miles of the city, and he believes that the developments recently made in multiphase apparatus make it commercially possible to utilize the slack or coal dust of these mines and transmit the energy to the city, a plan which he says is quite as practical as that at Niagara, the conditions being even more favorable.

Montreal Street Railway.—An illustrated description is published in the "Elec. Eng.," Dec. 26.

Present and Prospective Developments.—The reprint of a paper by Mr. Field is concluded in the "Elec. Rev.," Dec. 26. The paper is general in character, and hardly admits of being abstracted. He states among other things that the underground conduit system is ultimate and desirable results are to be obtained in large cities, and that within a few months it will be introduced on a large scale in several cities; such a conduit will be successful only if both circuits are insulated; no closed conduit system has yet been introduced on a commercial scale; the overhead construction, however, will continue to be used in the majority of cases for many years, and he considers it the most practicable and the best method; a slotted conduit will exceed in cost that of a cable duct on a straight track, but is less on curves. Regarding the cars, he states that the best length is 21 to 22 feet, and mounted on double trucks; there is a strong objection to 19 or 20 feet cars on a single truck, as there is a rapid destruction of the cars and the track; the general diameter of the wheels is 33 inches. He believes that it will be hard to excel the present motor. Regarding the power house, he states that in general a 15 to 25-hp per car may be taken as a basis of calculation for the station; the number of units should be the fewest which will give a safe and economical division of the units; the present tendency is to connect the generators and engines directly or by belt, as distinguished from countershaft connections; some hints are given regarding the engines and boilers. The old horse car lines in large cities operated at a total cost of 18 to 25 cents per car mile, the power service being from 8 to 11 cents, and in this direction the electric road has made its heaviest gains, these items to-day being reduced to 1.0 or 1.5 cents per car mile; the relative proportion of operating expenses to gross earnings on horse railways was from 70 to 80 per cent., while for electric lines it was 40 to 60 per cent., the operating expenses including "all the operating expenses of the road other than the fixed charges." Four years ago the standard price for an equipment of 2 to 15-hp. motors and the installation of them was $3,000 to $3,500; to-day the price of two 25-hp. motors, much superior to the older ones, is less than $1,000, making the total cost of a motor car about $2,200. A single mile of roadbed with 90-pound girder rails, not including a new pavement but including tearing up of the old track and replacing the old pavement, costs about $7,500; overhead line construction for double track with iron poles, feeders, etc., $4,000 to $5,000 per mile, and with wooden poles $1,000 less; steam and electric plant $70 to $80 per hp.; total cost of rebuilding an old horse-car road, including everything, $2,000 to $2,500 per mile of single track. In his conclusions he states that accumulators are not yet in a commercial state, and that the improvements which are being made in alternating current apparatus may be expected to lead to the use of that system, especially for long distance work.

Cast-welding Rail Joints.—The system which was shown at the Atlanta Convention is described with the aid of a number of illustrations in the "St Ry. Rev." for December. Cast iron, with a secret composition mixed with it, is melted in a portable cupola, and is poured around the joint while it is enclosed with a suitable iron mould, the latter being first heated to a red heat; it is stated that the cast iron welds itself with the rails, except at the very top; a joint weighs 120 pounds and costs about $3, requiring eight men, who can make 60 joints a day. This joint is in use on about three miles of track at St. Louis; the initial cost of the apparatus is said to be far less than that of an electrical welder.

Electric Braking for Motor Cars.—The "St. Ry. Gaz.," Dec. 22, contains the first part of an article by Mr. Nelson Smith, in which he discusses the subject of electric braking and explains the braking action of the two motors when each has an independent reversing switch, and when the controlling apparatus is reversed, with the line current cut off; he shows that the application of such a brake has limitations; it is impossible, for instance, to stop a car completely.

Conduit System.—A system described in the Digest, Dec. 1, which has been adopted in Germany by the firm of Siemens & Halske, is, according to the "Eng. News," Dec. 20, quite similar to the Barkley system, described in their issue of Oct. 20, 1892.

Series-parallel Controller.—According to the "St. Ry. Rev." for December, wattmeter tests taken on individual cars on one of the largest electrical railway systems of the West, show that the consumption of energy is 25 per cent. less with the series-parallel controller system than with the plain rheostat.

Street Railway Progress for 1894.—An article in the "St. Ry. Rev." for December summarizes the progress during the past year. It states that in round numbers there are now about 10,000 miles of electric railroads in the United States, with 20,000 electric motor cars.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Combined Lighting and Railway Power Station.—The "Elek. Zeit.," Dec. 13, publishes a long and well illustrated description of the plant at Zwickau, Saxony. The town has a population, including suburbs, of about 100,000; the one station supplies continuous current throughout the city by the three-wire system for lighting purposes, and by the two-wire system it supplies the current for a small trolley road; for the lighting current the generators are connected in parallel, and for the tramway circuit two are connected in series; in addition there is a transformer consisting of two dynamos, which will either bring the voltage of the lighting current up to that required for the railway, or the reverse; there are also two series of 68 cells of accumulators, having a capacity of 787 ampere hours. The railway is 2.4 miles long, and has 11 motor cars; the motors are regulated, not by inserting resistances, but by changing the field excitation, by which it is claimed that considerable economy is obtained; the energy required by car mile is 500 watts, which low figure is partially due to the contour of the road, and partially to the method of regulation. The system is discussed editorially, and is highly recommended for small cities, in which such a combined plant might be very profitable, while either alone would not pay; it is stated that the current actually delivered per year in an average central lighting station is only about 7 per cent. of that which the station could deliver if fully loaded all the time.

Train Lighting.—A description of the system at present in use by the Chesapeake & Ohio Railroad is described in the "Eng. News," Dec. 20. There are at present 70 cars equipped with this system, the number having recently been greatly increased; formerly a dynamo was used in connection with storage batteries, but this has been abandoned after eight years of service, in favor of using storage batteries alone; compared with oil and Pintsch gas-lights, all of which are in use on that road, the storage batteries show fewer failures of the light than either of the others for the number of cars operated; the storage battery plant now in service has a total capacity of 649,000 ampere hours; the average for six months shows the cost of the battery system per lamp per hour, including interest and depreciation, to be 2.4 cents, while that for the Pintsch system is 3.0 cents; the cars are fitted with 24 volt 2.5 watt lamps, requiring 12 cells of battery; two men can change all the batteries in an entire train in less than 15 minutes; they will light the cars for three nights with one charging, corresponding to a journey of about 2,000 miles. There are 21 plates 6x12x⅛ inches; the perforations in the grating are filled with metallic lead and oxide of lead, subjected to a pickling process which hardens it and fixes it firmly in the holes; the plates are separated by a sheet of porous material, which absorbs 50 times its weight of the acid, thereby forming nearly a dry cell. The cost for 41 passenger cars for July, 1894, is given in detail, the totals of which are about as follows: Cost of charging plant, $7,000; cost of car equipment for 41 cars, $3,000; batteries, 86 sets at $180 each; operating expenses, including interest and depreciation, $2,300, or a cost per lamp per hour of 2.17 cents.

Rectifiers.—Those to be used at the Cardiff station are briefly described in the Lond. "Elec. Eng.," Dec. 14. They were made by Ferranti; each of them operates two circuits of twelve arc lamps each, the lamps in each circuit being in series and requiring 12 amperes, the E. M. F. of the series being 600 volts. Each rectifier consists of a simple self-starting, single-phase, synchronous motor, having a small commutator for its own field current; a large commutator is secured to each end of the armature shaft; the brushes can be moved to the best position; the motors are run from two small transformers. It is stated that there are also four Ferranti constant current arc light transformers of two units each, giving a fixed current of 12 amperes in the secondary, with 2,500 volts at the primary; but whether these are used in connection with the rectifiers is not stated. A large and very good illustration of the rectifier is published in Lond. "Engineering," Dec. 14.

Cardiff.—A long and illustrated description of this station is published in the Lond. "Elec. Eng.," Dec. 14. The high tension alternating system is used; the two novel features are that rectifiers are to be used for public arc lighting, and the other is the introduction of vertical triple expansion condensing engines, fitted with separate cut-off gears for each cylinder. The rectifiers are briefly described above. A description of the station is also given in Lond. "Engineering," Dec. 14, and another, with illustrations, is published in the Lond. "Elec. Rev.," Dec. 14.

Frankfort.—A brief description of this alternating current station is published in "L'Eclairage Elec.," Dec. 1.

Selling Current or Light.—Mr. Vail, in the "Elec. Eng.," Dec. 26, discusses the questions of whether central stations should sell current or light. He is in favor of selling the current, his chief reason being that the energy is now applied for a number of different purposes, and that there are in the market many varieties of lamps, some of which are more efficient than others.

Economical Series Street Lighting Switchboard.—Mr. Farnsworth, in the "Elec. Eng.," Dec. 26, describes a cheap switchboard, in which only one ammeter is used with a number of bank lines, instead of a separate instrument for each circuit; it may be placed in any of the circuits by means of switches.

Electricity on Shipboard; its Present and Future Development.—A paper by Mr. Greene on this subject, read before the Institute of Naval Architects and Marine Engineers, is abstracted at some length in "El. Power" for December, and more briefly in "El. Ind.," for December; the former journal publishes a large number of cuts, illustrating the apparatus described.

Best Frequency.—A translation of the article, by Mr. Kolben, abstracted in the Digest, March 10, is published with the sets of curves in the "El. Power" for December.

Hints on the Building of Electrical Plants.—The first of a series of five articles on this subject, by Mr. Armstrong, is published in "El. Ind." for December; in the present issue he discusses the "inquiring stage."

Installation Rules.—Those adopted by the Worcester (Eng.) station are reprinted in the "El. Power" for December.

Alternating Current; its Generation and Distribution.—A third paper of the series by Prof. Shepardson is published in "El. Ind.," for December; it is of an elementary character and is accompanied by a number of good illustrations.

ELECTRO-PHYSICS AND MAGNETISM.

Counteracting Inductance.—In an article by Mr. Arno, in "L'Eclairage Elec.," Dec. 1, he describes a method by which the capacity for neutralizing inductance may be determined experimentally without knowing the value of the inductance, which latter is necessary for calculating the capacity. In this method he states that it is not necessary to have graduated condensers (it is not clear, however, how this is accomplished, as the only reference is in a foot-note in which it is stated that several condensers were connected in parallel); an inductionless resistance is placed in series with the coil whose self-induction is to be balanced; this resistance is first adjusted with a continuous current until the voltage at the terminals is the same as that at the terminals of the coil; this is accomplished by an electrometer, with its quadrants connected so as to form a differential instrument; the alternating E. M. F. is then applied in place of the continuous, and the condenser is added in series with the coil, and adjusted until the electrometer shows no difference in the two voltages.

Electric Rays.—An article by Prof. Zehnder on researches with rays of electric force and the production of these rays, from the "Wied. Ann.," vol. 52, page 34, is abstracted at some length, with illustrations, in "L'Eclairage Elec.," Dec. 1.

Cathode Rays.—Mr. Brooks' article (see Digest, Dec. 22) is concluded in the Lond. "Elec. Rev.," Dec. 14.

Electricity of Drops.—A paper by Prof. J. J. Thompson, from the "Phil. Mag.," 1892, is abstracted in "L'Eclairage Elec.," Dec. 1.

What is Electricity?—An article on this subject is begun in the "Elec. Rev.," Dec. 26. He considers electricity to be a motion which is transmitted with a most marvellous velocity, and that it is evidently a rotation of the molecules around an axis parallel to the conducting wire, which rotation is either right or left handed, corresponding to a positive or a negative current; this, he says, explains why they neutralize each other.

Magnetic Qualities of Gun-steel.—Lieut. Squier's paper, abstracted in The Electrical World, Nov. 10, p. 488, is published with illustrations and tables in "El. Power" for December.

ELECTROCHEMISTRY AND BATTERIES.

Energy of Electrolysis.—The "Electro. Chem. Zeit." for December contains an article by Mr. Gross, in which he discusses the subject of the mimimum E. M. F. of electrolysis; he discusses and criticises the theories and experimental deductions of others, and advances a theory of his own. He states that if one volt is applied to platinum electrodes in diluted sulphuric acid, there will at first be a comparatively strong current, which will rapidly decrease to a minimum, at which it will continue indefinitely; he states that this first current cannot be compared to the charge of a condenser; in solutions of salts a sudden increase in the current when a gradually increasing E. M. F. is applied cannot be observed, but it can be shown that at a certain value the decomposition will be appreciable; he discusses the supposed independence of the minimum E. M. F. on the pressure of the gases, and points out an apparent error in Helmholtz's researches; he claims that the phenomenon can be explained by the polarization without assuming any minimum E. M. F.; Bartoli and others have shown that water can be decomposed with an E. M. F. far below that usually given as the minimum; the continuous currents at every low E. M. F. can be explained by means of the energy equivalent; the article is to be continued.

Gas Battery.—In a discussion of the paper of Messrs. Colardeau & Cailleteton (see Digest, Dec. 8), published in "L'Ind. Elec.," Dec. 10, Mr. Berthelot states that platinum, palladium and analogous metals form at ordinary temperatures with hydrogen and oxygen true and definite chemical combinations, especially platinum, which has two hydrides, one of which is stable up to 200° C, while the other is dissociated at ordinary temperatures and is influenced by pressure; it is not a condensation or an occlusion of gases, as is sometimes supposed, but the compounds formed are true chemical combinations, and, therefore, they explain the actions in this new accumulator, as also the production of a current produced by the immersion of two platinum electrodes in acidulated water without any previous application of an E. M. F.

Purification of Sugar.—"L'Eclairage Elec.," Dec. 1, states that according to Dr. Bersch, of Vienna, the process of Schollmayer is as follows: A number of sheet zinc electrodes are suspended in vats of tinned iron, every alternate one being of the same polarity; the liquid has the temperature of 70° to 75° C., and is subjected to a current of 50 to 60 amperes at 5 to 7 volts for 8 to 10 minutes; the negative pole is soon covered with a gummy substance, which is nearly pure albumen, and which increases the resistance, to avoid which the current is reversed every two or three minutes, which readily detaches this deposit; the process eliminates partially the foreign organic and inorganic matter, and also acts in a marked degree as a decolorizer; the final purification requires a quantity of chalk, which is much smaller than that for the ordinary process.

Hermite Process of Disinfection.—In an article abstracted in the "Electro. Chem. Zeit." for December, it is concluded that not only is the sterilization incomplete, but the process is at least twice as expensive as disinfection with chloride of calcium, the latter having a further advantage in not requiring the sewage to be diluted.

Manufacture of Chloride Accumulators.—The process of manufacture is described briefly, with a large number of illustrations of the factory, in the "Elec. Eng.," Dec. 19. Commercial lead is reduced to a fine powder by a blast of air through a stream of molten lead; this powder is dissolved in nitric acid, and then precipitated as chloride of lead by the addition of hydrochloric acid; the chloride is then mixed with a certain proportion of chloride of zinc, and after being melted, the mixture is cast into moulds forming the pastilles, which subsequently become active material; these pastilles are placed in a frame and the lead grid is cast around them under an air pressure of 75 to 180 pounds per square inch; there is a slight addition of antimony to the lead; the two furnaces have a capacity of casting ten tons of battery plates per day; the active material is then reduced by connecting the plates with a slab of zinc and immersing them in a solution of chloride of zinc, which leaves the active material as finely divided lead; the positive plates are then peroxidized by a current, the process occupying two weeks of continuous charging. A sheet of asbestos cloth and a partition of perforated cherry wood are inserted between the plates.

Chloride Accumulator.—The "Eng. and Min. Jour.," Dec. 22, contains a brief description of this cell and its properties, without, however, giving anything that has not been published before.

Electroplating Plants.—In an article by Mr. Brownell, in "El. Ind." for December, he calls attention to the unsatisfactory way in which many such plants are constructed, and describes briefly a new dynamo and installation recently designed by him.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Determining the Efficiency of Dynamos and Motors.—The first part of a paper by Mr. Ashworth is published in the Lond. "Elec. Plant" for December. He gives the complete formulas for the electrical efficiency of a compound generator and motor, which can also be used for a series or shunt machine; a graphical method is described, but not sufficiently clearly to be generally understood; the electrical methods for determining the commercial efficiency are to be considered in the second part.

Simple Calculations with Three-phase Currents.—In an article by Mr. Chavannes in "L'Elec.," Dec. 8, he describes methods for making elementary calculations with three-phase currents, giving, however, nothing new. In an example he shows that to supply three lamps of 10 amperes at 100 volts it will require 17.32 amperes per wire in the three-phase system, and 30 amperes in the single-phase system, and in that case the weight of copper for an equal loss in the line will be 25 per cent. less for the three-phase system. In another case he calculates the quantities for transmitting 100-hp at 1,000 volts with a 10 per cent. loss, and finds that there will be the same economy, namely, 25 per cent. in favor of the three-phase system; in conclusion, he refers to a number of articles on this subject which have appeared in The Electrical World.

Bolometric Investigations.—The translation of Messrs. Lummer & Kurlbaum's paper (1892) is concluded in the Lond. "Elec.," Dec. 14. The method of construction is described and illustrated; the defects of other bolometers are avoided by the present method of construction, in which the branches of the bolometer are cut into suitable shapes on a dividing engine, out of a double sheet of platinum and silver, and are then mounted, after which the silver is dissolved off. The paper is editorially discussed in the same issue.

Localizing Faults in Submarine Cables.—An additional communication by Mr. Rymer-Jones is published in the Lond. "Elec. Rev.," Nov. 16.

Measuring Atmospheric Resistance.—A method described in the proceedings of the Engineers' Club of Philadelphia is published in the "West. El.," Dec. 22; the falling ball is operated electrically.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Polarized Relay.—A new form is described and illustrated by Mr. Lloyd in the Lond. "Elec.," Dec. 14; it consists essentially of a coil with a fixed hollow core and a pivoted core slightly smaller than the inside of the hollow one, the pivoted core having at its ends two arms at right angles to it, which in a normal position are midway between the poles of two vertical bar magnets; a contact piece on the end of one of these arms moves between two fixed contact points; several modifications, with double magnets, are also described.

Block Telegraph System.—Some improvements on the Caledonian Railway are described briefly in the Lond. "Elec. Eng.," Dec. 14.

Telegraph Statistics for 1893.—The Lond. "Elec. Rev.," Dec. 14, abstracts a table from the "Jour. Teleg.," including apparently all countries except America.

Submarine Cables of the World.—According to an abstract in "L'Elec.," Dec. 8, there are 1,304 submarine cables, with a total length of about 175,600 miles, of which 994 cables, with a length of about 20,000 miles, belong to various governments; those belonging to French companies are given in detail.

Pacific Cable.—A report from the Earl of Jersey on the proceedings of the Ottowa conference is abstracted in the Lond. "Elec. Eng.," Dec. 14, and discussed editorially in the Lond. "Elec. Rev."

Telegraphing the President's Message.—According to a short article in the "Tel. Age," Dec. 16, the recent message of the President was taken to the New York office of the Western Union Telegraph Company by a special messenger from Washington, and was received at one o'clock in the early morning of Dec. 3; it contained 17,040 words, was divided into four sections, the country being divided into 16 main circuits; the operators began at 1.40 and finished at 5.41; the telegraph company received no compensation, although the transmission cost it thousands of dollars. The Washington papers received their copy from New York.

Experiments in Cable Signalling.—The article by Mr. Delany abstracted in the Digest, Dec. 22, is published in the "Elec. Eng.," Dec. 19.

Wheatstone Automatic System.—A serial on this subject is concluded in the "Tel. Age," Dec. 16; it deals more particularly with the system in this country.

Telephone Patent Situation.—All the American electrical journals for the past week discuss the effects of the recent decision.

MISCELLANEOUS

Pole Indicator.—A compact French pocket device is illustrated and described in the "Elek. Anz.," Dec. 9; it can either be connected in circuit up to a voltage of 110, its internal resistance being 500 ohms, or it can be held directly beneath a wire conveying the current; it consists of a pair of astatic needles and a permanent magnet to direct the system; the needles carry a disk which shows a + and — sign below two little windows, thereby indicating the direction of the current.

Alignment Indicator.—A device suggested by Mr. Snyder and used at the Cramp ship-yard is briefly described in the "Elec. Eng.," Dec. 26th. In the erection of machinery the parts are often adjusted in position by means of a stretcher adjustment line, the parts being properly set with relation to this line; in the present arrangement the line is made of metal insulated at the ends, forming part of a circuit which is completed by the metallic gauge used in adjusting the parts; the object is to indicate the slightest contact between the gauge and the wire without exerting pressure on the wires.

New Book.

Treatise on Industrial Photometry, with Special Application to Electric Lighting. By A. Palaz, Sc. D. Authorized translation from the French by George W. Patterson, Jr., M. A., B. S., and M. B. Patterson, B. A. New York: D. Van Nostrand Company; London: Sampson Low, Marston & Company, Limited. 318 pages, 91 illustrations. Price, $4.00.

This translation of Dr. Palaz's exhaustive work on photometry supplies a much needed addition to English technical literature and one that will be appreciated by electrical engineers. Before the appearance of the original there was no work on the subject inclusive in its character, and information relating to many types of photometrical apparatus could only be obtained by a search through scientific periodical literature. It is particularly gratifying that the work was written with special reference to electric lighting, and its value is further increased by interesting sections relating to the principles of the arc and incandescent light and a discussion of "cold light."

In the first chapter the principles of photometry are developed, both physically and mathematically, and with reference to the composition and photometric actions of light, its intensity according to the undulatory theory, the photometric sensibility of the eye, etc. In chapter II. photometers are taken up and almost two-score different forms are described. The various types are classified according to the principle upon which they are based, which is treated in a section preceding the descriptions of the instruments of the respective classes. In the description of each photometer a diagrammatic sketch is given where necessary, besides an illustration of the complete instrument, and special points, if any, in its theory demonstrated.

Chapter III. is devoted to photometric standards, opening with a discussion of the requisites and then taking up in turn the carcel lamp, the various standard candles, and the Hefner, acetate of amyl and other proposed photometric standards. All of these are thoroughly treated and particularly the carcel and candle standards, in regard to which all the various precautions to be observed in their use are elaborated. Chapter IV. treats of the general equipment and auxiliary apparatus of practical photometry and, incidentally of personal errors of observation.

Chapter V. opens with a section on the principle of the incandescent lamp, followed by sections on its manufacture, horizontal and mean spherical intensity, variation of intensity and life with the energy supplied, the calculation of the tint, its efficiency, etc. The arc light is next considered with reference to potential differences, the nature and influence of the carbons, the variations of intensity with the azimuth, inclination and current, the mean spherical intensity, etc. The influence of opal globes and reflectors is considered and the special points applying to alternating current arcs brought out. A relation is established between the candle-power of arcs and the current supplied, and between the mean spherical and the maximum and horizontal candle-powers. The concluding sections are among the most interesting in the work, and treat of the rate of consumption of the principal sources of light, the brightness of radiants, the unit of brightness, the mechanical equivalent of light, the optical efficiency of sources of light and the artificial light of the future—the latter dealing with "cold light," which has recently been so frequently referred to in our columns.

The final chapter of the work is on the distribution and measurement of illumination, and has a direct practical bearing. Calculations are given to determine the most efficient distribution of illumination from lights of various intensities over surfaces of various areas, and practical hints added as to the most suitable illumination for different purposes.

In an appendix the translators have added notes containing some additional information on the general subject and remarks on some of the methods. The translation is well done and the mechanical execution of the book is excellent in every way. We do not hesitate to recommend the work not only to those directly interested in photometry, but to engineers, electricians and electrical students generally.

New Type of Shallenberger Alternating Current Measuring Instruments.

The extensive development of multiphase systems of alternating current distribution has created a demand for a new type of central station indicating instruments specially adapted for such currents, and also for an integrating meter, adapted to the requirements of the various types of multiphase motors now coming into general use.

This work was taken up by Mr. Oliver B. Shallenberger, at his laboratory in Rochester, Pa., with special reference to the requirements of the Niagara Falls plant, now being installed by the Westinghouse Electric & Manufacturing Company, and with a view to producing, if possible, instruments dependent purely upon the inductive effects of multiphase currents, so as to avoid the necessity for moving contacts, or connections of any kind to the movable portions of the instruments. In this respect he has followed the general plan of his now well-known alternating current meter, and has succeeded in producing a distinct group of instruments, all of which depend for their action upon the induction of currents in a movable closed secondary, and all operate more or less upon the same principles specifically developed in each. The instruments comprise an alternating current voltmeter, an amperemeter, a watt indicator, and integrating wattmeters for both multiphase and simple alternating currents. They are the result of a long series of experiments, and embody a number of novel features, both in principle and form. While designed particularly with reference to commercial uses, they are well adapted also for laboratory work, since they are capable of giving very accurate results.

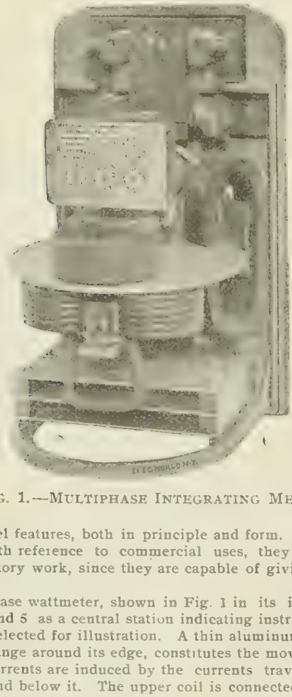


Fig. 1.—Multiphase Integrating Meter.

The multiphase wattmeter, shown in Fig. 1 in its integrating form, and in figs. 4 and 5 as a central station indicating instrument, is typical and has been selected for illustration. A thin aluminum disc, stiffened by a bead or flange around its edge, constitutes the movable element, in which eddy currents are induced by the currents traversing the coils placed above and below it. The upper coil is connected as a shunt, and the lower coils in series with the work-circuit as shown in diagram Fig. 2.

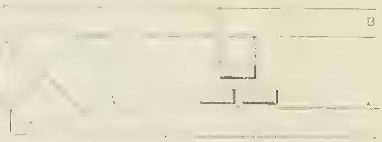


Fig. 2.—Diagram of Two-Phase Meter Circuits.

A and *B* are two-phase circuits. The series coils are connected in circuit *A*, and the shunt coil across *B*, through a resistance without self-induction. The currents in the two sets of coils are, therefore, in quadrature when there is no lag in the work-circuit, and would be exactly in phase with each other with a lag of 90 degrees in the work-circuit. The difference of phase between the currents in the meter coils is thus complementary to the lag angle of the work current. The conditions are such in the organization of the meter that the torque exerted upon the disc is proportional to the sine of the angle representing the difference of phase between the shunt and series currents, and, therefore, to the cosine of the lag angle of the current in the work-circuit, *i. e.*, the power factor. The torque is also directly proportional to the product of the shunt and series currents, so that it varies directly as the power transmitted. The permanent magnets, shown at the rear in Fig. 1, embrace the disc between their poles, and cause a retarding force directly proportional to the rate of rotation, so that the speed is proportional to the power. The law of operation is as definite as that of the Siemens' electro-dynamometer, and in the actual instrument can be carried out with greater accuracy, owing to the absence of moving contacts. The range of accurate working is large, owing to the lightness of moving parts and small friction in comparison to the forces at work, so that one per cent. or less of the maximum capacity is measured with accuracy. The speed at full load is low, not exceeding about 40 to 50 turns per minute at full load. The lightness of the disc, the slow speed and the use of the form of lower bearing, invented by Mr. Shallenberger in connection with his former meter, all contribute to render the friction very slight.

This meter may be used in connection with three-phase as well as with two-phase currents. Fig. 3 shows the three-phase connection in a simple form. The shunt coil is connected across two branches of the circuit, and the series coil in the third branch, so that, as in the former case, the current in the shunt coil is in quadrature with the electromotive force of the series circuit, although the currents in the three branches differ by 120 degrees. The resistance in the shunt circuit having been adjusted to suit the new conditions, so as to have a correct constant, the operation is exactly as in the former case.

For greater accuracy, two or more of the branches of a multiphase circuit are connected to corresponding series coils in the meter, and the shunt coils properly related to each, but for commercial purposes the single form is quite accurate enough when used on balanced circuits, as in the case of a multiphase motor.

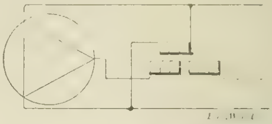


Fig. 3.—Diagram of Three-Phase Meter Circuits.

The form of watt indicator shown in Fig. 4, and with case removed in Fig. 5, has been specially designed for the Niagara Falls installation, and is known as the "Niagara Type," and corresponds in design with the volt meter and amperemeter. In these instruments the scale is in the form of a band, which encircles the disc and moves with the latter behind a fixed index. This arrangement allows the use of a long scale with large divisions, so as to be easily read at a distance. The operation is the same as that of the integrating watt meter, except that the rotation of the disc is, in this case, opposed by a spiral spring, the magnets acting simply to damp the oscillations. The damping action is so effective that the instrument is almost perfectly dead beat. Adjustments for the zero point and for temperature may be made from the front of the case.

In the voltmeter the two sets of coils are connected in series with a non-inductive and an inductive resistance respectively, the latter being of a form designed to cause a lag of nearly 90 degrees in its current. For this purpose the iron and copper losses of the inductive resistance are reduced to a minimum, and a small air gap is introduced into the magnetic circuit, so as to avoid high magnetization of the core and render the magnetizing current proportional to the induction. The current through this circuit is, therefore, directly proportional to the difference of potential, and this is of course true in the circuit containing the non-inductive resistance. The deflection is proportional to the square of the potential, and is also practically independent of, the periodicity within the range now generally used, for reasons which will be referred to later. The amperemeter is a modification of the voltmeter, the windings being adapted for larger current and low potential.

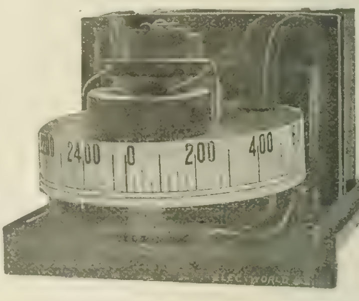


Fig. 4.—Indicating Wattmeter, without Cover.

In using these instruments at Niagara Falls, transformers specially designed for the purpose will be used to reduce the current and potential to convenient quantities. These transformers are proportioned so as not to introduce errors from change of phase, and they avoid the difficulty of constructing and connecting instruments for heavy currents.

Fig. 6 shows an integrating meter for simple alternating currents, similar in its general features to the multiphase meter, except that instead of a non-inductive resistance, a coil of high self induction is used in the shunt circuit, of the same construction as that used in the volt meter. Owing to the extremely high ratio of self-induction to resistance in this coil, the shunt current lags nearly 90 degrees, giving practically the phase relations of the multiphase instrument. It therefore correctly takes account of the power factor within the limits found in practice. The design of the inductance coil is a most important feature of this meter, since it must not only consume an almost inappreciable amount of energy in order to secure a sufficient lag, but must introduce no distortion of wave form due to hysteresis, such as is present in the primary current of a transformer without load. Important features are the use of an air gap of the right proportion, and a core of a high grade of iron. The iron losses are so small, however, that even if increased by "fatigue" after long use, the lag would remain practically unchanged, and owing to the large angle of lag, the change in the value of its sine, upon which the torque depends, would be still less. Owing, however, to the low induction in the iron, and entire absence of appreciable heating, it is almost impossible that any change should occur in the iron.

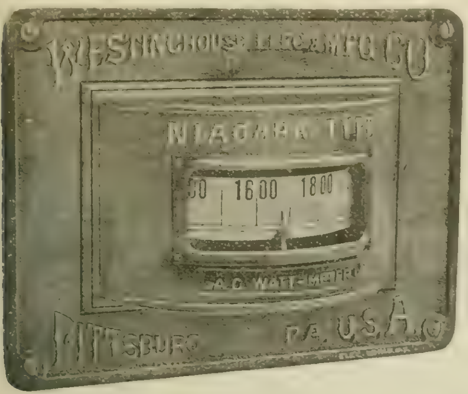


Fig. 5.—Indicating Wattmeter, with Cover.

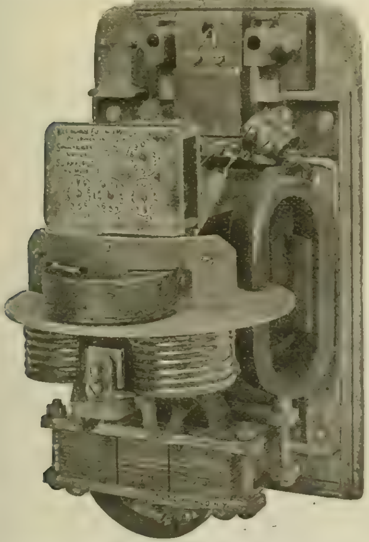


Fig. 6.—Simple Alternating Current Integrating Meter.

The reluctance of the magnetic circuit of this coil is so nearly that of the air gap, that the inductance coefficient is very nearly constant, so much so that the same meter may be used on either 50-volt or 110-volt circuits with an error of less than one per cent. in the registration. In this form of meter the proportions are such that for given currents and difference of phase in the actuating coils, the torque is directly proportional to the periodicity over the entire range now in use or proposed. Owing to the fact that the inductance coefficient in the shunt circuit is constant, the shunt current is inversely proportional to the periodicity for a given difference of potential. The result of these two laws of operation is evidently that the torque, and consequently the speed, is independent of periodicity. This is proven experimentally to be the case to a remarkable degree. Variations in wave form have no effect within ordinary limits, the constant being the same on circuits supplied from dynamos of radically different types.

One of the most valuable features of this type of meter is its extremely long range, which is secured without the use of any auxiliary winding to overcome starting friction, or any other device giving an initial tendency to rotate. A 50-light meter starts with a load of two 100-volt 16-cp. lamps in series on a 50-volt current, or about two-tenths of an ampere, and at one-half ampere registers with practical accuracy. Continuous rotation is maintained at a speed as low as one turn of the disc in fifteen minutes.

The shunt current is about one-tenth of an ampere as a maximum, and since it is practically a wattless current, the actual energy not exceeding half a watt in ordinary cases, the energy consumed is negligible.

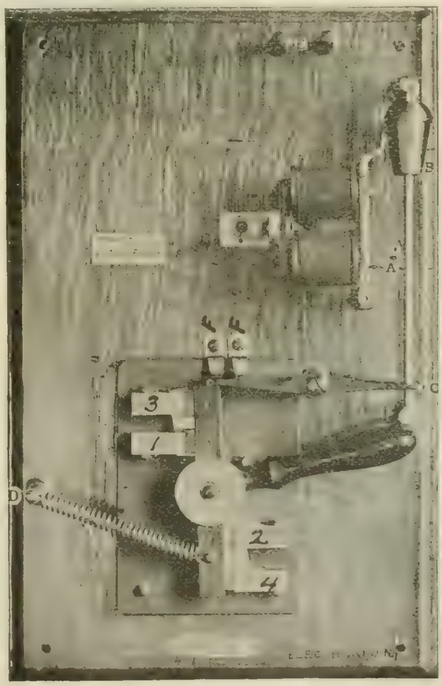
The constant of the instrument is entirely unaffected by changes of temperature, since the retarding eddy currents induced by the permanent magnets are affected by changes of temperature of the disc in exactly the same ratio as those induced by the actuating coils, so that no change in speed results. There is also no temperature coefficient for the shunt circuit, as its resistance is purely inductive.

The purpose in all the experimental work upon these instruments was to secure accurate operation by the simplest forms possible, and the results have been satisfactory in the highest degree.

A New Automatic Switch.

We illustrate herewith a new device for automatically turning off the current from light or power circuits, manufactured by the Charles Plumb Electrical Works, 89 Erie street, Buffalo, N. Y. The mains are connected to posts 1 and 2 and the circuits to posts 3 and 4. *D* is a spiral spring for breaking the circuit quickly, *C* a detent lever for holding the switch closed, and *A* the local magnets and armature. *B* is a sliding weight for opening the switch, and at *E* are the binding posts to which the wires run from the clock and battery.

The operation is as follows: The weight, *B*, is held up by the armature of the magnet, *A*, and the switch kept closed by the lever *C*, and the local circuit by the lever *C* and the springs, *FF*. The clock being set in the usual way for closing an electric circuit, when it reaches the time required it closes the local circuit through the magnet, *A*, attracting its armature; this releases the weight, *B*, which descends and strikes the lever, *C*, which in turn releases the switch; the quick-acting spring, *D*, then pulls the switch open, and the lever, *C*, is at the same time forced out of contact with springs *FF*, thus opening the local circuit so that there is no waste of current. This apparatus is operated with two cells of open circuit or dry battery.



Automatic Switch.

The Baltimore & Ohio Electric Locomotive.

The event for which electricians throughout this country are waiting with impatient interest—the operation of passenger and freight trains in the Belt Line tunnel of the Baltimore & Ohio Railroad at Baltimore by locomotives in which the sole propulsive power will be electricity—is now nearing realization. Work has been progressing steadily lately at the works of the General Electric Company, both upon the generating plant and the locomotives, and the early part of this new year will probably see the huge locomotives handling the long trains with the ease for which they are designed. This experiment will be the first practical step in this country toward the subjection of the steam trunk railroad to electricity. Two comparatively small locomotives, one of thirty tons and the other of forty tons on the drivers, are already running, but not upon any important lines, and while perfectly successful their operation gives but little clue to the outcome of the practical tests on the Baltimore & Ohio road. The delay that has occurred in the completion of the work has been of advantage in that it has allowed of the embodiment in this apparatus of all the recent improvements in electric railway practice.

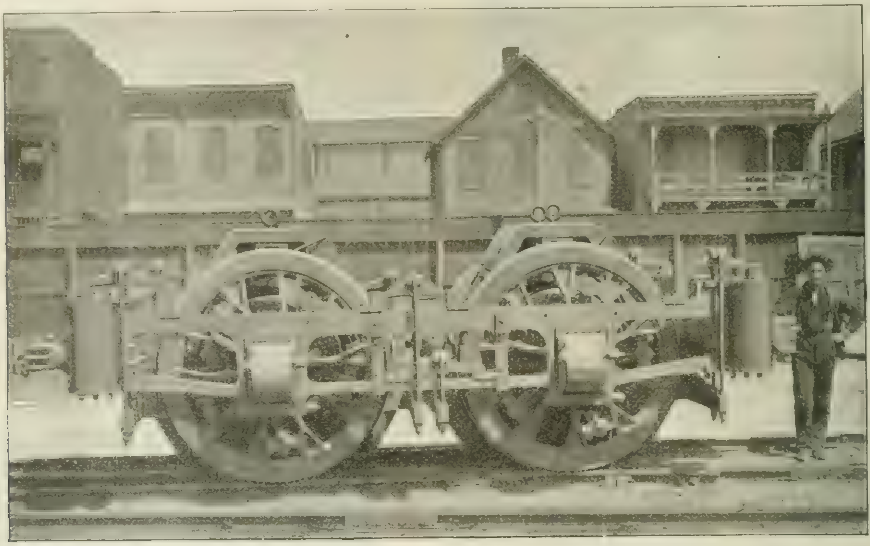


FIG. 1.—SHOWING ONE TRUCK OF ELECTRIC LOCOMOTIVE.

The trucks are of forged iron, each resting upon four driving wheels of cast steel, sixty-two inches in diameter. Flexibly supported upon each of these trucks are two six-pole gearless motors, one for each axle, transmitting their motion from the armatures to the wheels by means of an especially designed flexible coupling. The method of spring suspension has been carefully modified to allow of the immediate adjustment of the wheels to the irregularities of the tracks, and thus effect a diminution in the wear both to the motors and the track. The massive armatures are of the iron-clad type. A hollow shaft serves to carry the armature, and through this passes the wheel axle, to which it is connected by the universal coupling already mentioned, which allows of freedom of movement in any direction.

The complete motors are the largest railway motors in the world, and while ponderous in appearance are by no means so bulky as might be expected from the heavy duty they will be called upon to perform. They are so set on the truck that they will be easy of access under all circumstances, whether the locomotive is at a standstill or in motion.

The cab, which will be spring supported on the truck frame, will be of sheet iron and wood and will have windows on all sides in order that the occupants may have an unobstructed view in all directions. Within the cab will be set up the series parallel controller, by means of which the movements of the locomotive will be at the command of the driver, and the air pump, operated by a small electric motor, which will supply the air for the compressed air-brakes and the whistle. The locomotive will be also equipped with bells, safety devices, etc., and will have a Janney automatic coupler at each end.

From the illustration of one truck, Fig. 1, it will be seen that the finished locomotive will be an imposing piece of electrical machinery. It will weigh in its completed state 95 tons, will be 14 feet 3 inches long, 9 feet 6¾ inches wide, and will be of standard gauge. The maximum speed will be 50 miles an hour. This will be reduced to 30 miles an hour when only half the draw-bar pull is exerted, and to 15 miles an hour with full draw-bar pull. The average speed of the loaded train will be about 30 miles an hour. It can of course be run either forward or backward.

This locomotive is designed for heavy work, and will be called upon to handle trains as heavy as those now handled by the heaviest steam locomotives. A test of one of the completed trucks as shown, Fig. 2, representing one-half of the locomotive, was recently made upon the tracks at the Schenectady works of the construction company. In order to obtain the necessary load a New York Central heavy six-wheel engine was made use of and the electric locomotive truck coupled to it. The machines were then sent in opposite directions and tugged at the connecting coupling as in a tug of war. The electric locomotive had a slight advantage over the steam engine in weight on the driving wheels, and pulled it up and down the track with apparent ease. For the same weight upon the drivers it was shown that the electric locomotive will start a greater load than the steam locomotive; the pull being constant throughout the entire revolution of the wheel, the difficulty of variation of pull with the angle crank, as in the steam locomotive, is eliminated. The test also proved that not only were the motors sufficiently powerful, but that the driving mechanism and armature couplings are amply strong to transmit the torque of the armature to the axle.

The power house is rapidly nearing completion and the generating machinery is almost ready for installation. The overhead apparatus, which has been especially designed to meet the extraordinary requirements, will shortly be in position, and before many months have passed the electric locomotive will have become a normal object in the operation of trains in the Belt Line tunnel, which, untarnished by smoke and soot, will be brilliantly lighted by incandescent lamps.

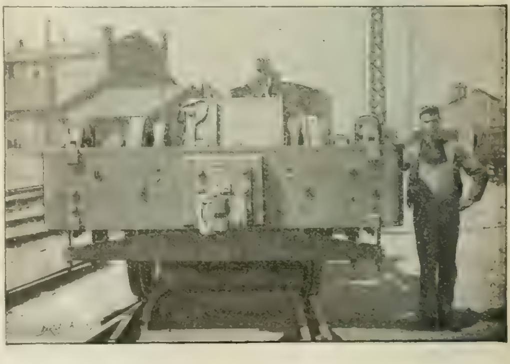
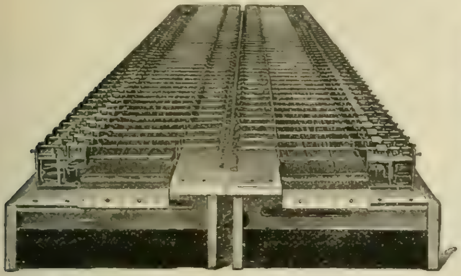


FIG. 2.—A COMPLETED TRUCK.

Automatic Telephone Switchboard.

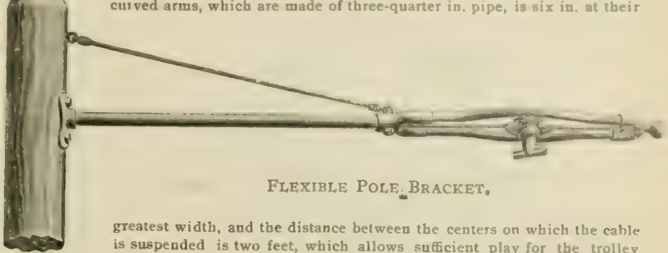
After many failures had been recorded by inventors of merit in the line of automatic telephonic switchboard appliances, Mr. A. B. Strowger hit upon the novel idea of using the decimal system as a foundation for its successful operation, and we illustrate one of the details of the new system. This was considered the first step in the right direction, and the Strowger-Automatic Telephone Exchange, "The Rookery," Chicago, was formed with sufficient capital, and energetically set to work at once to make the necessary improvements, in order to make it in every respect a commercial as well as a scientific success. This after two years of constant labor and a large expenditure of money, has now, it is claimed, been accomplished. The first switchboard brought out was looked upon with disfavor by the electrical world on account of using four wires, but this has been, by the late improvements, reduced to a simple two-wire metallic circuit, and with the automatic release, which is also a late improvement, the service of the automatic central is claimed to be perfect. The automatic switchboard will not only be appreciated on account of its superior and quick service, but it has also had the tendency of materially reducing the price of service to telephone subscribers, by doing entirely away with the operators at the central office, and reducing the cost of maintenance. The company is confident that now all this invention requires is a fair introduction, and as soon as understood by the general public, it feels that it cannot help but become the acknowledged and satisfactory method of telephonic service. It is now fully prepared to construct telephone exchanges complete under its automatic system, or to furnish the necessary switchboards.



Automatic Telephone Switchboard.

Flexible Pole Bracket and Bracket End.

A new style of the Wood's flexible pole bracket and the flexible bracket end, which we illustrate, has recently been brought out by the Ohio Brass Company, of Mansfield, Ohio. The new style of flexible pole bracket retains the flexible feature of the regular bracket, but is lighter in weight and cheaper in price. Its detailed construction is as follows: The horizontal arm, which is made in the standard sizes of one and one-half in. pipe, is threaded on its inner end into a pole socket casting of malleable iron, and on the outer one into the casting which supports the curved arms of the flexible end. This casting is provided with an eye for fastening the cable, which is attached to the pole by means of an eye bolt fastened through it. The cable is made of galvanized steel wire strand, and replaces the under brace arm employed on the regular style of bracket. The salient features of the Wood's flexible pole bracket have all been retained. The horizontal arm of any pole bracket in use can be cut off to the proper length, and the flexible end shown threaded on to it without removing it from the pole. The spread of the curved arms, which are made of three-quarter in. pipe, is six in. at their greatest width, and the distance between the centers on which the cable is suspended is two feet, which allows sufficient play for the trolley hanger to overcome the disastrous hammering effect characteristic of a rigid suspension. The tension on the flexible cable can be adjusted by means of the self-adjusting turnbuckle at the outer end of the bracket.

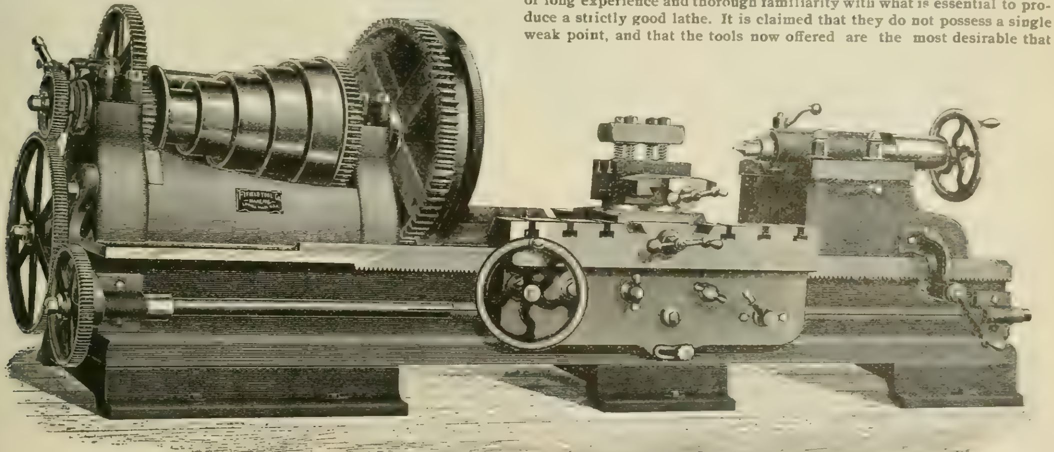


Flexible Pole Bracket.

A Large Swing Lathe.

We illustrate herewith a 40-in. swing engine lathe on a 14-ft. bed, built by the Fifield Tool Co., successors to G. W. Fifield, Lowell, Mass. The cut shows one of the new pattern lathes just brought out by this company and specially designed for producing a good, efficient tool at a low cost. They are heavy, strong, rigid, accurate and durable, will run easy and produce a large amount of good work. They do not possess any useless attachments, put on for the single purpose of aiding a sale with those not thoroughly versed in what is essential, and which invariably prove a source of trouble and annoyance; they do, however, possess every appliance necessary for practical and satisfactory results.

Mr. Fifield for the past twenty years has been engaged in the manufacture of lathes, and the patterns now being produced and offered are entirely new, ranging from 17-in. to 64 in. swing, and are the results of long experience and thorough familiarity with what is essential to produce a strictly good lathe. It is claimed that they do not possess a single weak point, and that the tools now offered are the most desirable that can possibly be produced. This company has the largest and most complete establishment in America which is devoted entirely to the manufacture of lathes, and that the attention given to every detail is appreciated is attested by the fact that after a first lathe ordered from it has been fully tested a permanent customer is secured. The following is some of the data of the lathe illustrated: Swing over ways, 40 in.; length of bed, 12 ft.; turns 4 ft.; weight, about 13,000 lbs.; diameter, front bearing, 7 in.; diameter, back bearing, 4¾ in.; diameter of spindle through cone, 5½ in.; width of cone belt, 5 in.; distance between head and tail stock of V's, 22 in.

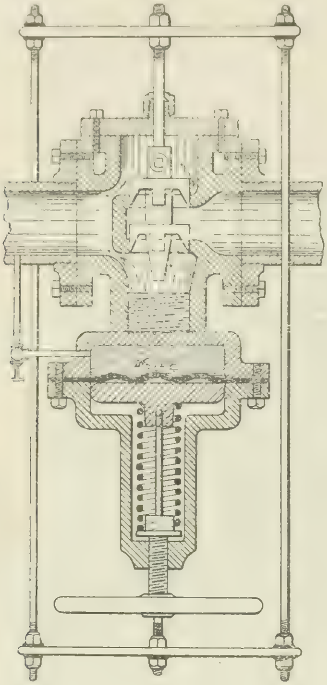


FIFIELD TOOL Co.

40-Inch Swing Lathe.

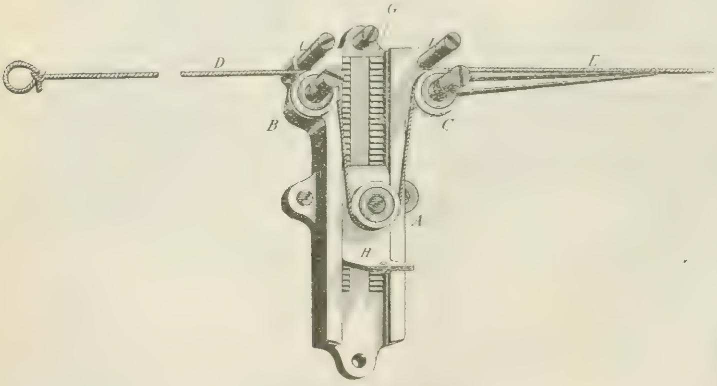
A New Regulating and Reducing Valve.

We illustrate herewith a new regulating and reducing valve particularly adapted for use with electric light and heavy duty engines, and manufactured by John Acton, 79 Washington street, Brooklyn. The particular claims made for the valve are that it is extremely sensitive without a sacrifice in uniformity of working, and will check the engine speed quicker in an emergency than any other governor on the market, that it is adjustable within wide limits and has a safety attachment by means of which, in case of an accident to the controlling device, the valve does need to be closed down while the device is being replaced, thus not interfering with the operation of the machinery.



Acton Valve.

Referring to the illustration it will be seen that the main valve is balanced, consisting of two short pistons. The regulating device consists of a corrugated metal diaphragm and a steel spring having its tension regulated by a hollow screw. The upper end of the valve stem has a cross head carrying two vertical parallel rods; these rods at their lower ends connect with another cross head, which in turn connects with the diaphragm cup through the hollow screw. The function of the spring is to balance the pressure on the diaphragm. A large number of these valves are already in use on electric plants, and have been adopted in a number of Edison and other large central stations.



Indicator Drum Stop.

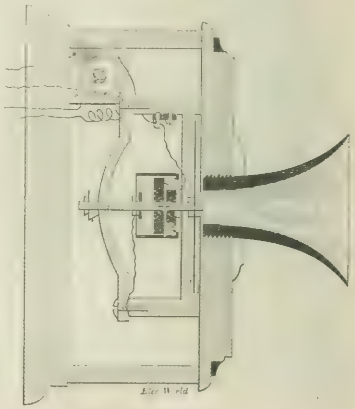
The Henderson Drum Stop.

The accompanying illustration shows a drum stop for steam engine indicators, manufactured by Queen & Co., Philadelphia. The cut shows the instrument with the movable or tension pulley *A* distended as in the act of taking a card. Raising the tension pulley *A* into line with pulleys *B* and *C*, relaxes the cord (to the amount required to rotate the Indicator drum), stopping the drum. Distending the tension pulley *A* overhauls the slack of the cord, starting the drum gradually from a state of rest to full speed, with a force starting from nothing to full power. The changes are effected almost imperceptibly at no matter what speed the engine may be running.

The cord is passed around the three pulleys, *A*, *B* and *C*, two of which, *B* and *C*, rotate upon fixed pivots, while the third, *A*, is attached to a movable carriage, *H*. The carriage *H*, slides in guides over a rack *G*, and is held in any position by a spring clip. Guard rollers *I*, *I*, are placed above the upper pulleys *B*, *C*, and the tension pulley is provided with a lip for keeping the cord within the pulley grooves. The cord from the indicator hooks to the small loop, on cord *D*, shown to the left. A common elastic band is fastened by one end to the cord *E*, as shown on the right. The other end is slipped over the pin of pulley *C*. This holds the cord always in tension between that point and the cross-head on the engine, or the reducing motion, preventing any possible whipping, snapping or entanglement of the cord, virtually taking the place of the drum recoil spring when that is at rest. The upper pulleys, *B*, *C*, and pins being in duplicate, the instrument can be used right or left. The device may be attached vertically, as shown by the cut, to a metal or wood angle form as an *L*, secured to the steam chest; or it may be inverted or secured flatwise on the steam chest, pointing either way; or it may be fastened in any position on a bar of wood or metal, as convenience may suggest, depending upon the surroundings of the engine.

A New Telephone Transmitter.

We illustrate herewith a new improvement in telephone transmitters, recently patented by William C. and John M. Lockwood, of Brooklyn, N. Y., who are now making a specialty of its manufacture. The main feature of the transmitter is a granular contact surrounding the margin of the front of the electrode, the back electrode being the full size of the metallic incasement. The electrodes are not in contact between their broad surfaces, either direct or by the granular carbon, being separated by an air space whose object is to prevent packing and burning of the granular carbon; in every other form of granular carbon transmitters the conductive material is directly between the solid electrodes. It is clear that this form of transmitter does not depend upon any pressure between electrodes in constant contact, the variation of electrical resistance in this instrument being caused by the variation of friction. It is claimed that for a perfect talking transmitter it is unexcelled, either for long or short distances. The instrument is in the form of a Blake box, having only a projecting mouth piece, and, as will be seen, it can be mounted on any form or style of back-board, and besides, it is claimed, will give better satisfaction with less battery power than any other instrument. It is also claimed that, unlike other carbon pencil transmitters, this is entirely practical for exchange purposes, not being continuously subject to changes.



A New Telephone.

The C. & C. Multipolar Dynamo.

To comply with the demand for slow speed dynamos that may be coupled direct to engines, The C. & C. Electric Company, 143 Liberty street, New York, has brought out during the past year a line of multipolar machines presenting several unique features of design. These machines have been specially designed to meet the rigid requirements as to heating and regulation which are now so frequently demanded by consulting engineers. They are also so mechanically constructed as to admit of a variety of methods of coupling, according to the desire of the purchaser.

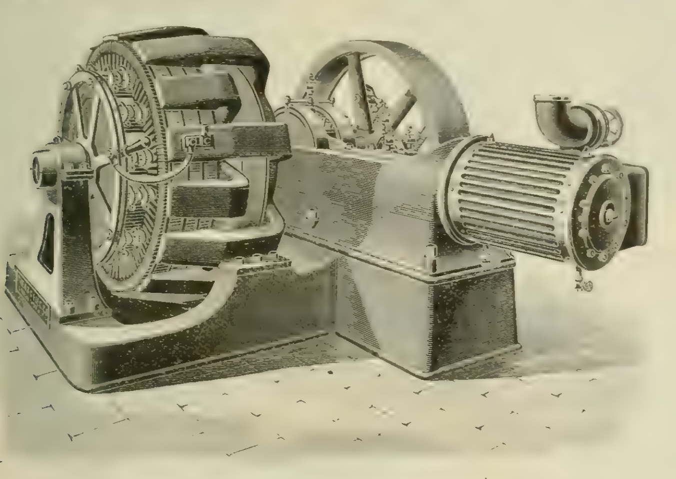
The field magnet consists of two annular steel castings having projecting arms which form the pole pieces. These castings are fitted together so as to enclose a single exciting coil, which produces opposite polarity in the two sets of arms.

This forms a very simple and compact magnet, light in weight and easily handled. The single coil reduces the number of field connections to a minimum, thus doing away with one source of trouble experienced in multi-coil field magnets.

The bed may be bolted to the engine bed or be of one piece with it, and is of very simple and strong construction. The outboard bearing is supported by an A frame pedestal bolted to bed.

The armature is a ring supported on a double set of driving arms projecting from heavy hubs, which are keyed to shaft. The construction is such that a powerful draft of air is created by the rotation of the armature, which, combined with the very low heat loss per square inch of surface, keeps the running temperature very low.

The insulation on core is chiefly of mica. The commutator is bolted directly to the driving arms and is built up of cast copper bars insulated with mica. It is very large and admits of the use of carbon brushes for all voltages. This is a great advantage. The brush holders are the well known C. & C. reaction holder, using flat carbons with bevelled ends. These holders do not require exact-sized carbons, give good contact with minimum spring pressure, and are very easy to adjust.


Direct Connected Multipolar Dynamo.

Interior Telephone Outfit.

There are two collecting rings, having projecting arms which carry the brush holders, supported on the front pedestal. These rings are insulated from each other, and but two cables leading from them are required to carry off the current. The bearings are self-oiling and self-aligning. The shaft is carefully proportioned to carry the heaviest accidental strains which may come upon it, and is made either separate or in one piece with engine shaft.

These dynamos are usually compound wound and will preserve a constant voltage within one per cent. through the extreme load range. This regulation is entirely automatic, requiring no brush or regulator movement, and is obtained without sparking at brushes. Eddy currents in armature core and conductors are, by proper construction, almost eliminated, and the $\frac{C^2R}{\text{Losses}}$ are so reduced as to bring the efficiency of the machine to a point averaging 95 per cent. between one-fourth and full load.

Automatic Interior Telephone Service.

Within the past year a field has been opened for the utilization of the telephone for intercommunication in business houses, hotels, public buildings, mines and manufacturing plants of every description, and to meet the occasion Mr. Thomas McCoutray, ex-secretary of the National Electric Light Association, has designed an auto-telephone system, which is now being placed on the market by the Tucker Electrical Construction Company, 14 Whitehall street, New York.

Until their expiration the fundamental patents covering the art of telephony had rendered this particular field inaccessible, so that, until recently, the nearest approach to a practical system of intercommunication has been the speaking tube, which at best is a bulky one, covering a very limited space for successful operation. The advantages of a system which places the departments of an establishment in touch with each other without loss of time and without the necessity of leaving the desk or department are obvious. In designing such a system, however, there are many points to be considered.

First.—The importance of locating the battery source at one place, instead of having a source at each station, because it is very evident that a multiplicity of battery sources necessarily entails much more care and attention than if located all at one place.

Second.—The importance of such signalling devices as will instantaneously give notice that a call has been heard, without the necessity of placing the receiver to the ear repeatedly.

Third.—The great advantage of being able to talk together through any two stations in the system without interrupting any other pairs that may be using it, or without being heard by others on the line, and without hearing any but the person with whom one might be in communication.

A still more important feature to be considered is that of providing for a conference between any number of persons, without the necessity of either of them leaving his desk. In providing for these conditions simplicity combined with durability in construction, should not be neglected, but the system is so designed in all its details as to minimize the probability of derangement by changing adjustment, etc.

The inventor claims that in his system, of which we illustrate one of the stations, all of the conditions herein referred to have been met. A number of pairs of stations in the system may hold converse at the same time without interruption or being overheard by others using it. A single battery source furnishes the energy for the whole lot, and at the same time it is claimed the system it is so flexible that any number of persons may through it confer, as though all were assembled in one room. An operating system has been in use at the offices of the Tucker Electrical Construction Co., which is sole licensee for the system, for the past six months, and after careful study it is claimed that every possible source of weakness has been eliminated, so that it may be safely guaranteed in every particular, not only as to satisfactory results and durability, but also against annoyance from any one relative to patents or infringements.

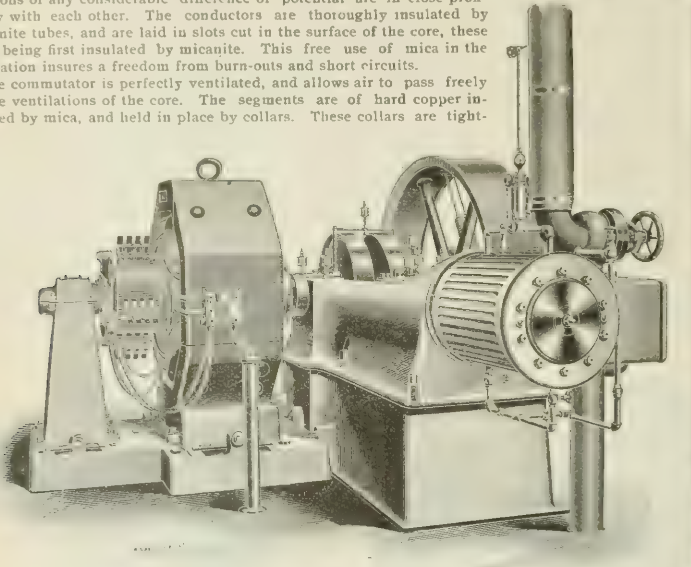
The Eddy Direct Connected Generator.

We illustrate herewith a generator manufactured by The Eddy Electric Manufacturing Company, of Windsor, Conn., direct connected to a Ball and Wood engine. The generator is of a type which The Eddy Company has had in successful operation for over a year past, and which has met with universal approval. It is multipolar, the four cast-steel pole pieces being bolted to a cast-iron frame, a form of construction that requires the least expenditure of energy in obtaining a strong magnetic field. The field coils are wound on metallic spools which are held at a distance from the pole pieces, so as to allow for an air space to ventilate the inner surface of the spool. Those familiar with the trouble and annoyance that hot coils produce in the regulation of a machine, greatly appreciate this feature. To secure the insulation of the windings, a liberal supply of mica is used, and to still further insure safety, the series coil is not wound over the shunt, but placed in a separate compartment.

The armature is of the "iron-clad" type. The core is built up of washers of charcoal iron laminated and ventilated, and mounted on a ventilated sleeve, which also supports the commutator. This sleeve slips on the extension of the engine shaft, or onto a separate shaft rigidly coupled to that of the engine.

The armature conductors consist of copper bars of rectangular section, and connected at the ends by bent strips in such a manner that no connections of any considerable difference of potential are in close proximity with each other. The conductors are thoroughly insulated by micanite tubes, and are laid in slots cut in the surface of the core, these slots being first insulated by micanite. This free use of mica in the insulation insures a freedom from burn-outs and short circuits.

The commutator is perfectly ventilated, and allows air to pass freely to the ventilations of the core. The segments are of hard copper insulated by mica, and held in place by collars. These collars are tightened by bolts extending through the commutator under the strips, and prevented from loosening by an efficient and simple nut lock. It is quite easy to tighten the commutator without any other tool than a wrench.



Direct-Connected Multipolar Generator.

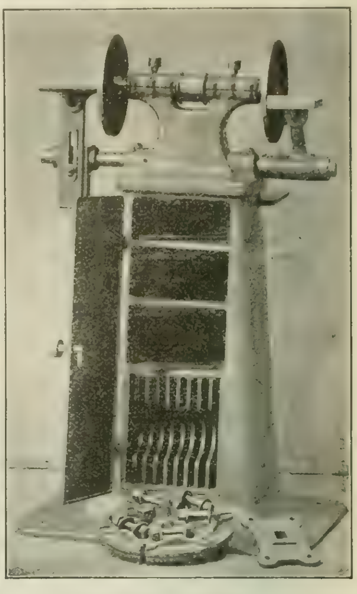
The outboard bearings as well as the frame are adjustable to the alignment of the engine, by means of sliding wedges on the base. In addition to this adjustment, the bearing is equipped with a universal sleeve, so that all difficulty in bringing the three bearings in line and maintaining them there is reduced to a minimum.

The generator illustrated is of 65-kw capacity, generating 125 volts at 300 revolutions per minute. On a ten hours' continuous test at full load the machine in no part attained a temperature exceeding 80 degrees Fah. above the atmosphere, and there was no sparking at the brushes at any load. The Eddy Company have in operation a number of direct connected units of this type in capacities varying from 40 to 200-kw.

The Gardner Grinder.

The grinder we illustrate, made by Charles H. Besly & Company, 10 Canal street, Chicago, is principally intended for grinding flat surfaces or rough surfaces on drop forgings or castings when the finished surface, is to be flat. The machine will not only do all kinds of rough work but also the finest finishing, and at a rate faster than that of a solid wheel. It will grind right-angled surfaces truly and being itself flat, the work produced is always true. The makers do not claim to compete so much with emery wheels as with files; a good part of the filing of flat surfaces may be done on it with a great asving of time.

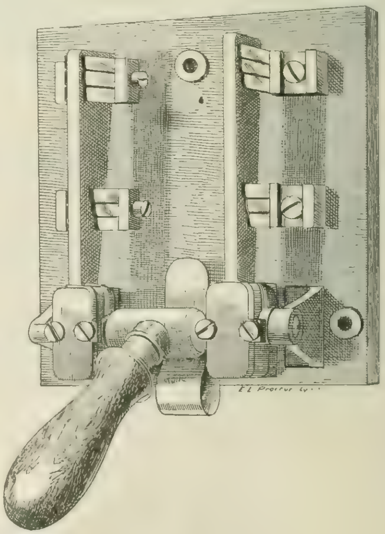
The steel disc shown, which is the principal feature of the machine, has a spiral groove running from the centre to the circumference on each side, which holds the glue that secures the emery paper or cloth grinding faces to the disc. The grinding faces are pressed into the spiral groove, thus forming a clearance for particles of emery or metal, and thereby enabling the machine to cut many times faster than a solid wheel. The discs are true on both sides and are quickly reversed, using ordinary glue to secure the paper or cloth to the disc. In thus renewing the emery surface, the paper or cloth is pressed into the spiral grooves by placing the disc in the press shown in the cut while the glue is soft, and allowing it to remain for an hour or more until it sets. In one type of grinder made, the right-hand table is set at a right angle to the face of the wheel and has a rocking motion parallel to the face of the wheel. In another type, the right-hand table is adjustable up and down, and is also set at a right angle to the face of the wheel, and slides across the face on covered ways.



Gardner Grinder.

The Heinze Switch.

A new style of switch is being placed on the market by Messrs. Heinze & Son, of Lynn, Mass., manufacturers of electrical apparatus, which is claimed to possess in its mechanical construction and electrical features a great amount of merit, and to embody the qualities of a high grade of finish, careful workmanship and correct principles of breaking an electric current, the arc formed thus doing as little injury to the metal parts as possible. Particular attention has been paid to the parts, such as the knife blades, which are made of hard rolled sheet copper and are necessarily of even thickness, forming a quick breaking contact surface for the metal springs. The parts are all in duplicate, and in case of injury to the metal springs or knife blades they can be easily replaced by simply removing the screws and the caps. They can also be withdrawn from the sockets and new ones inserted, and all changes can be made without removing the switch from the wall or place where it may be secured.



Heinze Switch.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Jan. 2, 1894.

THE ELECTRICAL STOCK MARKET is in the dumps, but it has lots of company in its unhappy experience. Stagnation pervades the entire stock exchange district. Commission houses all report that speculative dealings in all kinds of stocks have received a chill quite in harmony with the current "cold wave." Professional traders also fail to see anything in the stock market, and quotations consequently fail to show any signs of life. It is hoped that the dividend and interest payments on January 1, which in New York City alone caused the distribution of over $100,000,000, will revivify the stock market, but Wall street's long record of disappointment and contrariness has made everybody skeptical of the wish being realized.

GENERAL ELECTRIC gratifies its friends somewhat by not yielding to any appreciable extent to the prevailing depression in prices. None the less, it does not respond to the continued glowing reports one hears as to the company's business conditions and prospects. Talk on the stock is bullish enough as a result of these semi-official announcements, but the stock's price fails to act in accordance. Of course its intrinsic value is being continually bettered by reason of better trade conditions, and the man who holds on to his stock will reap his reward, but there is no ready market for the stockholder who wants to sell out, and any offering of long stock in the present financial situation is sure to create lower prices. Some recent selling is understood to have been in anticipation of a serial newspaper attack, whose statements, it was promised, would be sure to induce long selling of the stock. So far the attacks have failed of appearance, nor would they be likely in Wall street's present frame of mind to find it very responsive to such methods of campaigning. On the other hand the company is understood to be at present doing as large a proportion of the electrical trade as ever it did, and that on a cash basis, and at less cost to manufacture. The gross volume of business is at the rate of $1,000,000 a month, and enough profit is made to allow of a continual reduction in the capital impairment, despite the continuation—of course, in a much diminished degree—of the charging-off process. Nothing looking to the correction of the impairment in the capital stock will now be done until after the annual meeting in the spring, though at the last annual meeting of the stockholders a committee was appointed to formulate some plan to be submitted within the year. The times have, however, not been propitious for such financiering, and it is impossible as yet, to determine what line of action in the matter will be eventually taken. Pending the settlement of this difficulty, no dividends on either class of stock can be paid, and cash keeps on piling up in bank to the company's credit. It now is about $500,000, and will soon be larger, to judge from the prospects. It is gossip that the General Electric Company is about to close one of the largest contracts ever awarded in the history of the trade in this country. No names are mentioned, but this probably refers to the Manhattan Elevated Railroad, though the Westinghouse people are also reported as figuring on the same business. The General Electric has secured all the contracts for elevated rairoad equipment thus far competed for, and the company's officials believe that once the efficiency of the Metropolitan West Side Elevated of Chicago, which will be in operation in February, is demonstrated, it will receive all similar business.

THE AMERICAN BELL TELEPHONE stock issue, under the new legislative restriction, is a failure. As a result of the adverse decision in the Berliner patent case, the stock has dropped to 190, the price fixed for subscriptions by the State authorities, but the market price is below the State's price by just the amount of the $4.50 declared dividend payable on January 15. Of course Bell telephone rights now possess a minus value and there is no market for them. It is figured that in an ordinary market, Bell telephone would have dropped a good many points lower than it did on the legal blow it received, in which case the man who sold his right for 5 cents would have had to pay many times that amount by guaranteeing a subscription at 190. It is not now expected that 1,000 shares of the 5,000 offered will be subscribed for. According to the new law the rest must be sold by auction; no limit of time is set, however, and no official action has, as yet, been taken in the matter. Speaking of the patent in question, prominent people in the Bell Company say that its real strength and value is in the system and possession of the field and not in the patents held. The net output for the month ending December 20 was 1,784 instruments, as against a loss last year of 1,234, a total gain of 3,018. For the year ending December 20, 1894, the record stands as follows: Gross output, 89,493, increase, 8,075; returned, 72,318, increase, 6,880; net output, 17,175, increase, 1,195. The company apparently easily held its own, and that is doing well enough in a year of commercial hardship. The International Bell Telephone Company, one of the allied organizations, has declared a dividend of 5 per cent., payable January 3.

BOSTON ELECTRIC LIGHT 5s are a new security offered to investors. An issue of $360,000 has just been put out, being part of the issue of $660,000; the other $300,000 will be used to retire a like amount of bonds falling due. The new bonds are a consolidated first mortgage, and the proceeds are to be used in building underground cables. The bonds are offered to stockholders at par and accrued interest, payable in cash January 10.

AMERICAN RAPID TELEGRAPH COMPANY bondholders will soon participate in the distribution of $1,000,000; there are about $3,000,000 of the old bonds. This will mark the final winding up of the concern. Among the assets to be divided among the bondholders and other creditors are the 5,500 shares of Western Union Telegraph paid for the Rapid Telegraph Company's property and the $237,000 recovered from the Western Union Telegraph Company under its contract to maintain the lines in as good condition as it received them while it was operating them under lease at $60,000 per annum on account for the receiver.

*EDISON ELECTRIC ILLUMINATING (New York) stock is now selling "dividend on," a quarterly distribution of 1½ per cent., payable February 1 next, having just been ordered paid by the board of directors.

EDISON ELECTRIC ILLUMINATING (Boston) stock is in quite active demand. Rights to subscribe at par for the $425,000 new stock recently authorized are selling at from $3 to $4.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	127	130
Cleveland General Electric	100	80	90
East River Electric Light Co.	100	—	50
*Edison Electric Ill., New York	100	100½	101
* " " " Brooklyn	100	109	112
" " " Boston	100	126	128
" " " Philadelphia	100	120	125
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	37	39
Electric Construction & Supply Co., com.	15	7⅛	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2	3
General Electric	100	34⅛	35
General Electric, pref	100	67	70
Westinghouse Consolidated, com.	50	32	32½
* " " pref	50	49	49½

BONDS.

Edison Electric Ill., New York	1,000	108½	109
Edison Electric Light of Europe	190	75	85
General Electric Co. deb. 5's	1,000	93¼	93½

TELEGRAPH AND TELEPHONE.

*American Bell Telephone	100	194	195
American District Telegraph	100	35	40
American Telegraph & Cable	100	91	92
Central & South American Telegraph	100	102	105
*Commercial Cables	100	130	145
Erie Telephone	100	51	51½
Gold & Stock Telegraph	100	103	105
*Mexican Telegraph	100	180	190
Mexican Telephone	100	75	80
New England Telephone	100	66	69
New York & New Jersey Telephone	100	97	98
Postal Telegraph-Cable	100	50	55
*Western Union Telegraph	100	86⅛	87

*Ex. Div.

TRACTION STOCKS are suffering from causes similar to those affecting electrical stocks. The New York market for such stocks as North Shore, Worcester, Long Island, Brooklyn, New Orleans, etc., is practically dead, though there are signs of reviving demand from investment sources, now that the January distributions are at hand. Philadelphia electric traction stocks are also depressed; this is due, it is stated, to an effort to accumulate stock preparatory to a boom in legislative action early in the new year.

ELECTRIC TRACTION STOCKS.

	Bid.	Asked
Union Ry. Co. (Huckleberry)	125	130
Brooklyn Traction, pref	65	70
" " com.	14½	15½
Long Island Traction	13	14
Rochester St. Ry	38	39
Columbus St. Ry	45	50
Louisville St. Ry. pref	87	88
" " " com	37	39
Cleveland Electric Ry.	45	47
Cleveland City Ry.	68	70
North Shore Traction	23½	25
New Orleans Traction	63½	65
Worcester Traction pref.	79½	89⅛
" " com	13	14
Metropolitan Traction, Philadelphia	103⅛	104
Philadelphia Traction	99½	100½
People's Traction	52⅛	53
Binghamton R. R. common	100	—

BONDS.

	Bid	Asked
*Union Ry. 1st. mtge 6s.	106	108½
*Westchester Electric 1st. mtge. 5s.	98	101
Rochester St. Ry. 1st. 5s.	95	97
*Columbus St. Ry. 1st 5s.	89	92
Columbus Crosstown 1st. 5s.	95	97
*Binghamton Railroad Co. 5s	99	100

*With accrued interest.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
253 Broadway, New York, Dec. 29, 1894.

C. H. McINTIRE, of the C. H. McIntire Company, 13 Franklin street, Newark, N. J., has gone on a Southern trip for his health.

JULIUS SOMBORN, treasurer of the Universal Electric Pull Socket & Switch Company, New York, died on December 26th, of Bright's disease.

MESSRS. WARREN & LOZIER, of 465 Greenwich street, New York, gave on New Year's eve a pleasant little dinner to 35 of their employees and a number of invited guests. The occasion was much enjoyed by all present.

MR. F. W. HARRINGTON will leave New York next week with his family for St. Augustine, where he will remain during his four weeks' vacation, and hopes to return much benefited by the trip, and fully prepared to enter on his new field of labor.

THE STIRLING COMPANY, Pullman Building, Chicago, Ill., has severed its relations with Mr. John MacCormack, who formerly represented it in New York, and has turned the Eastern territory over to Mr. Frederick A. Scheffler. The New York office of the company will remain as heretofore, No. 126 Liberty street.

WALTER PHILLIPS, M. E., electrical engineer of the Illinois Steel Company, South Chicago, was in New York last week investigating various electric systems of power transmission. The Illinois Steel Company has installed a large amount of electrical machinery, and will ultimately employ this method to the exclusion of mechanical drives.

MESSRS. JAS. W. GODFREY, F. W. HARRINGTON AND J. B. OLSEN gave a pleasant "at home" at their office, 15 Cortlandt street, Monday afternoon, Dec. 31st. Though the notice was short, about 300 of their friends called to wish success to the well-known and popular trio, both individually and as representatives of the India Rubber & Gutta Percha Insulating Co. Some of the gentlemen present were as follows: Jas. Kelley, W. A. Vail, J. P. Hall, J. B. Phillips, R. B. Corey, Fremont Wilson, Maj. Evarts, H. A. Reed, Harry M. Shaw, T. J. Smith, G. M. Phelps, T. C. Martin, Jos. Wetzler, B. F. Hamilton, David Chalmers, W. Hanks, N. D. Webster and W. T. Hunt. Mr. Godfery has moved from room 38, 15 Cortlandt street, to room 52, same building.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, December 28, 1894.

MESSRS. LINTON & SOUTHWICK, of Worcester, Mass., have just issued a new catalogue, in which they modestly and tastefully present the claims and advantages of their station switches, switchboards and other appliances, which have already received liberal recognition, and for which the demand continues to increase. A live firm, and generally "up to date" in all that it does.

THE FITCHBURG MACHINE WORKS, of Fitchburg, Mass., reports business as very much improved, and that it is receiving some good orders from the electrical trade, to whom it needs no introduction, or to the general public either, for that matter, before whom it has been prominent for over thirty years in the manufacture of first-class tools, lathes, drills and all important metal-working machinery and machine specialties.

THE BRODIE ELECTRIC COMPANY, of Manchester, N. H., is in the field with a line of specialties, including an automatic motor switch of simple and effective design, for the protection of motors from burning out, an automatic telephone switch, which is sold separately to be applied to the ordinary magneto bell, and a line of insulators for use upon trees and in other unfavorable places for which very high insulating qualities are necessary.

MR. J. J. GATES has identified himself with the Perkins Electric Switch Manufacturing Company, of Hartford, Conn., as general manager. His energetic business methods in the management of this company have already had their effect in the increased number of orders for its well known switch and socket manufactures and Waterhouse arc lamps, and it is safe to assert it will continue to be so. Mr. Perkins and Mr. Gates are business associates "of old," and as co-workers will undoubtedly increase the volume of business of the Perkins Company in a marked degree.

THE THOMPSON BROWN ELECTRIC COMPANY, 97 High Street, Boston, is announcing to the trade in connection with the conduct of its business a new and quite important feature—the introduction at its storeroom and warehouse of a free Bureau of Registry, in the interests of employers and employees, appreciation of which has already been manifested. The idea is certainly an excellent one and it will undoubtedly at once appeal favorably to both employers and employees, as the former may feel assured of obtaining through the bureau only the most competent help and the latter only good and reliable employment. Aside from the fact that the Thompson-Brown Company strives to please in every way its customers, one of its points is progressiveness, and this new feature is right in that line. The company also announces as a New Year's surprise that it will have ready for delivery about February 1, 1895, an entirely new and novel line of street railway material which will be manufactured under the Thompson Patent. It is claimed that the material will be smaller, stronger and more easily put up than any material, now on the market and at a saving of 15 per cent. in price as compared with the cheapest material now in the market.

General News.

NEW INCORPORATIONS.

THE ACME ELECTRIC COMPANY, East Palestine, O., capital stock $10,000, has been formed to produce and supply electricity for light, heat and power. Geo. E. Sebring, R. N. Chamberlin and D. H. Mackintosh are the promoters.

THE OHIO VALLEY ELECTRIC COMPANY OF AVALON, Avalon, Pa., capital stock $5,000, has been formed to supply light, heat and power. Wm. Jackson, Donald M. Sloane and John H. Fults, Allegheny, Pa., are interested.

THE DETROIT ELECTRIC LIGHTER COMPANY, Detroit, Mich., capital stock $50,000, has been incorporated. Wm. R. McGraw, chairman; Louis C. Sherwood, vice-chairman; Leopold Godfrey, secretary; and Israel T. Cowles, treasurer.

THE KNOXVILLE ELECTRIC COMPANY, Knoxville, Ia., capital stock, $20,000, has been formed to operate an electric light and power plant at Knoxville. J. H. Auld, W. O. Robinson and J. S. Bellamy, Knoxville, Ia., are the promoters.

THE FLORISSANT AVENUE ELECTRIC RAILWAY COMPANY, St. Louis, Mo., capital stock $2,000, has been formed for the purpose indicated in its title. The interested parties are E. R. Feuesborn, T. P. Bell and J. H. Shroeder, St. Louis, Mo.

THE HOME HEATING & LIGHTING COMPANY, Toledo, O., capital stock $50,000, has been incorporated to do heating and lighting by electricity, steam and hot water, etc. J. F. Zahm, Homer Yarryan and R. W. Smith are interested.

THE SUBURBAN LIGHT, HEAT & POWER COMPANY, Pittsburg, Pa., capital stock $5,000, has been incorporated to supply light, heat and power. Samuel P. Conner, J. W. Patterson and Thomas A. Noble, Pittsburg, Pa., are the organizers.

THE WHITEHALL ELECTRIC COMPANY, Whitehall, Ill., capital stock $10,000, has been formed to furnish electric lights, also electricity to propel machinery. Gilbert S. Vosseller, Orlando F. Griswold and Henry W. Hand are the promoters.

THE BELLEVUE ELECTRIC LIGHT COMPANY, Bellevue, Pa., capital stock $500, has been incorporated to supply light, heat and power. H. H. Veeder, Pittsburg; E. G. Caughey, Allegheny, and George H. Quaill, Bellevue, Pa., are the promoters.

THE TRELEAVEN OPTICAL COMPANY, Chicago, Ill., capital stock $30,000, has been formed to manufacture and deal in electrical, optical and photographic goods, etc. Walter N. Treleaven, Geo. M. Stannard and Thos. S. Jackson are the incoporators.

THE POTTS MACHINERY SUPPLY COMPANY, Columbus, O., capital stock $10,000, has been formed to manufacture and deal in electrical specialties, water, gas, steam, oil and air. Wm B. Potts, Walter B. Page and I. N. Hansbrough are the promoters.

THE OHIO VALLEY ELECTRIC COMPANY OF BEN AVON, Ben Avon, Pa., capital stock $10,000, has been formed to supply light, heat and power by means of electricity. Wm. Jackson, Donald M. Sloane and John H. Fults, Allegheny, Pa., are the incorporators.

THE OHIO VALLEY ELECTRIC COMPANY OF EMSWORTH, Emsworth, Pa., capital stock $5,000, has been formed to supply light, heat and power by means of electricity. Wm. Jackson, Donald M. Sloane and John H. Fults, Allegheny, Pa., are the organizers.

THE OHIO VALLEY ELECTRIC COMPANY OF BELLEVUE, Bellevue, Pa., capital stock $5,000, has been formed to supply light, heat and power by means of electricity to the public. Wm. Jackson, Donald M. Sloane and John H. Fults, Allegheny, Pa., are interested.

THE SOUTHAMPTON ELECTRIC LIGHT COMPANY, Southampton, L. I., capital stock $5,000, has been incorporated to manufacture and use electricity for light, heat and power, etc. The promoters are W. D. Van Brunt, H. M. Wowell and Daniel Vail, all of Southampton.

THE WINOOSKI LIGHT & POWER COMPANY, Winooski, Vt., capital stock $2,500, has been formed to generate electricity by water and other power; also to furnish light, heat and power to Winooski. E. P. Crandall, O. W. Peck and H. F. Wolcott, all of Winooski, are interested.

THE FLUSHING AND COLLEGE POINT ELECTRIC RAILWAY COMPANY, Flushing, N. Y., capital stock, $125,000, has been formed to build and operate a street surface road in Queens County. P. D. Cravath, Daniel O'Dell, and E. B. Halstead, New York City, are the organizers.

THE POLAND RAILWAY COMPANY, Youngstown, O., capital stock $25,000, has been formed to construct and operate an electric railway between Youngstown and Poland, O. Gilbert M. Dill, Zebulon P. Curry, Arthur O. Fording, Asael E. Adams and Henry W. Davis are interested.

THE CALUMET CONSTRUCTION COMPANY, Chicago, Ill., capital stock $10,000, has been formed to construct electric power and light plants, railroads, canals, water works, buildings, sewers, etc. Edward H. Gorse, James W. Burson and Clinton W. Howe are the interested parties.

THE DELANEY HEATER & RHEOSTAT COMPANY, South Orange, N. J., capital stock $100,000, has been formed to manufacture and sell rheostats and electric heating apparatus. Ezra T. Gilliland, John C. Tomlinson and Frank W. Toppanall, all of New York, are the incorporators.

THE KEYSTONE TRACTION COMPANY, Lancaster, Pa., capital stock $10,000, has been formed to construct and operate motors, cables or other machinery for supplying motive power to passenger railways. J. J. Patterson, Jno. D. Skiles, Lancaster, and Wm. B. Given, Columbia, Pa., are the promoters.

THE COMBINATION POLICE & FIRE ALARM COMPANY, Chicago, Ill., capital stock $1,000,000, has been formed to manufacture and sell apparatus actuated by electricity, steam, water or other motive power; also machinery, tools, etc. Chester B. Davis, Wm. H. McAndrews and Roy S. Bates are the promoters.

THE CINCINNATI, HAMILTON, MIDDLETOWN & DAYTON STREET RAILROAD COMPANY, Cincinnati, O., capital stock $500,000, has been incorporated to construct and operate an electric street railroad between Cincinnati and Dayton, O. A. Hickenlooper, Chas. Fleischman and L. C. Weir are the incorporators.

THE MUTUAL ELECTRIC LIGHT COMPANY, San Francisco, Cal., capital stock $500,000, has been incorporated to generate, transmit and sell electricity for light, heat and power, and to manufacture and deal in telephones, etc. Thomas R. Hemshelwood, John B. Halsted and Cyrus C. Dow, San Francisco, are interested.

THE SUSQUEHANNA RIVER ELECTRIC COMPANY, Baltimore, Md., capital stock $100,000, has been incorporated by Moses H. Houseman, George K. McGaw, Winfield J. Taylor, of Baltimore, and Chas. R. McConkey, of Peach Bottom, Pa. It is proposed to transact a general business in electrical appliances, merchandise, lands, bridge building, etc.

THE NEW MARTINSVILLE AND MANNINGTON TELEPHONE COMPANY, New Martinsville, W. Va., maximum capital stock $20,000, has been incorporated to maintain and conduct electric telephone lines, underground and overhead, etc., and to manufacture and use all electrical apparatus. Amos Jollefer, Uniontown, John C. Poe, Sincerity, and O. M. Crow, Littleton, W. Va., are the promoters.

THE SUSQUEHANNA RIVER ELECTRIC COMPANY OF BALTIMORE CITY, Baltimore, Md., capital stock, $100,000, has been formed to buy, sell or otherwise deal in lands; construct, own and operate telegraph lines; carry on a forwarding business and construct wharves, steamboats, etc. Moses H. Houseman, Chas. R. McConky, Geo. K. McGrew, Jno. S. Bull, and Winfield J. Taylor, are interested.

Telegraph and Telephone.

VALPARAISO, IND.—The Valparaiso Telephone Company has been organized, with a capital of $50,000. The president is James H. McGill; vice president, A. D. Bartholomew; secretary and treasurer, Frank A. Turner.

SOUTH BEND, IND.—W. F. Benfield, of Frankfort, Ind., general manager of the Indiana Telephone & Construction Company, is looking over the field with a view to establishing a telephone exchange at South Bend.

FINDLAY, O.—The stockholders of the Findlay Telephone Company are as follows: Aaron Blackford, Milton Gray, J. S. Patterson, U. K. Stringfellow, Jason Blackford, C. C. Harms, J. T. Barton, W. A. Byal, Dr. J. C. Kimmel and J. T. Adams. U. K. Springfellow is the prime mover in the company. It is not known what kind of telephone will be used.

Electric Light and Power.

CAREY, O.—There is some talk of establishing an electric light plant here.

STRONGHURST, ILL.—Stronghurst is considering the project of establishing electric lights.

CRESCENT CITY, FLA.—The Crescent City Traction Company will light the city by electricity.

ATLANTA, GA.—The contracts for electric lights with the Georgia Electric Light Company will expire shortly.

BALTIMORE, MD.—The Mayor may be addressed concerning the erection of an electric light plant in Druid Hill Park.

POTTSVILLE, PA.—Pottsville citizens will be given a chance to vote to establish a borough electric plant at the February election.

BINGHAMTON, N. Y.—The State Armory has received an appropriation of $800 to change its lighting system from gas to electricity.

SHAWANO, WIS.—The Council has resolved to install electric lights, and await proposals from parties competent to put in the plant.

NATCHEZ, MISS.—Address Rufus R. Learned, of the Natchez Electric Railway Company, concerning the erection of an electric light plant.

PALMYRA, MO.—H. M. Howard has been granted a franchise to operate an electric light plant and also expects to put in a telephone exchange.

SCRANTON, PA.—The Select Council passed a resolution directing the City Clerk to advertise for bids to light the municipal building and fire company houses.

RICHMOND, VA.—The Committee on Light has considered at some length the question whether the city should own its electric light plant. Chairman Grimes.

SOUTH BEND, IND.—Messrs. Baker and Yeck, electrical contractors, have leased the electric light plant of General Haupt, of Philadelphia, and will put it in operation.

WORCESTER, MASS.—The Worcester Electric Power Company is said to contemplate adding heating and cooking to its business. The company is considering plans for a new station.

SPENCERVILLE, O.—Spencerville will hold a special election on the 12th day of January, 1895, to vote upon the question of bonding that village in the sum of $12,000 for an electric light plant.

CINCINNATI, O.—The Music Hall trustees have decided to expend $20,000 in improving the Music Hall. An electric light plant will be put in. A. T. Goshorn is president of the Board of Trustees.

ALBANY, N. Y.—An ordinance is on file authorizing and directing the letting of a contract for the lighting of the city of Albany by means of electricity. Wm. W. Dennin is Clerk of the Common Council.

NIAGARA FALLS, N.Y.—Arthur Schoellkopf, of the Niagara Falls Hydraulic Power & Manufacturing Company, is getting bids from electrical companies for the electrical machinery that his company will soon require.

TRAVERSE CITY, MICH.—The Village Council has let the contract for lighting the city streets to the Broadman River Electric Light and Power Company for five years at $60 per 2,000 candle power arc light per year.

MIDDLETOWN, O.—The Middletown Electric Light and Power Company has secured a site for the construction of its plant on Clinton and Canal streets. The work of erecting the buildings will be commenced immediately.

CLEVELAND, O.—City Civil Engineer Rice has gone to Chicago. The object of this trip is to examine the electric bridges which are in operation in that city. The new Columbus street bridge here will be operated by electricity.

SOUTH HAVEN, MICH.—The South Haven voters have rejected the scheme to spend $10,000 in securing the ownership of an electric lighting plant. There was a majority for it, but it takes a two-thirds vote there to order an issue of bonds.

PAWNEE CITY, NEB.—The Council has directed the City Clerk to prepare an advertisement for bids for the erection of an electric light plant in accordance with plans and specifications on file in the office of the city engineer, and that such advertisements should be published.

BELLWOOD, PA.—The Robinson Company's plant has been sold by the receiver to a company of Altoona capitalists, and operations will be resumed under the new management, which will give employment to [illegible]. The company manufactured electrical apparatus.

LYNN, MASS.—An order was adopted by the Lynn Aldermen requesting the mayor to petition the Legislature [illegible] having established fire limits to compel the burial of all electric lighting, telegraph, telephone and other wires within said limits.

The Electric Railway.

VALDOSTA, GA.—It is stated that a company is being formed to [illegible] electric line on several of the city streets.

MANCHESTER, N. H.—General Williams, Depot street, is interested in the construction of the proposed electric road.

CHARLESTON, S. C.—Julius Fishburnie and others are interested in the proposed electric line to be built in Charleston.

NEW HAVEN, CONN.—The New Haven & Hartford Railway Company will build an electric line from Stratford to Woodmont.

IOWA CITY, IOWA.—The Iowa City Improvement Association offers $[illegible] to any company who will build an electric street railway.

SAN ANTONIO, TEXAS.—The San Antonio Rapid Transit Company has decided to make several extensions to its Alamo Heights line.

MARSHALL'S CREEK, PA.—The Delaware Valley Electric Railway has commenced the erection at Marshall's Creek of a power house.

ATLANTA, GA.—W. A. Hemphill and others are interested in building an electric road along Peachtree and several other suburban streets.

BANGOR, PA.—The Bangor, Pann Argyl & Wind Gap Electric Railroad Company will shortly be reorganized, and the road built as soon as practicable.

BOSTON, MASS.—The Waltham Aldermen have granted a franchise to the Newton Street Railway to lay tracks in Woord avenue as far as Forest Grove.

KANSAS CITY, MO.—The Vine street electric line is to be relaid with 100-pound steel rails, according to the statement of General Manager Bernardin.

COHOES, N. Y.—Engineer Vail has submitted plans for the proposed new Cohoes electric street railway, and at a meeting soon to be held the contract will be awarded.

NEW HAVEN, CONN.—A. C. Pond, of Boston, is among those who are interested in the big electrical scheme of connecting New Haven with points 30 miles distant.

NEW BRITAIN, CONN.—The Common Council has received a petition from the electrical company asking permission to extend its lines from East Main street to the city limits.

CRESCENT CITY, FLA.—An electric traction road is to be built from some point on the line of the J. G. K. W. R.R. system to Crescent City, the Crescent City Traction Company.

FALLS CHURCH, VA.—Mr. R. A. Phillips, of Washington, D. C., was here recently with a civil engineer, with reference to the proposed electric road from this place to Washington.

ATTLEBORO, MASS.—The new street railroad will soon build a power house. The company which is to run the road consists of J. T. Sweet, M. B. Short and Peter Merry, of Attleboro.

SENECA FALLS, N. Y.—Mr. Hammond has made application for a franchise to construct an electric line from Bridge street through Bayard street to the eastern boundary of the village.

GREENWOOD, IND.—The Commissioners of Johnson County have granted a right of way to the Indianapolis, Greenwood & Franklin Electric Railway Company from Greenwood to Franklin.

JACKSON, TENN.—The Jackson Suburban Street Railway Company is considering the idea of rebuilding its line for the trolley system. It is seven miles long. J. L. Wisdom is general manager.

NASHUA, N. H.—Some of the directors of the Lowell Electric Railway were in Hudson recently with G. O. Sanders, taking measurements along the streets. They will construct an electric line.

KNOXVILLE, TENN.—It is reported that the directors of the Knoxville & Fountain Head suburban road have decided to change it to a trolley road. George Bargfeldt and Curtis Cull are directors.

TRENTON, N. J.—Articles of incorporation of the Mt. Holly and Burlington Electric Railway have been filed in the Secretary of State's office at Trenton. General W. J. Sewell is one of the incorporators.

NEW HAVEN, CONN.—The New Haven & Hartford Railway Company will build an electric line from Stratford to Woodmont. President Clark, of Bridgeport, Conn., can probably give further information.

NATCHEZ, MISS.—R. F. Leonard, W. A. S. Wheeler and J. A. Clinton are among the incorporators of the Natchez Electric Railway Company, which proposes to build a line in the city. The capital is $100,000.

WOODBURY, N. J.—A new company has been organized in Gloucester County, and is known as the Rapid Transit Traction Company. It wants to run an underground conduit road out Delaware street to Paulsboro.

CAMDEN, N. J.—Supt. A. O. Dayton, of the West Jersey and Camden & Atlantic railways, has confirmed the report that electricity would replace steam as a motor power over the whole Camden & Atlantic road.

HARTWELL, O.—Sealed proposals will be received at the clerk's office until 12 M. on the 21st day of January, 1895, for the construction and operation for a term of 25 years of Street Railroad Route No. 1. T. H. Marpe is Clerk.

WATERVILLE, ME.—Hon. I. C. Libby, of Waterville, says that the proposed new electric railway from Waterville to Weeks' Mills, China, and thence to Augusta, is a Maine project. Hon. A. F. Gerald, of Fairfield, is the chief promoter.

LANCASTER, PA.—The Railroad Committee of Councils was to have held a meeting on December 19 for the purpose of taking action on the new electric railway ordinance introduced by Common Councilman W. D. Weaver. No business was transacted.

JOPLIN, MO.—D. R. Powell, of St. Louis, has bought at trustee's sale the Joplin Electric Railway, for $35,000, for the Carthage, Webb City, Joplin & Galena Railway. The road purchased was bonded for $150,000 held by the Union Trust Company, which was represented by Judge Geo. A. Madill. It is believed that the new company will at once extend to Galena, Kas., and connect with the road soon to be built from Carthage to Carterville and Webb City.

CAMDEN, N. J.—The question of substituting electricity for steam on the Camden and Atlantic Railroad, between this city and Atlantic City, is being considered by the Pennsylvania Railroad Company. A meeting was held in Philadelphia last week by the officials of the company, when the question of electricity as a motive power was earnestly discussed. They have decided to invite plans from electrical manufacturers for an improved motive power.

PHILADELPHIA, PA.—An ordinance has been passed granting permission to the Chestnut Hill and Spring House Passenger Railway Company to lay tracks and to use electric motors to be supplied from overhead wires, and to erect and maintain poles. An ordinance was also passed permitting the Philadelphia, Bala & Narborth Railway Company to lay its tracks and to use electric motors to be supplied from overhead wires and to erect and maintain poles.

ST. LOUIS, MO.—The Florissant Avenue Electric Railway Company has been incorporated by Ed. R. Deurborn, 315 North Seventh street; Joseph H. Schroeder, 808 North Fourteenth street; Theodore P. Bell, 925 Chestnut street. The purpose of the corporation is to build and operate street railways in the city and county of St. Louis, by cable, electric or horse power, to acquire the franchises necessary to do so, and to build and equip the roads, or acquire them by purchase.

KANSAS CITY, MO.—The Westport & Waldo Railway Company was granted a franchise by the County Court, to build an electric line from Thirty-ninth and Cherry streets to Brooklyn and Springfield avenues. The company is also contemplating buying the People's Cable Railway system. If this is done, the Tenth street line will be extended from its present terminus on Twenty-seventh street and Brooklyn avenue to Springfield avenue, by way of Brooklyn, and there connected with the new line.

NEWINGTON, CONN.—A hearing was held in the Town Hall in Newington, before the Selectmen of that place, in regard to the extension of the electric road through the town. Superintendent Breed, F. G. Platt, C. S. Landers and a number of other representatives of the Central Railway and Electric Company were present. The opponents of the road have called a town meeting. They expect to pass a vote denying the road the privilege of passing through the town unless it goes through the south end.

BELLEVILLE, N. J.—The Belleville township committee has heard the application for a public hearing of the Union Electric Traction Company, which has laid out a route from Hackensack, through Hasbrouck Heights, Carlstadt Rutherford, and Belleville to Newark, etc. The company desired a franchise through Main street, Belleville, to three separate terminals up on the Newark line. Its application was refused until it could produce some consents from property owners along the proposed route.

SKOWHEGAN, ME.—It is announced that there is prospect of an electric railway being built from Skowhegan to Madison and Athens. A company consisting of J. P. Oak, T. H. Anderson, S. W. Gould, R. B. Shepherd, and others, has been organized and a meeting is called by the selectmen to see if the inhabitants will vote to grant the company the right of way through certain streets. The name of the company is known as the Skowhegan, Madison & Athens Street Railway and Power Company.

DAYTON, O.—The various electric traction companies have consolidated and the Cincinnati, Hamilton, Middletown and Dayton Street Railway Company incorporated. The new corporation is capitalized at $500,000, which sum may be increased. The incorporators: General Andrew Hickenlooper, president Cincinnati Gas Company; J. C. Weir, vice-president Adams Express; Henry B. Moorehead; O. C. Barber, president of the Barber Match Company, and O. B. Brown, of the Dayton Traction Company. The road will be run through a well-populated district and will be operated by June 1, 1895.

ILION, N. Y.—Negotiations were commenced two years ago to consolidate the street car lines between Herkimer and Frankfort, and operate them by electricity, and recently President Clinton Beckwith has secured an option for the Ilion and Frankfort road and has substantially agreed on terms for the purchase of the Ilion and Mohawk line. His plan is to change the road at Herkimer, entering the village at Prospect street. If the Mohawk and Ilion road can be bought, it is proposed to extend this road along the foot of the hill to Ilion.

WASHINGTON, D. C.—The Washington & Georgetown and Columbia Railways have asked permission to extend their lines. The route sought by those two roads is practically the same, the only difference being that the Washington & Georgetown Railroad desires to build a new north and south line on Twenty-second street. The Columbia road desires to extend its line from its western terminus over the tracks of the Washington & Georgetown Railroad to Seventeenth street, and thence along F and G streets to the river. This is also desired by the Washington & Georgetown road, with the addition of the new north and south line.

BALTIMORE, MD.—Several ordinances were introduced in the Council, conferring additional privileges upon street railways. Mr. Smith, in the Second Branch, introduced an ordinance authorizing the Edmondson Avenue, Catonsville and Elliott City Railway Company to lay double standard gauge tracks from the western city limits on Edmondson avenue, on that avenue to the Calverton road, etc. The ordinance also provides for a reciprocal transfer system with other companies. Referred to Committee City Passenger Railways. Also, ordinances authorizing the Baltimore Traction Company to lay a double track from Huntingdon avenue and St. Paul street to Waverly avenue, etc. Referred to same committee.

APPLETON, WIS.—The Wisconsin Interurban Railroad Company, which is to build an electric railway from Oshkosh to Kaukauna via Appleton, has filed at Appleton with the register of deeds a list of its officers as follows: A. L. Smith, president of the Appleton Edison Electric Company; H. D. Smith, capitalist, and T. B. Reed, of the Appleton Post; Charles H. Aldrich, ex-Attorney General of the United States; Thomas A. Scott, capitalist of St. Louis, Mo.; Judson T. Sherman, of Lake Geneva, Wis.; F. C. Ratan, of Chicago, and J. M. Thompson, also of Chicago. The capital stock is $1,000,000. It is believed that the matter is now on a business basis. No further trouble about franchises will be experienced at Neenah, Menadha and Kaukauna.

BATAVIA, N. Y.—On December 14 the first car was operated by electricity on the Beecher single railway system at this place, and the experiments with this car proved satisfactory beyond anticipation to those interested. The single rail bicycle system, covered by the patents of Capt. Lina Beecher, Batavia, N. Y., has been advertised to some extent, but this is the first experiment of electrically propelled cars upon his track. The equipment was designed and installed by Mr. M. H. Johnson, and consists of fifty 200-ah cells of chloride accumulator and five- Westinghouse series motor, together with rheostat battery, controller and instruments. The car, with a load of eighteen passengers, on a piece of track 600 feet long, is reported to have developed a speed of eighteen miles an hour with an expenditure of about 4-hp.

MILLBURN, N. J.—The Millburn Township Committee, by a unanimous vote, has declared itself in favor of granting a franchise to an electric trolley line between the village and Newark. On Thursday night representatives of two companies seeking the franchise appeared before the Town Committee in Bonnell's Hall. Judge Wilbur A. Mott, of Newark, addressed the meeting, and stated that he represented the North Jersey Traction Company, which wishes to enter the city. Mr. Frederick T. Johnson appeared in behalf of the New York & Philadelphia Traction Company. This company has already secured consent for two-thirds of the route. The committee decided to give no preference to either company, but promised to grant the franchise to that company making the most concessions and granting the most privileges. The subject will be discussed at greater length at a further meeting.

NYACK, N. Y.—For years Nyack has been waiting for an electric railway, but now no less than three different companies are fighting for a franchise. The Nyack Traction Company, with a capital stock of $50,000, has been incorporated, its prime movers being Congressman-elect B. B. Odell, Jr., who is president of the Newburg trolley line; Ferdinand B. Bain, the builder of the Poughkeepsie lines, Rockland's County Judge, and others. They propose to build a trolley road from steamboat dock at Nyack to the West Shore depot at West Nyack, also a line from the Northern Railway depot in Nyack to the Hook mountain. Business men have formed a combination, and on Monday the River and Valley Traction Company was incorporated in Albany. Among the directors are Harrison & Dalley, Lydecker Bros., C. Quidor, Ernest Bros. and John D. Blauvelt. This company proposes to build its line over the same route as the Odell Comany. The other company is not yet incorporated, but it is said to be composed of out of town capitalists. They wish to build a trolley from Piermont along the river front and through Broadway in Nyack.

Trade and Industrial Notes.

W. R BRIXEY sends us a unique reminder that the new year is upon us in the shape of a neat little case inclosing a fragrant cigar and a "small bottle" containing, we presume, the "best wishes" of the manufacturer of Kerite wire.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., is building a new highway bridge for the Boston & Maine Railroad, at Somerville, Mass. The Long Island Railroad Company has also placed a contract for its new pier shed with the same company.

THE ST. LOUIS IRON AND MACHINE WORKS, Main Street and Chouteau Avenue, St. Louis, are building four 30 by 54-inch 700-hp. heavy duty engines of the St. Louis Corliss type for the St. Louis Street Railway Company, and also a cross compound 26 by 50x48-inch 800-hp. engine for Kansas City, Mo.

THE WATERTOWN STEAM ENGINE COMPANY, Watertown, N. Y., reports the sale of no less than 30 engines and boilers during the month of November. That the merits of their engines and boilers are widely recognized is attested by the wide range of territory covered by these sales, two of them being credited to Mexico.

M. H. DEVEY, 160 North Fourth street, Philadelphia, is meeting with great success with his insulating compound cements, having a much larger demand than he is able to meet at present, and he hopes to get soon a much larger manufactory. The Government has the material now under consideration for adoption

THE FOSTER ENGINEERING COMPANY, Newark, N. J., in a pamphlet of 40 pages, gives many facts worth knowing about pressure regulators and pump governors. The various types of this kind of apparatus manufactured by this company are well illustrated and described, and accompanied with complete directions for their installation and use.

W. H. FLEMING, 393 Pearl street, New York, suffered from a fire on Christmas eve, which broke out in the factory where he manufactures his patent woven wire dynamo brushes. The damage amounted to about $1,700, only partially insured. We understand that the work will be carried on without interruption during rebuilding, other premises having been secured.

THE FUEL ECONOMIZER COMPANY, of Matteawan, N.Y., in a large-paged, well printed and illustrated pamphlet, presents the merits of that world-wide known apparatus, the Green Fuel Economizer. Applied to 15,0000 boilers, and with a list of medals which forms almost a complete catalogue of the world's exhibitions from 1851 to date, the claims made by the manufacturers are amply sustained.

THE TAYLOR-RICE ENGINEERING COMPANY, of Wilmington, Del., manufactures a large variety of appliances for measuring with the extreme nicety demanded by modern mechanics, and is also prepared to meet any requirement in the line of measuring devices of guaranteed accuracy for special uses. It issues a handsomely illustrated and very complete catalogue of its goods, which it will be pleased to mail interested parties.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is offering something new in the line of an alternating current switchboard instrument made by the Whitney Company. The instrument is of a special form, with a large scale particularly adapted for switchboard work. The frame and case is entirely of metal, and all connections are made at the back of the board. The instrument does not require recalibration and is not affected by external magnetism, and promises to be a winner.

THE WHEELER CONDENSER & ENGINEERING CO., 39 Cortlandt street, New York, has perfected a new feed water heater of the double tube system, which has so successfully been applied to its surface condensers. The Wheeler feed water heater can be used either with condensing or non-condensing engines or may be used to take the exhaust steam from the pumps or auxiliary engines as desired.

THE LANCASTER RAILWAY CONSRTUCTION COMPANY, Lancaster, Pa., has secured the contracts for building the extensions of the Reading Traction

Company's system at Reading, Pa. The first line will be some fifteen miles in length, and work will be commenced at once. Everything will be up to the highest standard, and the Medbury line material will be used on the overhead line work. All material will be furnished by the Hubley Manufacturing Company, of Lancaster.

THE TRIUMPH ELECTRIC COMPANY, CINCINNATI, O., announces that it will, on the first of the year, open a New York office at No. 203 Broadway with Mr. J. A. Machado as manager. Mr. Machado is so well known in electrical circles that no assurance is necessary that any business intrusted to him will receive prompt and careful attention. This move will bring the enterprising Western firm into closer and more cordial relation with its Eastern trade, which has begun to assume considerable proportions.

THE GOULDS MANUFACTURING COMPANY, Seneca Falls, New York, has issued a fourth edition of its special catalogue devoted to triplex and other types of improved power pumping machinery. The catalogue contains 96 pages, and is handsomely bound in cardboard. Several new designs of triplex and other pumps are here illustrated and described for the first time. A feature of the catalogue is the illustrations of the different applications in various kinds of work that have been made of Gould pumps; views being given of installations showing the situation and connections of pumps.

W. C. STERLING & SON have received and are preparing for shipment an order for telegraph poles to go to Buenos Ayres, South America. The order was placed through W. S. Peaks & Co., of New York City, and will go to New York by car, then to London, Eng., by steamer, where they are transferred to a South American steamer, which will deliver them at Buenos Ayres. This is a trial order, and if poles go through safely and are satisfactory the Monroe Company is promised some large orders. The poles are inspected at Monroe and paid for, less the freight on arrival at New York

THE PHILADELPHIA ENGINEERING WORKS, Limited, of Philadelphia, announce that they have completed contracts with the Laidlaw-Dunn Gordon Steam Pump Company, of Cincinnati, O., to furnish them with three 32x60 inch Philadelphia Corliss engines of the rolling mill type, to be used for gas compressors, which they furnished to the Carnegie Natural Gas Company. Also a pair of 24x60 inch Philadelphia Corliss engines to be used for gas compressors, which they furnished the Pittsburg Natural Gas Company. Also a pair of 26x60 inch Philadelphia Corliss engines to be used for gas compressors, which they furnished the Ohio Valley Gas Company.

MR. C. E. SARGENT, of Chicago, so long identified with engine interests and so well known in these circles in the West, will, on January 1, become the representative in Chicago of the Ball & Wood Company, prominent engine builders of New York. Mr. Sargent's headquarters for the present, at least, will be in the Home Insurance building, and we have no doubt that he will make for the Ball & Wood engine in the West the same reputation and popularity it enjoys in the East. We congratulate both of the interested parties upon the new arrangement, and are sure that Mr. Sargent will be glad to welcome not only his many old friends, but new ones in his new headquarters.

THE MIAMISBURG ELECTRIC COMPANY, Miamisburg, Ohio, announces that it closes this year's business with very flattering results, having had a large trade in its batteries and increased output in the copper department. It states that reports from all over the country in reference to the Imperial dry battery have substantiated the claim which the company made some three years ago, that at last a successful dry battery had been found, and the fact that all batteries are made under the personal supervision of Wm. Burnley is a guarantee to the trade that they can rely upon the batteries to maintain the high standing they have made on the market. The Burnley cartridge battery manufactured by this company is claimed to be growing more popular every day, being largely adopted for telephone use. The company are putting on the market now what they call the No. 3 cartridge battery, to be used in a jar 6 by 8 inches. The fact that this battery has proved to be very economical for gas engine use shows that it is a very powerful battery. The company have some entirely new specialties which they will put upon the market in a short time.

THE STROWGER AUTOMATIC TELEPHONE EXCHANGE, "The Rookery, Chicago," has, we are informed, expended nearly $175,000 in perfecting its automatic switchboard, and offers assurance that it has been brought down to a corresponding state of perfection. Its system at La Porte, Ind., which has been reconstructed for metallic circuits, and with the automatic release, is claimed to be, by comparison, far superior to the manual mode of operation. Those interested would do well to write to any of the subscribers at that point, asking them for an unbiased opinion of the system, and that the information may be reliable, the Strowger Company suggests that such men be written to as the mayor of the town, Mr. E. H. Scott, Ex-Mayor, the postmaster, the manager of the electric light plant, or the manager of the Postal Telegraph Company. These gentlemen, as well as other subscribers in other towns, will doubtless be glad to communicate the information desired, and it speaks well for the Strowger system that the company can thus freely refer the inquirers with confidence to those whose opinions will not be colored by any commercial interest.

THE E. S. GREELEY & CO., 5 and 7 Dey street, New York, on December 23 were the victims of an extensive fire which occurred in their office and works at the above address. The fire originated in the hallways of the second floor, beween the flooring of that story and the ceiling below, and is supposed to have been occasioned by the drifting of the spark from a discarded cigarette or cigar through crevices in the floor, communicating fire to the dust and light particles of every description which, during a long period of years, had sifted through and found lodgment in the ceiling space, where it smouldered until bursting into the flames that were discovered shortly after midnight. From this point the flames worked downward into the large and variegated stock of the establishment, located on the store floor, and shot upward through the intervening stories to the Greeley factories on the sixth floor of the double building, burning a flue of some 40 feet in diameter from bottom to top of the buildings. The deluge of water necessary to put out the fire inundated the stock from one end to the other, and rained through the store floor and basement, packed with electrical supplies of all kinds, and accumulated in the sub-cellar to a depth of two or three feet, submerging the entire stock deposited in this part of the building and flooding the electrical test rooms and zinc casting departments located in adjoining premises. The damage to the property of the corporation is confined entirely to the stock, fixtures and building, all the books and papers being miraculously left unharmed and intact, in no wise impairing the working effectiveness or records of the business, which went on a few hours after the fire had occurred as freely and uninterruptedly as if the disaster had never occurred, the corporation drawing upon its large reserve stock from adjacent warehouses to fill orders without delay. No removal from the burnt premises is contemplated. The loss in stock, fixtures and machinery will probably not exceed $25,000 to $30,000, and that on the building about $5,000, all of which is amply covered by insurance to four times the amount involved.

MISCELLANEOUS NOTES

THE HEALTH DEPARTMENT of the city of St. Louis celebrated the inauguration of its electric ambulance car service on December 27, at 8 p. m., by entertaining a number of invited guests at the Union Station Cafe.

MR. JOHN B. O'HARA, editor of the *Western Electrician*, was married at Rochester, N. Y., on December 27th, to Miss Margaret Anna Hickey. We offer our accomplished confrere and his charming bride our heartiest wishes for their matrimonial welfare, and feel sure that in this we also voice the sentiment of the electrical fraternity which Mr. O'Hara has so faithfully served in the editorial chair.

THE NORTHERN SOCIETY OF ELECTRICAL ENGINEERS OF ENGLAND elected at its annual general meeting, held December 10, 1894, the following officers: President, Mr. Henry Edmunds; past president, Dr. John Hopkinson, F. R. S.; vice-presidents, Mr. G. E. Preece and Mr. W. P. James Fawcus; honorary solicitor, Mr. John B. Parkinson; honorary treasurer, Mr. George J. Somerville; honorary secretary, Mr. John Darney.

Business Notices.

WOVEN WIRE BRUSHES.—The Belknap Motor Company, of Portland, Me., are the patentees and manufacturers of the best woven wire commutator brush on the market.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DECEMBER 25, 1894.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

531,006. **COMMUTATOR**: Henry L. Bidgman, Blue Island, Ill. App. filed July 3d, 1894. A commutator comprising an insulating frame having flanges affording pockets and an electro-deposited filling of metal in said pockets affording the conducting portions of the comutator.

531,301. **MAGNETIC-ORE SEPARATOR**: Charles G. Buchanan, New York, N. Y. App. filed May 12th, 1894. The combination of two horizontal moving belts, occupying parallel horizontal planes, and whose direction of motion is oblique to each other, and means for varying the angle included between the respective axes of movement of the two belts.

531,310. **ELECTRIC CUT-OUT**: Harry Hansen, Everett, Mass. Application filed January 23, 1894. An electric cut-out and box combined, consisting of a sunken box of insulating material having a face plate and detachable cover, said box having longitudinal and lateral insulated ribs, conductors connected by fuses to the line wires, and lamp wires connected to said conductors by means of binder posts and fuses.

531,331. **TROLLEY**: Charles E. Powell, Philadelphia, Pa. Application filed October 31, 1894. A trolley rod for use on overhead electric railway systems, having a bracket at its upper end, in which is mounted a roller, the said bracket being provided with a fender consisting of two integrally formed outwardly projecting arms, one on each side of the roller, said arms having inclined upper faces and pins projecting from their outer ends.

831,354. **ELECTRIC CONDUCTOR SUPPORT**: Johan M. Anderson, Boston, Mass. Application filed July 9, 1894. A support for electric conductors, comprising grooved end portions and an intermediate portion weaker than the said end porion, a bridge or anti-buckling device intermediate of the said portion, and re-enforcing the weaker intermediate portion of the support.

531,365. **CONTROLLING ELECTRO-MAGNETIC MACHINES**: William I. Donshea, New York, N. Y. Application filed January 29, 1894. A method of controlling the electro-magnetic machines, which consists in exciting the field coil of such machine by connecting it to a source of current exterior to the machine itself, when throwing the machine into use, and before closing the armature circuit and converting it into a self-exciting machine before or while throwing it out of use, whereby field discharge is accomplished gradually.

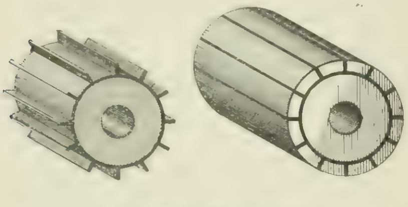
531,366. **MEANS FOR CONTROLLING ELECTRIC LOCOMOTIVES**: Ernst Egger and Ferdinand A. Wessel, New York, N. Y. Application filed May 17, 1893. The combination with a constant speed electric motor, and with the wheels of an electric car, of conical pulleys, on the motor axle and car axle, respectively, and connected by a driving belt, a belt shifter for adjusting the belt along the length of the pulleys and means carried by the belt shifter for automatically tightening the taut and loose portions of the belt as the load increases.

531,380. TROLLEY-CATCHER: Peter D. Milloy Buffalo, N. Y. Application filed April 2, 1894. A trolley catcher, consisting of a cylindrical barrel, having a weight and compression spring acting jointly to draw down the rope when the bolts are released.

531,383. TROLLEY: George T. Newhouse, New Albany, Ind. App. filed July 28, 1894. A trolley comprising a pole, a fork, and connections between the fork and pole included within the limits thereof, and tending to maintain the fork and pole in their normal relations while permitting an oscillating movement of the fork.

531,414. HINGE FOR ELECTRIC APPARATUS: Authur B. Davis, Elkridge, Md. App. filed May 12, 1894. A box to contain electrical instruments, and provided with a lid or cover; hinges having two leaves secured respectively to the box and cover; a pintle of non oxidizable, malleable material expanded within the bore of joints of the hinge to fill the interstices thereof, and circuit wires in electrical connection with said leaves.

531,421. ELECTRIC LIGHTING SYSTEM FOR RAILWAY CARS: Morris Moskowitz, Newark, N. J. App. filed August 10, 1894. A system for electrically lighting railway cars, in combination with the car wheel axle frame sections, having bearing portions, and bolts for securing said sections to the car wheel axle, a tube on the car wheel axle between the bearing portion of said frame sections, field magnets on the outside of said frame-sections, springs connecting said frame-sections with the truck-frame, and room for more armatures arranged and wound on said tube and connected in series or tension.

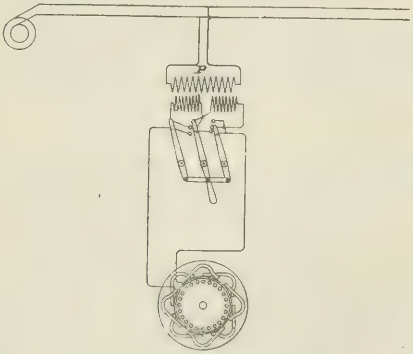


No. 531,406.—Commutator.

531,422. ELECTRIC ARC LAMP: E. J. Murphy, New York, N. Y. App. filed February 16th, 1894. The combination with a vertically movable upper carbon carrying rod, and a shaft for moving said rod, of a brake wheel connected with said shaft, a brake strap applied to said wheel, two levers connected to opposite ends of the strap, and a magnet for operating one of said levers.

531,423. INSULATOR: Louis McCarthy Boston Mass. App. filed November 19th, 1894. An insulator comprising a case having holes or perforations there through, one or more connections within said case, insuating material adjacent said connection or connections and a mass of insulating composition applied exteriorly to the said case interiorly thereof, around the connection or connections and extending through the said holes or perforations.

531,424. ELECTRIC PLUG SWITCH: Augustus H. Palmer, Utica, N. Y. App filed Oct. 17th, 1894. The combination in a plug switch or "Jack," of a body or face-plate having a plug opening and a line-wire connection, a spring attached to the cab of the plate, and having a shoulder on its movable end, closing the plug opening against the plug, and also having a projection through the face of the plate, by means of which the spring may be operated, and a conductor with which the spring will engage when the plug is removed.



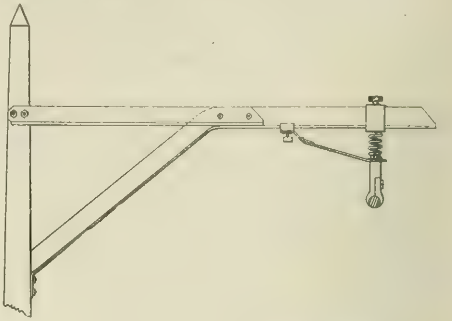
No. 531,432.—Starting Alternating Current Motors.

531,432. STARTING ALTERNATING-CURRENT MOTORS; Louis Bell, Boston, Mass. App filed March 12th, 1894. A method of operating an alternating current motor, supplied from a transformer, having a divided secondary coil, which consists in arranging the divided secondary coil in series to start the motor, and changing the relation to multiple, when the motor attains speed.

531,437. TROLLEY-WIRE BRACKET: Winfield S. Kline, Bolivar, O., and John B. Westhafer, New Philadelphia, O. App. filed October 17th, 1894. The combination of an arm and clips provided with set screws and a spring connection to the trolley-wire.

531,441. ELECTRIC RAILWAY: Charles H. Macloskie, Schenectady, and Henry M. Brinerho, Matteawan, N. Y. App. filed, May 17th, 1894. The combination with a railway track and a vehicle thereon, of a conducting rail outside of the track, branch track and a branch conductor outside of the branch track, the main and branch conductors being separated by a mechanical break, and a supplementary section of conductor located near the switch on the side of the track opposite to that upon which the main conductor is located the arrangement and location of the parts being such that contact device makes contact with the conductors to preserve the continuity of the circuit.

531,445. ELECTRICAL CONNECTION FOR RAILWAY RAILS: Arthur J. Moxham, Johnstown, Pa. App. filed, June 2nd, 1894. A cross electric connection for railway rails, said connection consisting of a metal bar, having a flexible portion or portions, and having integrally secured to its ends portions of metal adapted to be welded to the track rails.

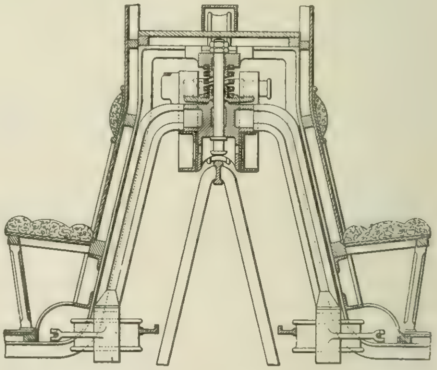


No. 531,437.—Trolley Wire Bracket.

531,450. CONDUIT ELECTRIC RAILWAY: Wiliam H. Swift, Boston, Mas. App. filed April 27th, 1894. An underground railway, sub masonry enclosing a conduit, beams extending across said conduit and having centrally located sockets, chairs fitting inside sockets, a conductor rail supported by said chairs and castings forming an entrance for the trolley.

531,455. FUSE-BOX: Claude L. Ashley, Atlanta, Ga. Application filed April 30, 1894. An automatic magazine fuse box controlled by gravity, said fuse-box consisting of a box containing several compartments, each of which contains a binding post and a fuse wire, a contact plate, a spring contact point, guides and means for moving the box along the guides and means for stopping the same at the correct position.

531,617. AUTOMATIC RHEOSTAT. Rudolphus W. Hollis Atlanta, Ga. Application filed April 30th, 1894. A rheostat comprising segments and a spring brush pivoted by the middle concentrically thereof, an electro-magnet in cicurit with the motor-field coils, an armature thereto, and means for connecting said armature with the rheostat lever operatively, a shunt-circuit, including a switch, adapted to close said shunt-circuit after the energizing of the magnet, and a switch adapted to open said circuit on the rheostat, being to full on.



No. 531,499.—Electric Locomotive for Elevated Railways.

531,614. ELECTRIC CABLE: Theodore Guilleaune, Cologne, Germany. App. filed April 26th, 1894. A strand or bundle consisting of one or more pairs of flat wires or ribbons, each insulated from the other or others and each pair serving to convey flow and return currents in a closed circuit, the several wires or ribbons being laid flatwise against one another, and the whole group being then twisted together.

531,499. ELECTRIC LOCOMOTIVE FOR ELEVATED RAILWAYS: Fritz Bernhard Behr, London, England. Application filed Feb. 27th, 1894. An electric locomotive for a single rail elevated railway, having a pair of bogies, each consisting of a bogie frame carrying a pair of vertical running wheels and a pair of horizontal guide wheels, and passenger compartments supported on said frames, each of said vertical wheels being mounted between a pair of electro-magnets, and provided with coils and a commutator on each of its faces to operate as an electric motor.

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ELECTRICAL EFFECTS IN THEATRES.

The services which electricity has rendered to the stage are well illustrated by the article which we print elsewhere, descriptive of the electrical effects used in presenting living pictures. Of all the stage effects ever attempted none has even approached the success that has attended the production of living pictures, and which has resulted from a secure basis of real artistic merit, and not mere theatrical claptrap being involved. While the audience has little evidence of the fact that without electricity the effects necessary to render possible the successful production of the pictures would be impossible of realization, it is nevertheless true, for no other system of illumination would at all admit of the range and flexibility required. The description given in our columns of the various electrical details involved in the production of the pictures is the first that has appeared in print, and will be appreciated by electricians as another illustration of the multifarious uses to which the electric current may be put.

CURRENT AND POTENTIAL.

We print elsewhere an article by Prof. Stine, relating to the question recently raised in our columns between Prof. Waddell and Mr. Pierce, in regard to the generation of a current in a straight wire moving in a magnetic field of varying intensity. Prof. Stine brings out very clearly the principles upon which rests the generation of an E. M. F. on open circuit, and calls attention to an ambiguity in Lenz's law, which has doubtless often been a source of misunderstanding to the student and others. He shows that in considering the generation of current, stress should be laid upon a conductor being closed outside of the coercing magnetic field, or in one of a different strength, and that the fact of closing a circuit does not affect the force but the *amount* of energy transformed. It is also shown that any conductor moved in a magnetic field will absorb energy dependent upon its capacity, and it follows that if a straight conductor is moved in a field of varying intensity, there will be a flow of current in the wire, though negligable in extent—thus far sustaining the position of Prof. Waddell.

SIMULTANEOUS TELEPHONY AND TELEGRAPHY.

The installment in the present issue of our series of popular technical articles, besides giving an intelligent account of long distance telephony, contains a description of the methods of simultaneous telephony and telegraphy. While this subject has been treated at length in several foreign publications, its details have become little known in this country, notwithstanding their interesting character. It will be seen that the principles upon which the system rests are very simple, and consist of the addition of inductance coils and condensers to the telephone circuit. The former allow free passage to the telegraphic instrument of the telegraphic signals, and prevent the rapidly alternating telephonic currents from being shunted away from the telephone, which latter function with respect to the telegraphic current is performed by condensers. Another interesting feature is the use of inductance coils to round off the telegraphic signals so that they will be inaudible in the telephone. This latter object is so thoroughly accomplished that long distance telephone lines can be, and are, used for telegraphic purposes without the telephone subscriber having any indication whatever of the fact.

STATIC ELECTRICITY AND PRINTING.

In another column we print a communication asking a remedy for eliminating the frequent source of trouble and expense encountered in printing from the presence of static electricity on the sheets. In dry weather this is not only a constant source of serious annoyance in printing, but sometimes renders it difficult to produce satisfactory work. The sheets when printed on one side adhere, thus smearing them when being manipulated for the second impression, and also making it difficult to feed, "to register," while in delivery the sheets are not straightened automatically, thus requiring an attendant at the fly-board. Numerous methods have been proposed to obviate the difficulties referred to, but none, as far as we can learn, has proved practicable. As a practical remedy would be welcomed by the printing trade, and should prove a source of considerable profit, the matter is one well worthy of the attention of electricians. Heretofore inventors seem to have worked on very vague ideas as to the origin of the static charge, and this is the point which should first receive attention. If, as seems probable, the charge is largely generated by the friction which results in separating the sheets in feeding, the question is by no means one easy of solution.

SYMBOLS AND ABBREVIATIONS.

We print elsewhere a reply by our esteemed London contemporary, the *Electrical Review*, to our recent remarks concerning Prof. Jamieson's criticism of the symbols and abbreviations recommended by the Committee on Notation of the Chicago Electrical Congress for international adoption. As will be seen, it consists principally of a narrative of the misfortunes encountered by Prof. Jamieson in his endeavors to bring his own system of symbols before the Congress, and we regret that so much perseverance met with so little success. We will remark, however, that had Prof. Jamieson joined Prof. Macfarlane and others in criticizing the system of Prof. Hospitalier when it was placed before the world in the provisional programme of the American Institute of Electrical Engineers for that purpose, the gentlemen who afterwards became members of the Committee on Notation would have had an opportunity for the preliminary consideration which it was the object of the programme to give. We must reiterate our statement that the system, as far as its main outlines were concerned, had been before the world for some years, and, moreover, from the beginning was put forward for international adoption, which object was advocated at the Frankfort Congress, and led to the table embracing the symbols being printed in the provisional programme. We, perhaps, allowed our remembrance of the system of notation, which Prof. Jamieson desired to bring before the Congress, to influence us when we wrote that his criticisms repudiated the essential points of the International Congress system. In the former, for example, block letters were made to do duty, not only as symbols for physical quantities, but also to express linear dimensions; **B**, for instance, representing gausses, and **Lm**, length of magnetic circuit. In the later suggestions the same lack of method becomes apparent in the proposition to replace **H** with *H*, when considering the earth's field. As has been remarked by Prof. Hospitalier, what is wanted are logic and order in the formation of a terminology or notation, and there is a conspicuous lack of these essentials in the propositions of Prof. Jamieson. When we wrote that French script characters were found in every printing office, we were not aware that in England the French name of *caracteres rondes* was followed; with this change in name, it seems that the investigation of our contemporary confirmed our statement. We are glad that our contemporary recognizes that the Congress system is conceived upon intelligible, common sense principles, and betokens on the part of its author much care, and a painstaking appreciation of the subject. As to the "one man" qualification, it should be borne in mind that the man referred to was unusually fitted for the work, not only through his practical, theoretical and intellectual qualities, but also from the fact that he devoted several years of study with the distinct object in view of formulating a system of notation that would be not only scientific in its method, but of a character most adapted for international usage.

THE NATIONAL SCHOOL OF ELECTRICITY.

In another column we print a number of statements from gentlemen connected with the National School of Electricity, concerning its policy and work, and also a list of the instructors. We will here state that no assurance was necessary in regard to the good faith and disinterestedness of the members of the active faculty, nor is any needed as to the other gentlemen who, upon the inception of the enterprise, lent to it the use of their names. An educational scheme such as that proposed may, we believe, be made to accomplish an excellent purpose, and we can thoroughly sympathize with the aims of those who consented to support it, either by lending the weight of their reputations, or, in addition, by bearing part of the burden of its educational duties. The preparation of the lessons, it can readily be seen, has been no small matter as far as labor is concerned, and as their nature is such as to entail much drudgery, which, with one exception, we believe, has received no monetary remuneration, there can be no doubt as to the loyalty of at least the active members of the faculty to the ideal which had enlisted their support. The criticism to which the school has been subjected has had its source, not in the faculty, nor the instructors; but in the management. The lack of sympathy, so apparent among electricians, is, we believe, most largely due to the fact that the electrical profession, justly or unjustly, considered that the men who are now the managers of the School were officially responsible for the admittance of the electrical belt, hair brush, and similar exhibits to the Electricity Building of the World's Fair. Every electrician who visited the Fair felt humiliated at the sight of these exhibits in the temple of electricity and irritated at the thought of the probable effect on foreign visitors. It is but fair to say here that it is claimed that the responsibility for this most unfortunate and mischievous recognition of these articles at such a time and in such a place was "higher up" in the councils of the World's Columbian Exposition. Evidently, however, the electrical profession feels inclined to place the blame upon those it can reach, and it is not, therefore, to be wondered at that the antipathy felt toward those thought to be responsible should incline electricians to view with anything but favor an enterprise with which they afterwards became connected, and when one has an inclination to criticise, it is never difficult to find flaws. What we have said has not been in a spirit of criticism, but in explanation of the comparatively limited success of what, under favorable auspices, we feel sure would have found almost a boundless field of usefulness. In conclusion, as we now have the assurance that all the lessons are actually prepared by members of the faculty, whose competency is unquestioned, and that as the faculty also appear to choose the instructors, many of whom, as will be seen from the list we print, are well known in electrical circles, we can repeat what we said before, but without the accompanying qualification, that the school offers real advantages to those who desire to obtain general ideas on electrical science, or who wish to supplement their practical experience with a knowledge of the simpler points of electrical theory.

Technical Education.

So far as engineering of all kinds is concerned, says the London *Electrician*, there can be but little doubt that the decay of the old system of pupilage, and the rise of the new system of technical tuition has been brought about by the ever-increasing specialization of the engineering workshop, and the increasing impossibility for mere rule of thumb knowledge, engineering instinct, call it what you will, to hold its own unaided against minds with a sound scientific equipment and brains trained to reason accurately.

Electric Waves.

BY ALFRED G. DOLL.

I have three Bunsen cells of medium size, bichromate of potash being used as a depolarizer, and a Ruhmkorff induction coil giving a one-inch spark. The current from the coil passes into the corner of each of two 12 by 14-in. brass plates, swung by silk threads; the plates are nine inches apart, and have stiff brass wires (No. 16) extending from the middle of one side of each to a spark gap of pointed gold wires, with rounded, not sharp, points. If the brass wires are pointed they will answer as well, only they are more difficult to keep clean. Back of the two plates there is a plate of sheet zinc extending nearly the whole length of the brass plates and about 1½ inches distant. A piece of sheet zinc, 2 by 3 feet, fastened in a wooden frame, is placed opposite to each of the brass plates, and as near to them as possible without touching; these are brought up until the spark gap just appears between two of the sides, care being taken that they are not close enough for sparks to pass into them from the coil.

As resonators I have two circles two feet in diameter, made of Nos. 16 and 18 copper wire, one having the wire extending from each side of the spark gap without a break, and the other broken directly opposite the spark gap, the wire being in two pieces, each about three feet long; both of these are fastened to wooden crosses. The spark gaps are made of small brass bolts, filled to points, not sharp but rounding, a small brass knob being fastened on each side to give them capacity, and the points being adjustable by means of the screw. With the above arrangement I obtain constant sparking in either circle at great distances, the magnetic and electric forces passing through the floor and walls. I can obtain bright sparking as far as I can go with a circle, provided that it is at all favorably situated relative to the large zinc plates. Such a circle will spark under the conditions given, so that it can be easily seen forty or fifty feet away, the force passing through the floor and plastered walls. I do not use a lens to see sparking, as it is bright enough to be seen five feet or more away at the greatest distance I can go. All Hertz's experiments with circles are thus easily obtained.

A Winter Carnival.

A grand Winter Carnival will be held in Ottawa, commencing January 21 and continuing until the 26th. The winter weather in Ottawa is practically the same as Montreal, where such successful winter carnivals have been held, and as Ottawa is the political capital of Canada, and beautifully situated, with a population of 50,000 progressive people, the city should be especially attractive to visitors. As Ottawa is also generally recognized as an electrical headquarters, and is said, in proportion to population, to have adopted electricity on a larger scale than any other city in America in its various domestic applications, the occasion will doubtless attract many electrical visitors. The management of the Carnival requests us to extend a hearty invitation to our readers to visit the city during carnival week, which we take pleasure in doing, and add our assurance that they will be well taken care of upon making themselves known to their electrical confreres in the vice-regal city.

Mr. T. Ahearn, managing director of Ottawa Electric Railway and a member of the American Institute of Electric Engineers, on behalf of the Carnival management, extends a hearty invitation to his fellow members and their friends to visit Ottawa during the week of the Carnival.

The National Electric Light Association.

The following partial list of papers to be read at the Cleveland meeting, February 19, 20 and 21, 1895, is announced:

"Some Economies in Electric Light and Power Stations," by Professor Edward Weston; "Arc Carbons and the National Electric Light Association Standard of Light," by L. B. Marks; "The Monocyclic System," by Dr. Louis Bell; "The Correct Method of Protecting Electric Circuits," by W. E. Harrington; "The Evolution of Arc Lighting Machines," by C. N. Black.

Mr. E. A. Leslie's paper, read at the Buffalo meeting, "The Operation of High Tension Currents Underground from a Physical and Financial Standpoint," will be taken up and discussed.

The Central Traffic Association has granted an application for excursion rates to the Cleveland meeting, to be, from all points in its territory to Cleveland, a fare and one-third for the round trip on the certificate plan. The other associations will undoubtedly concede the same rate, due notice of which will be given.

Patents and the Statute of Limitations.

The United States Supreme Court has decided that the statute of limitations holds against claims growing out of alleged infringement of patents, as well as against claims arising under other transactions.

In the case decided, one Campbell sued the City of Haverhill, Mass., for an infrinegment of the Phillips patents for the improvement of pumps, and on the trial it was held that the State statute of limitations was a good defense to the claim. In announcing the decision Justice Brown, who delivered the opinion of the Court, said that the question had been decided both ways by Circuit Courts in about twenty cases, and the weight of authority was about equally divided. In the absence of any Federal statute on the subject the opinion of the Court was that in the several States their respective statutes of limitations should apply.

Journalistic Instructions.

A German electrical journal gives a very brief description of the now well-known method of heating metals by immersing them in a liquid and passing the current through it, the voltage of which is about 100. The description is so meagre that it misleads, but besides this it makes the absolutely incorrect statement that this phenomena is quite similar to what takes place when a workman in a foundry puts his bare hand in the moulten metal without injury. Whether the latter is possible or not need not be discussed here, but that it should be given as an analogy seems to us to be very misleading.

The Northwestern Electrical Association.

The third annual meeting of the Northwestern Electrical Association will be held at the Hotel Pfister, in Milwaukee, January 16th and 17th, 1895. This young organization has had a phenomenal growth since its inception and is continually increasing in strength. At the last meeting in St. Paul there were over 100 members present, and the promise is for a large meeting this winter. An interesting and profitable programme has been prepared, which includes the discussion of practical subjects. Space will be reserved for the display of electrical goods if application is made in season.

The Telephone Patent Situation—Still Another Note.

One of our contemporaries, noted for its championship of the Bell patents when they do not interfere with the telephone system commercially exploited by one of its own staff, criticizes in a recent number one of the statements in the article on "The Telephone Patent Situation," which appeared in our issue of December 29, 1894.

The first claim of the Thomas A. Watson patent, granted January 9, 1883, numbered 270,522, apparently covering all forms of telephone hooks which, in combination with an induction coil, break the call-circuit and cut in the telephone and transmitter circuit in one position and do the reverse in the other position, seems to be at the bottom of the criticism. This claim our contemporary, in its issue of January 31, 1894, characterized as "especially productive of insomnia" to the inventor, and later adds that "when a transmitter is employed that uses an induction coil the claims of the Watson patent would seem to cover the simplest switching devices in which springs are used, whether automatic or not." In an excess of zeal our contemporary evidently neglected the fact that the American Bell Telephone Company itself had three years previously found another method of using an induction coil transmitter which was not covered by these Watson claims, and that it had been gradually introducing this new method and abandoning the old Watson system. This point we brought out in our issue of December 29, 1894, and suggested that the "sleepless nights" over this Watson claim might be abandoned. In defense of its previous position, however, our contemporary assumes that the patent granted to J. J. Carty on March 31, 1891, numbered 449,106, and controlled by the American Bell Telephone Company, covers all other combinations of an induction coil transmitter, with the switch and calling and talking circuits, which are not covered by these Watson claims. By so doing it gives its readers a wrong impression. What the Carty patent does claim in reference to a subscriber's outfit on an individual line is:

"A telephone station apparatus comprising a permanently continuous conductor uniting the main line terminals of said apparatus, an electromagnetic call instrument included in the circuit of said permanent conductor, two normally open or discontinuous branch circuits also extending between the said terminals and adapted when closed to form additional connections between them in parallel circuit with the said permanent conductor, a call generator included in one and a telephone included in the other of said normally open branch circuits, means, as indicated, for closing the generator branch circuit, and other means for independently closing the telephone branch circuit, substantially as described and for the purposes set forth."

But the object of this invention of Carty's was the improvement of party lines; thus in the language of the specification:

"The object of my present invention, broadly stated, is in a *multiple station circuit* to arrange the apparatus in a parallel circuit, etc."

The first claim of this patent covers broadly such a *multiple station* telephone circuit. After quoting this broad claim and forgetting that it is for a party line system our contemporary concludes, "We cannot, however, quite endorse his (The Electrical World's) proposed remedy for insomnia, which consists in avoiding a patent which runs out on January 8, 1900, and in infringing a better and more recent one which does not expire until 1908." The absurdity of such a statement may be well seen by a comparison between the old Watson claims and claims 8, 9 and 10 of the later Carty patent. Does our contemporary wish to give its readers the impression that an induction coil transmitter can be combined with the hook and signaling and talking circuits in only these two ways?

Symbols and Abbreviations.*

Our esteemed American contemporary, The Electrical World, in its issue of November 24, again returns to the attack, by way of rejoinder to our leaderette of November 2. We really cannot compliment our contemporary on this reply, as regards either accuracy, tone, or pith. For example, it says: "Prof. Jamieson was at Chicago, we believe, and must have been aware that the system of Prof. (*sic*) Hospitalier was to be brought before the chamber of delegates. He should then have entered his objections, which he certainly could have done through one of the delegates." . . . "Finally, the system of Prof. Jamieson was embodied in a paper read before the Congress. . . ."

The facts of the whole case are these: Prof. Jamieson was at Chicago, and was aware that M. Hospitalier's system was to be brought before the chamber of delegates. Further, he offered to read a paper on the subject before the Congress, and his offer was accepted. Before leaving home, accordingly, he had a large number of slips printed, in illustration of the views he meant to set forth. On his arrival at Chicago, he was informed by those in authority that, seeing that a committee had been formed to consider the whole subject, it would be neither just nor proper to discuss it at any of the ordinary meetings. In this view he acquiesced, the more willingly because he was given distinctly to understand by delegates occupying official positions, that the committee, before submitting their decisions to the delegates, would give to all members interested in the subject ample opportunity of expressing their views. Shortly before the committee met, however, it transpired that they had finally decided not to hear the views of any one on the subject, and to hold their meeting *in camera*. Prof. Jamieson immediately sent to the committee's secretary the printed proofs which he had had prepared, with the request that he would distribute them amongst the members of the committee. This the secretary unfortunately omitted to do, for after the meetings the whole of these slips were found intact at the bottom of his hand-bag! The upshot of all this secrecy was, that nothing about the committee's proceedings was divulged until after they had presented their report, and even then no reliable information was imparted to individual members. True, a short report of the meeting, accompanied by a table of symbols, etc., appeared in The Electrical World of September 23, 1893 (*i. e.*, fully three weeks after the termination of the Congress), but as Prof. Jamieson had then no means of verifying its authenticity and accuracy, he took what he was undoubtedly justified in doing, the very earliest opportunity of criticising the complete and authentic recommendations of the committee. Our contemporary is not accurate when it alleges that "the system had been before the world for some years; it had been formally brought in 1891 before the Frankfort Congress, and was by it referred to a committee for report to the next Congress, and it was published by the committee on the Provisional Programme for the Chicago Congress *in order to invite discussion. It is rather unreasonable, in the light of this, to imply that there was not ample opportunity to publicly criticise the measure.*" (The italics in the above quotation are our own.) We quite admit that a system was brought before the Frankfort Congress by M. Hospitalier in a paper which he read there; but that it was "before the world," as a complete proposal, we do not admit. Further, it was referred to a committee, not for report to the next Congress, but "to examine this system . . . in a general way, and to submit it to practical tests; to publish shortly in the special technical journals the results of their examination, with a view to a common understanding, and to leave it to the next Congress to establish definitely this system of notation." How far this committee has fulfilled its functions we leave it to the public to judge. Had they even gone so far as to publish an account of the proposed scheme in the technical journals, it would have been better than nothing, and would have afforded ground for discussion. With regard to the statement that "it" was placed on the Provisional Programme in order to invite discussion, we should like to offer two remarks. The general subject of "The consideration of an International System of Notation, etc.," undoubtedly was there, but certainly not any particular system whatsoever; discussion may have been invited, but instead of being accepted it was burked. The foregoing remarks will serve to show how much opportunity has hitherto been given for a fair expression of opinion, or what pains have been taken by the committee to ascertain what other people thought. Our criticism of the constitution of the committee—as an international one—was certainly called for, and is amply justied by the list of names as given by The Electrical World, viz., Ferraris, Ayrton, Carhart, Hospitalier, Palaz, A. Siemens and Budde. The only real Britisher on the committee is Prof. Ayrton, and he, unfortunately, was not able to be present at a single meeting! Moreover, Profs. Carhart and Hospitalier are the only two men in the above list who have made anything like a special study of this matter, and who could be designated "experts" in electrical notation.

Apart from all these considerations, however, we admit freely and fully that the system is about as good and as perfect as such a "one man" system can be. It is conceived upon intelligible, common sense principles, and betokens on the part of its author much care, and a painstaking appreciation of the subject. Much credit is due to M. Hospitalier for his earnest labors in constructing it, and to our contemporary for really making it known to the electrical world. But whilst admitting all this, we do not thereby relinquish our right to criticise the system as a whole, or in part, and we are quite at a loss to imagine why it is that our contemporary accepts with such a poor grace the remarks that have already been made. We have said this much by way of justifying our own and our correspondent's position in this matter, and we consider that we have succeeded in showing that the present is undoubtedly the best, because it is the earliest possible time for criticising the whole system.

Our contemporary remarks that the criticism of Prof. Jamieson "repudiates almost every essential point of the International Congress system." We have again looked carefully over that criticism, and we cannot make out how any fair-minded man can see in it a repudiation of any essential point whatever, unless it may be the matter of so-called French script *versus* gothic (so-called "block") letters. How far that matter is considered essential, even by M. Hospitalier himself, may be gathered from his article on the subject in The Electrical World of August 26, 1893, in which he avows his preference for the former (French script) on account of the time required in writing these latter characters with the pen or on the blackboard!"! We have been making inquiries at some of our leading printers who have had large experience in scientific and mathematical work, and not one of them ever heard of *French script*. Moreover, we have turned up the illustrated lists of various type founders, and cannot find these characters. There are many forms of script letters, but none termed *French script*, the nearest approach to it being here known as *Ronde type*. No two founders, however, make them exactly alike. All printers, however, have the plain, bold gothic letters, and are well acquainted with them. With all deference to Prof. Hospitalier's opinion we consider still that the well-known, easily written and distinguished gothic (or *block*) letters ought to be appropriated to the oftener used and more important magnetic quantities; and that the various quantities pertaining to light (which are comparatively seldom used here) will be much more appropriately represented by the lighter, more fanciful *French script*. The remainder of Prof. Jamieson's criticisms was directed to what he conceived to be faults of detail, rather than errors in principle. It is all very good to have a thing constructed on right and proper principles, but if it is to be a workable scheme, it must be carefully elaborated in its details, so that nothing which is likely to cause confusion or misunderstanding, or needless worry, may have a place there. We consider that we have done no more than our duty if we have succeeded in directing public attention to the manner in which this most important matter has been carried through.

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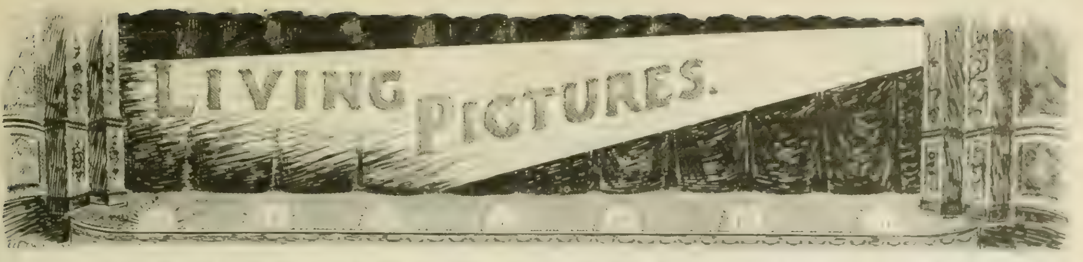
* From the London *Electrical Review*.



LIVING PICTURES.

THE Living Pictures as we now have them are the very latest development in decorative lighting effect. Modern stage lighting has advanced more in the last decade than it did in all its preceding history. This is due in large measure to electricity, which from its very nature offers advantages never to be obtained from gas. In stage lighting, rapidity of manipulation is the most important element to be considered. Hence, the advent of the current opened up avenues of accomplishment of which the old theatrical "gasman" never dreamed. It is safe to say that had the latter old-time functionary been confronted with the problems which the electrician of Koster & Bial's had to solve, he would have pronounced them unsolvable. And so they would have been under the old regime. Under the new, however, they come easy and with a little explanation any one may make "Living Pictures."

All the world has seen them—from the front. The "grand old masters" have enjoyed a new lease of life as far as the gallery is concerned. The projectors of the scheme have in some measure sought to pander to a certain element by making the exhibition an illustration of the "preponderance of the nude," but with those spectators who do not hold nudity and nakedness to be synonymous this will not count. There is plenty of eminently proper subjects, and besides we have to do only with the part that electricity plays in the matter.

NOON, MORNING AND NIGHT.

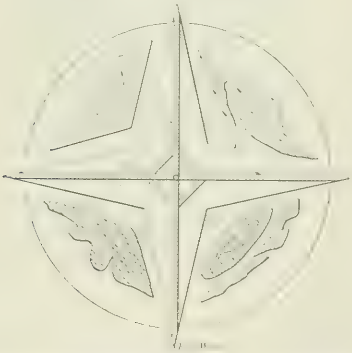
There are several cardinal points to be remembered in making Living Pictures. The original picture must be studied and followed in every particular. No tint or shade which the artist has introduced must be omitted. His high lights are not more important than his shadows. The combination of colors must be reproduced. The relation of one figure to another must be the same. Unimportant objects must not overbalance the principal figures, The picture must tell precisely the same story as the painting, and due account must be made for the fact that the audience is removed from the scene of action. Comparatively so, that is, and in this case the scenic artist had an element to contend with that did not concern the original painter.

The electrician is the real artist in this case. His lights are everything. The scene painter tells him that he will want this or that effect produced; more light here, a shadow there, a tint at this point, a deeper tinge at that. He is to remember that these subordinate figures are to be in shadow, and at the same time strongly enough defined to allow the audience to take in every lineament of their form. If they are just so strong, then the highly lighted figures at the front must be all the stronger. How is it to be done? The secret lies in the fact that Living Pictures are examples of highly exaggerated lighting effect. Let the electrician remember that shadow depresses and light tends to make the object prominent.

We will select, for instance, a picture in which the principal object is the nude figure of a girl. It will be necessary to bring this figure into vivid contrast with its surroundings. These surroundings must show out well also. All that is necessary will be to throw a good light upon them. This will bring them out. Then an intense reflected light is thrown upon the figure of the girl alone. It practically lifts it out of the picture, making it the most prominent figure. The other figures appear to be in shade, yet they are not, as a matter of fact, and are plainly discernible to every one in the audience. This is one of the main effects. Another point to be considered is the avoidance of shadows. The intense light from the reflectors might cause a shadow to fall where it did not exist in the original painting. To counteract this effect, lights must be placed at various points so that the shadows shall be dispersed. At the same time it may be necessary to throw a shadow. There must be a special arrangement for this purpose. Then there are isolated lighting effects, such as the interior of a house, or perhaps a gas lamp. Lastly come the color effects.

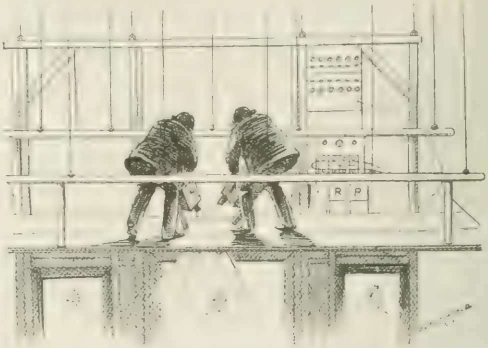
The Living Picture seen from the front presents one or more large gilt picture frames in which are grouped the models. This is all the audience sees. The frames are fronted by black curtains which are pulled aside as each picture is shown. Each frame is part of the electrical equipment. Rows of lamps line the back of the frame, out of sight of the audience, but so placed as to cast an intense light upon the figures in the picture. The figures themselves stand back from the frame a distance of two, three or more feet. The background to the picture is painted upon canvas and is semi-circular, wedge, half-pentagon or half-octagon in shape, as may best suit the occasion. Just above the front of the frames is a bridge on which stand the electrician and his assistants. It is out of sight of the audience, being protected by a drop curtain which reaches down from the "flies" to a position just below it. The three frames at Koster & Bial's are secured to a large scaffolding framework which can be hoisted up into the "flies" while the other performances are going on. The last picture of the series is presented in an immense gilt frame which has a scaffolding framework of its own and is lifted up out of the way in the same manner as is the one in which the three smaller gilt frames are secured. When the scaffolding containing the three frames is lowered to the stage, a small switchboard which controls the lights in the pictures and which is attached to the framework stands directly on a level with the bridge on which are located the electricians. Wires run from all the lamps up to this switchboard, where they are controlled by cut-outs and switches. A "flexible" extends from the "mains" which run along the bridge and is plugged into the switchboard on the framework. Thus current can be had in a second after the framework is lowered into position.

GOOD-NIGHT. (*Birket Foster.*)



TURN-TABLE CARRYING FOUR LIVING PICTURES.

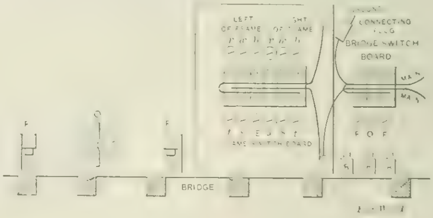
The bridge carries an extra switchboard of its own to control the arc focusing lamps which are used to cast an intense glare on certain figures in the pictures. On the bridge also is a variable resistance for graduating the intensity of the light. The centre frame of the series of three has three circuits, red, white and blue, down each side. There is also a circuit of white lamps along the base of the frame. Two extra circuits of white lamps are on the sides of the frame, but they are around almost on what would be considered the outer edge of the frame and throw their light further back on the picture. This makes nine circuits in all. The two smaller side frames are only shown once during the evening, hence the effect is never varied, so there is only one circuit of mixed colored lamps —30 lights at the top, 15 along the base and 8 along each side. The centre frame has forty lamps on each side. Hanging from the bridge is a flexible, ending in a plug which is to be used in case there is some individual lighting in the picture to be done. In that case there are wires running from the individual lamps in the picture to a socket in the frame-work beneath. The plug is then fitted into the socket and the current controlled from the bridge above. Branching away from the mains are lines to a Ward lamp which is suspended from the paint-bridge at the back of the stage. This is for transparencies such as sun or moon effects in a background of sky.



WORKING FOCUSING LAMPS ON BRIDGE.

Now for the pictures themselves. Each picture is grouped on a platform which is then rolled into position on the stage behind the picture frame. The platform most used is a turntable affair which presents four pictures before it is removed. The scenery on it is in the shape of a four-pointed star. Each group reposes in the space between two points of the star. Thus the background is V-shaped, the audience looking into the V. Other platforms have the scenery arranged in the shape of a half-pentagon or octagon. The turn-table platform is the best for suggesting how the entertainment is conducted.

The three pictures—"Morning, Noon and Night," after Mackart —form a good subject for illustration. The central and largest frame shows "Morning." Two disheveled female figures—one above the other—float above the gray clouds, which latter are beginning to be lighted by the flambeau held in the upstretched hand of the upper figure. "Noon," in the frame on the left, is the sun at full power—a female whose flowing hair becomes the rays, enveloping her form and streaming to all points of the compass. "Night," heavily draped, hovers high up under the stars, forbidding and gloomy.

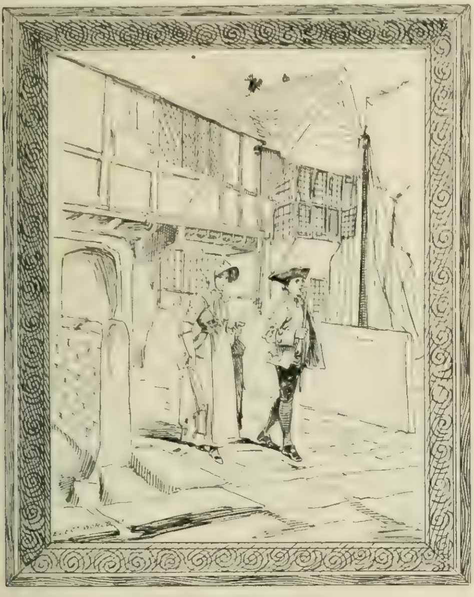


FRONT VIEW OF LIGHTING BRIDGE, SHOWING SWITCHES, &C.

The general illumination of "Morning" comes from the white lights around the edges of the frame. These in themselves are enough to light up the figures of the girls. But it is necessary to lift them out by means of the focusing lamps, therefore an intense light is thrown on them from the bridge. To the casual observer the background of "Morning" looks dim. It is only an optical illusion, however, created by its contrast with the exaggerated light thrown on the two female forms. The torch in the hand of the upper figure gets its light by means of an incandescent lamp, the current to which comes through a bifurcated wire running down back of the figures. This is where the flexible, hanging from the bridge, comes in. It is plugged into the framework of the turntable.

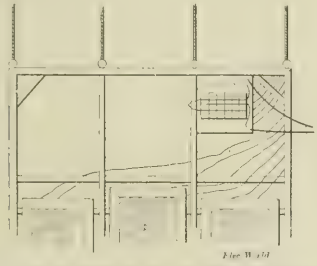
"Noon" is a generally illuminated picture with the central figure highly wrought. "Night" differs from the others in that its background is less clearly defined. The main figure is, of course, acted upon with the focusing lamps. The background of sky is dark except where small holes in the canvas allow the arc light behind to give the appearance of innumerable stars.

Everybody has seen the "Rock of Ages," that wonderfully draped figure, clinging to the cross, with the plunging surf roundabout and the light of hope streaming upon it from above. It is one of the best of living pictures. Its lighting effects explain themselves. The heavy glare from above is self evident. The waves, the cross, the figure, rest under a glare of light. Even the despairing hand reaching from the water in the foreground feels its influence.



SALLY IN OUR ALLEY.

"Salambo," by Gabriel Ferrier, is still more interesting from the lighting standpoint. The story of the beautiful ancient, beautifully told by Flaubert, is very realistically depicted. "Salambo," a naked woman, is in the power of the prophet snake. She is wrapped in its coils and its head is pressed against her cheek. Moonlight streams in on the temple floor, and a slave crouches in the background, where he has lighted an incense burner. The stars have come out. It is night.

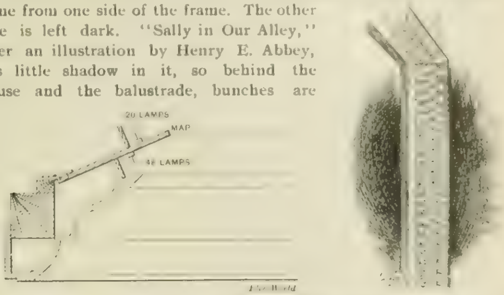


PLAN OF SUPPORT FOR PICTURE FRAME.

There was a variety of effects to be obtained in this picture. The girl was first lifted out with the focusing lamps. The slimy appearance of the snake was obtained by means of varnish, and further heightened by means of a blue lamp placed behind the reptile and out of sight of the audience. A red lamp from a brazier at the side and another behind a pillar brought out the peculiar glow of the incense burner and mingled with the moonlight on the floor. Thus, the slave's face had two tints, reddish from the brazier on one side and bluish from moonlight on the other. The stars were formed by placing lamps behind holes in the background of canvas.

Suppose there is to be no lifting out with the focusing lamps as before, and that a shadow is to be thrown to one side. How easy it is to accomplish this by judiciously cutting out circuits on one side of the frame, until the lights on the other side predominate enough to throw the required shadow. Stage lighting is reduced to a science in the Living Pictures. Almost every effect ever produced is used here, always exaggerated, and yet never seeming to be so.

"Evening Prayer," after Birket Foster, is a good illustration of how shadows are thrown. A child is kneeling by a bed. The lights come from one side of the frame. The other side is left dark. "Sally in Our Alley," after an illustration by Henry E. Abbey, has little shadow in it, so behind the house and the balustrade, bunches are placed to dispel all shadows. This is but a small part of the manipulation, and when it is known how much there is to the proper presentation of each picture, one wonders that they are produced so quickly. The workmen behind have less than a minute in which to make all connections as each picture is shown. In fact, this time is all that is allowed from the exposing of one picture to that of another. Everything is adjusted to a nicety, the water in "La Source," a brook scene, is run through a hose to the platform, where it is coupled to the stationary pipe by means of a railroad air-brake coupler.



SECTIONAL VIEW OF FRAME AND ARRANGEMENT OF LAMPS.

The theatrical electrician must be well up in local expedient.

ROCK OF AGES.

In a series at the above named concert-hall was a picture of Andromeda crossing the rocks at the seashore. In the original picture her hair was represented as flowing in the wind. In the living picture it really was so, the feat being accomplished by means of an electric fan placed just behind the gilt picture frame. A short time ago one of the pictures presented was "Luna." The moon was quarter full. A dim ring of bluish light showed the outlines of the whole moon The middle part was bluish black. The quarter of the moon that showed was composed of the form of a girl bent into the required shape. The figure was "lifted out" with the focusing lamps, the rest left in comparative darkness. It was a transparency picture.. Luna fitted into the hole that was cut out for her. The rest of the picture was lighted from behind. But in order to get a proper gradation of light around the edges, the latter were lined with fringed paper, cut so as to gradually separate the light from the darkness. Such is the value of expedient.

The wiring here is in simple multiple. The theatre has its own generating plant. The wires run along the sides and top of the picture frames and up to the simple switchboard at the bridge, where they are protected with cut-outs. It is a very simple affair after all. Standing on the bridge, under the switchboard, are a set of resistance boxes—two wire and one Carpenter carbon resistance. They are right at hand and under the electrician's control. There are three Ward "photograving" lamps in use. The focusing lamps were built in Paris by the French Edison Company, especially for use in producing "Living Pictures." The focus is instantly adjustable and can be fixed in a moment, a very necessary quality, as each picture has to be treated differently. They are held in the hands while being worked.

The inspiring genius of the lighting effects at Koster & Bial's is Mr. Chas. Meulenbergh, a native of Germany and a graduate of the Columbia School of Mines. He it is who has so much contributed to the great success of the Living Pictures by his admirable and judicious arrangement of the lamps. The scenic artist is Mr. Albert Operti, who is famous enough to need no further introduction.

Perhaps the gallery might have some trouble in determining the names of the different subjects as they appear were it not for a happy thought of the management. That is, to use a condensing lens and lantern, by means of which the name of each picture is thrown in letters of light on the black curtain just before every change of scene.

Electrical Power Transmission -VIII.

BY LOUIS BELL, PH. D.

Power Transmission by Constant Currents.

34. In its general aspect this method must now be regarded as a makeshift. It came into existence at a time when the only circuits extensively installed were those for arc lighting, and hence, if motors were to be used at all, they must needs be of the constant current type. As incandescent lighting became more common the arc motors were gradually replaced by shunt motors worked at constant potential. A few constant current plants, especially for motor service, have been installed both here and abroad, but for the most part they have merely dragged out a precarious existence, and are probably doomed to abandonment.

There is good reason for this. The motors at best regulate indifferently, and there is serious objection to running high voltage wires into buildings when it can be avoided.

The objections of the insurance companies alone are quite sufficient to discourage the practice. The constant current has often been advocated for long distance transmission of power where high voltage is a necessity. For such service the method has the great advantage that the motors do not need extraordinary insulation except from the ground. A constant potential service at 5,000 volts continuous current would be utterly impracticable, if distribution of power in moderate units were to be attempted, while with constant currents it is entirely feasible, although objectionable on the grounds mentioned. In addition, unless a proposed transmission be for power alone, the constant current method shares with constant potential of high voltage the very grave difficulty that an incandescent lamp service is out of the question, without secondary transformation of the necessarily high line voltage to a very moderate pressure. This is difficult and costly with continuous currents of any kind, and doubly so when the troublesome question of regulation at constant current is involved.

35. To reduce the energy sent over a high voltage continuous current line to a pressure at which incandescent lamps can be fed, two methods are generally available. We may pass by the plan of using many lamps in series as of very limited applicability and forbidden by the fire underwriters. First, the required power may be received by a motor of appropriate size, which is belted or coupled to a low voltage generator. This device does the work, indeed, but it involves installing three times the capacity of the lamps desired in machinery of a somewhat costly character, and losing in the motor and generator fifteen or twenty per cent. of the energy supplied from the line. The other alternative is to employ a composite machine combining the functions of motor and generator. This piece of apparatus is variously known as a motor generator, dynamotor, or continuous current converter. It is a dynamo electric machine having a double wound armature and two commutators. One winding with its commutator receives the high line voltage and operates as a motor. The other winding and its commutator furnishes, as a dynamo, low tension current. The field is common to both windings. Fig. 22 shows a small machine of this kind, adapted to receive 5,000 volts from the line, and to deliver 110 volts or *vice-versa*.

This particular machine works at constant voltage on both circuits. Either circuit, however, could be made to work at constant current, provided the means of regulation for this purpose were so chosen as to leave the field and speed unchanged.

The cost of a motor generator, while less than that of two separate machines, is still high, and although its efficiency is somewhat greater than that of the pair mentioned above, it is obtained at the cost of a rather complicated armature, which, moreover, rom a practical standpoint, is quite objectionable.

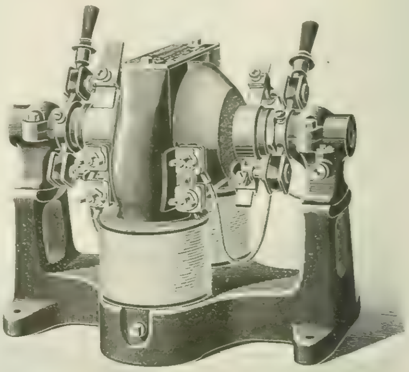


Fig. 22.

36. In spite of the difficulties incident to working incandescent lamps from a high voltage constant current circuit, the ease with which such circuits can be worked, even if for power alone, at voltages far above those available on the constant potential system, encouraged their installation during the period between the first efforts at long distance transmission and the very recent date at which alternating current apparatus has become thoroughly available. For some years it was constant current or nothing, so far as long distance transmission, coupled with distribution, was concerned.

As a result of the various adverse conditions mentioned, transmission at constant current has never made really any headway in American practice, and at present the method is followed to a noticeable extent in only one locality—San Francisco. There, through the activity of local exploiters, constant current power circuits have been established and have been in fairly successful operation for several years.

(To be continued).

A New Application of the Telephone.

A London engineering journal states that "the telephone is made use of on Australian sheep ranches, in some of which the sheep and shepards are watched and given instructions telephonically by means of six or more stations, all communicating with a central point." We are not surprised to hear that the telephone will transmit the language of the sheep, and that they can be given instructions telephonically, but it seems to us that it would require a sort of boss sheep at the transmitor, unless the shephard can talk the sheep language; the most surprising part is that in Australia the sheep may be seen through a telephone.

A New German Scientific School.

Dr. Nernst, who was offered a chair at Münich, has declined it, having been informed by the Minister of Education that a Physico-Chemical Institute will be shortly started at Göttingen.

Long Distance Telephony.

BY F. W. DUNBAR.

THE factors of all others, it has been truly said, which give confidence and stability in our modern business methods, and stimulation and activity in our business transactions, are the instantaneous transmission of news and thought between distant points. And of all the known methods of communication at a distance, the possibilities of the telephone as furnishing a natural and satisfactory means of instantaneous communication can be certainly placed in the front rank.

The telephone as a toy had long been known, when suddenly by the introduction of electricity its era was at once marked as a commercial factor in the progress of the civilization of the world. The old whispering galleries were nothing more nor less than the telephone in its first crude form. The energy of the voice was concentrated and directed along a certain path, and then condensed at a distant point, instead of being allowed to radiate out in all directions and thus waste itself in useless vibrations of the air.

The next step in advance was the mechanical string telephone, or lovers' telephone, by which the better conductive power of a tightly stretched string or wire was utilized to conduct the sound waves which were concentrated upon a vibratory diaphragm at the transmitting end, and reproduced upon a similar diaphragm at the receiving end. But the string or wire, while far superior to the air was still, even at best, a poor conducting medium, because of the great loss in the energy of vibration which necessarily occurred upon it during the transmission of the sound waves. Thus the distance to which audible conversation could be carried on was limited by this great loss upon the conductor. It was at once seen that until this loss could be reduced, the telephone would have to remain a toy.

When the laws of electrical induction and conduction became known, brilliant minds perceived that the solution was at hand; for the energy of the vibrating diaphragm could be transformed into electrical energy at the transmitting end, and this *electrical* energy could then be transmitted over long lines with incomparably less loss of energy than could the mechanical vibrations or sound waves. It was only necessary to place similar apparatus at the receiving end to retransform this transmitted electrical energy back into mechanical energy, and thus the receiving diaphragm would then reproduce the same sounds which were impinged upon the transmitting diaphragm.

Fig. 1 shows this important step and is simply the familiar magneto transmitter and receiver of Alexander Graham Bell, which was thrown open to public use nearly a year ago. The method of the transformation from the mechanical energy of vibration of the diaphragm to the electrical energy of the circuit and back again is now a well-known process. It will be noticed that as the iron diaphragm, *D*, is forced toward the soft iron pole piece, *I*, which is in magnetic contact with the permanent magnets, *S*, *S*, the magnetic flux or "lines of force from these permanent magnets will be increased through this core, *I*, owing to the formation of a better return magnetic circuit through the iron diaphragm and back to the other end of the permanent magnet. As the diaphragm recedes from the pole piece the magnetic flux through this pole piece or core, *I*, will decrease. A coil of wire, *C*, is placed around this core, and when the instrument is in use it forms part of the electrical circuit running to a similar coil in the receiver. When used as a transmitter the opposition to the forced vibrations of the diaphragm which is offered by the inertia of this changeable magnetic flux through the core and the surrounding closed circuit coil appears, with certain losses, as electrical energy in the circuit. This electrical energy, transmitted with certain slight losses, acts upon the diaphragm of a similar instrument used as a receiver at the distant end of the circuit and causes its diaphragm to vibrate similarly to the diaphragm of the transmitter, but with less energy.

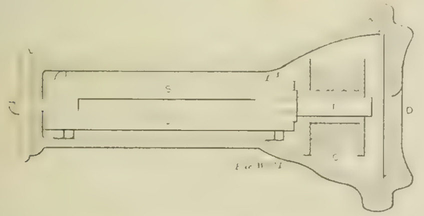


FIG. 1.—THE BELL TELEPHONE.

Now, it is obvious that in all of these classes of instruments, whether mechanical or electromagnetic, it is the energy of the *voice* which is transmitted, and the received sound, owing to certain unavoidable losses, must be weaker than the transmitted sound. It is also equally true that no purely electromagnetic transmitter can be made which will transmit as loudly over a short, very short, line as will an equally well made mechanical or string telephone. The advance in the art up to this point has been simply one of *reduced loss* upon *long* transmitting circuits, and has offered no solution to long distance telephony.

Practically simultaneously with Bell's telephone came that invention which has made long distance telephony a reality, *i. e.*, the battery transmitter, the public use of which Judge Carpenter, in his recent decision against Emile Berliner and the American Bell Telephone Company, has just offered to the public as a fitting Christmas gift. By means of this invention it is no longer required that the voice itself should furnish the energy which passes out upon the line to the distant point, but it allows a separate source of power, a battery, to furnish the energy which is thrown out upon the line and required to traverse such immense distances, and the function of the voice is simply to choke or throttle this energy in a rhythm identical with the rhythm of the voice itself. The importance of this invention will be appreciated when we consider the difference in the available energy between a hand car and a steam locomotive. In the one the energy is furnished by the muscular power of the operator, and in the other the muscular power of the engineer is simply used to vary the opening of the throttle valve, and a separate source of energy, the steam boiler, is allowed to do the work. The method by means of which the energy from the battery is throttled or varied is briefly as follows:

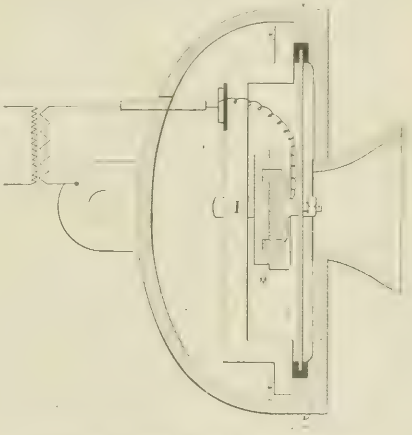


FIG. 2.—THE BATTERY TRANSMITTER.

In the battery circuit is placed a resistance varying medium, such as granular carbon or some similar substance, the electrical conductivity of which varies with the intimacy of contact and number of contacts of the granules. If, now, the diaphragm of the transmitter be allowed to communicate its vibrations directly to this resistance varying medium, the current from the battery will be caused to vary in a rhythm similar to the rhythm of the vibrating diaphragm. Fig. 2 shows such a transmitter and is similar to the transmitters which have been found best adapted for long distance telephony. *D* is the diaphragm receiving the sound waves from the air and transmitting them directly to the front electrode of a circular box, whose cavity, *C*, is partially filled with granular carbon. The back electrode is rigid and is connected electrically through the framework of the transmitter to one side of the battery. The front electrode, which is firmly attached by means of a small bolt and nuts to the vibrating diaphragm, carries a small, thin mica disc or diaphragm, *M*, clamped at its edges. This mica disc gives sufficient freedom of motion to the electrode and confines the carbon granules in the box. This front electrode and diaphragm are insulated and connected electrically to the other pole of the battery; first passing through the primary, or low resistance side, of a transformer or induction coil. The functions of this transformer are twofold: First, it allows a greater output, and consequently a greater variation in energy, from the battery by maintaining the battery circuit of low resistance; and, second, it transforms this variation of energy.

The important point to be borne in mind is that the energy which may be transmitted to the distant end of the circuit by such a transmitter is only limited by the mechanical and electrical construction of the instruments and is not directly dependent upon the energy of the voice. In fact, voices and music have been transmitted to distant cities and heard there with a greater volume than were the original sounds at the transmitting end.

Fig. 3 shows the arrangement of the essential apparatus for conversation by long distance telephony. The signaling devices (bells and generators), lightning protectors, switchboard apparatus, etc., are omitted for the sake of clearness. It will be noticed that the apparatus at each end is similarly arranged, and that the primary circuit of each transformer, *C*, contains the transmitter *T*, and battery *B*. The secondary circuit of each transformer passes directly to the line circuit and includes the receiver *R* on one side. Thus each party during conversation will hear his own voice in his receiver with the full energy of the current which his transmitter sends out to the line, but will only hear the voice of the distant party with a diminished energy, due to the loss upon the circuit. This loss of energy is caused by the electrostatic absorption of the current upon the circuit, and has been found to be of such magnitude upon very long lines as to apparently justify the use of copper wires for such circuits of a size sufficient to transmit many million times the amount of energy which they actually convey. Another great problem which has been commercially solved is represented also in Fig. 3.

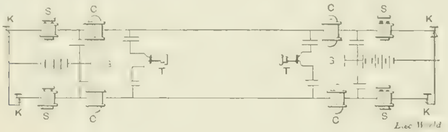


FIG. 3.—A LONG DISTANCE TELEPHONE CIRCUIT.

If two or more long distance telephone circuits are carried side by side on the same pole lines, and no especial provision is made to the contrary, it is found that the inductive disturbances from one circuit to another—"cross-talk," as it is familiarly called—are so great that but one circuit can be commercially used at a time, owing to the confusion of voices. But if the circuits are "transposed," as shown in Fig. 3, so that each side of each circuit is, on the average, equidistant from each side of all other circuits, then the cross-talk is eliminated. Although the problem is readily solved for two or three circuits, it grows more and more complex as additional circuits are added. In general, it has been found that at least one transposition per mile on each circuit is required to successfully eliminate the trouble.

Another problem, which, from its practical and commercial importance as well as scientific fascination, demands some attention. This is the simultaneous transmission of telephonic and telegraphic messages over the same circuit without mutual interference. Fig. 4 shows the method of Van Rysselberghe for accomplishing this object. The apparatus is the same for each end of the circuit, and by its use each side of a telephone circuit is used as a separate telegraph wire, while the metallic circuit is used at the same time for telephonic purposes. *T* represents the telephonic apparatus which is shown in greater detail in Fig. 3. At each end of the main line circuit this telephone circuit is connected to the main line through condensers as shown. These condensers allow free passage to the rapidly alternating telephonic currents, but effectually bar the passage of the Morse signals from one side of the circuit to the other, and thus prevent any interference between the two telegraph circuits. *S* and *K* represent the standard relays and keys which are used in ordinary telegraphy. *C* represents the special retardation coils which are used both for "rounding off" the abrupt Morse signals, and thus rendering them inaudible in the telephone circuit, and also for preventing the rapidly alternating telephonic currents from taking the shunt path from one side of the metallic circuit to the other through the relays and keys of the two telegraph stations situated at the same end of the metallic circuit. The other condensers, which are shown legged to ground, aid in decreasing the abruptness of the "kick" at the "break" in the Morse signals, and thus farther soften or round the Morse characters, which would otherwise be audible in the telephone circuit. With circuits thus arranged, allowing the simultaneous use of two Morse lines with each telephone circuit, the earning capacity of each pair of wires is seen to be enormously increased.

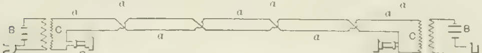


FIG. 4.—SIMULTANEOUS TELEGRAPHY AND TELEPHONY.

Current and Potential.

BY W. M. STINE.

An editorial in THE ELECTRICAL WORLD of December 29, 1894, together with two letters bearing on the question of the generation of an E. M. F. on open circuit, are suggestive of some aspects of the subject of potential and current in general. It is not the intention of the writer in any way to enter into the discussion between Messrs. Waddell and Pierce, but simply to state some phases of a subject to which but little attention is directed.

Potential may be defined as a condition of ether stress, while an electrical current is the equalization of this stress through a conductor, or substance, whose dielectric resistance approaches zero.

Lenz's law is usually stated by saying that whenever a *closed* circuit, capable of bearing an electrical current, lies wholly or in part in a magnetic or electromagnetic field of force, any disturbance in the intensity of the field of force will induce a current in the circuit. While this is generally accepted as true it is not a full statement of the *immediate* actions in the case. When a conductor sweeps through a field of force, or a region in which the ether is under a magnetic or electromagnetic stress, this stress in whole or in part is taken up by the conductor; or, in other words, the conductor itself becomes stressed. This stress in the conductor is its potential difference, or E. M. F. If now the circuit be closed by a conducting path *outside* the coercing field, or through a portion of the field so weak that its E. M. F. is less than the impressed, the stress will be equalized through it and a current will flow. In short, the *immediate* result of a conductor cutting lines of force is the establishment of an E. M. F. The current is secondary, depending upon conditions of conduction. To this extent Lenz's law is misleading. The establishment of an E. M. F. is then wholly independent of the fact that the circuit be open or closed. This latter governs only the *amount* of energy transformed. If a conductor, forming an open circuit, either a straight or bent piece of wire, cut lines of force, energy will always be absorbed, and it can be evaluated by $W=ECt$ could we measure the current and the E. M. F. But in such cases the value of W depends upon the capacity of the conductor. No conductor, not even a straight piece of wire, can be moved in a magnetic field without an absorption of energy equal to its capacity. If the conductor were ideal and yielded to impressed stress without an effect which closely resembles inertia, there would then, of course, be no absorption of energy, or rather the amount would be infinitesimal. The case is analogous to that of a battery on open circuit. Its two poles always show a definite stress or difference of potential.

When a dynamo is started on open circuit it is generally regarded that it absorbs no power, except for mechanical reasons, until the circuit is closed. It really absorbs power to establish an E. M. F. When this reaches its maximum, no further transfer of energy occurs until the circuit be closed.

It may be scarcely necessary to mention an experiment made by the writer, for its results are entirely self-evident. A 110-volt dynamo was separately excited through its shunt coil and run at standard speed. The terminals of the armature circuit were connected to a Kelvin electrostatic voltmeter. The armature circuit was thus open, but the voltmeter recorded 110 volts. The momentary current necessary to establish this E. M. F. was, of course, dependent upon the capacity of the circuit and voltmeter.

Whether the copper of an open secondary circuit of a transformer becomes heated or not, will depend on the conditions mentioned above.

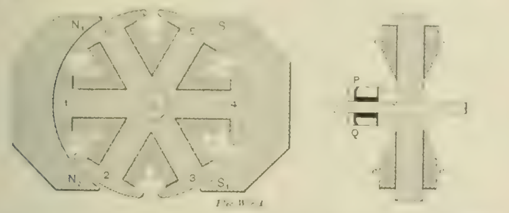
English Honors for American Work.

It may interest Americans to know that the only paper read before the London Institution of Electrical Engineers during the past year which was awarded the Institution premium, was that of Mr. Wilkinson on "Notes on Electric Tramways in the United States and Canada."

Electrodynamic Machinery—XXII.

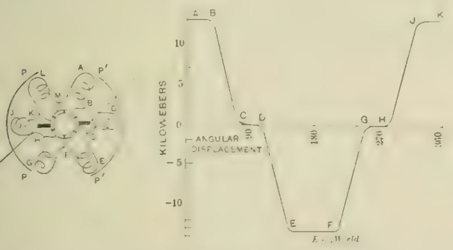
BY EDWIN J. HOUSTON AND A. E. KENNELLY.

107. In order to determine the amount of flux passing through a single projection, let the armature be considered as slowly rotated counter-clock wise. Starting with the core, the magnetic flux passing through it will be found by dividing half the M. M. F. by the reluctance of the air gap over its face, or $\frac{260}{\frac{0.2}{10}}$=13,000 webers. As it moves counter-clock wise towards 2, no appreciable change is effected in the amount of flux it carries until the advancing edge of 2 emerges from beneath the polar face N_2. The flux through 1, rapidly diminishes until before 1 becomes half way between the pole faces N_2 S_1, it is entirely deprived of flux from the coil. When the position 3 is reached, the flux re-enters the coil of 1, but in the opposite direction, and when it passes position 4, the total maximum flux of 13 kilowebers is in the reverse direction. The curve, Fig. 90, commences at 13 kiloweber in the position corresponding to 1, Fig. 87, falls steadily from *B* to *C*, and, after a short pause, from *C* to *D* where the coil lies midway between the poles, falls again from *D* to *E*, until the flux is 13 kilowebers negative, corresponding to the position 4. Continuing at this value to *F*, it rises to *G*, corresponding to the position 5, and then pauses at the zero line, in the gap between the poles, rising finally to *J*, corresponding to the original position P_1, at *K*.



FIGS. 87 AND 88.—RADIAL OR POLE ARMATURE. SECTIONS AT RIGHT ANGLES TO AXIS AND THROUGH AXIS.

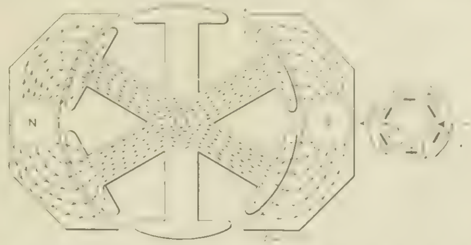
108. The E. M. F. established in any turn of the coil is found by ascertaining, from the speed of rotation, the rapidity with which the flux, threading through the coil, changes in value. If, for example, the armature be driven at a speed of 1,500 revolutions per minute, or 25 revolutions per second, corresponding to the time of 0.04 second per revolution the E. M. F. will evidently be zero at the positions represented by the straight line *AB*, *CD*, *EF*, *GH*, and *JK* of Fig. 90, since here, the rate of change in the flux is practically zero and the E. M. F. will be nearly uniform during the periods represented by *BC*, *DE*, *FG*, and *HJ*, since the rate of change is nearly uniform in one direction or the other during those periods. As shown in Fig. 93, the E. M. F. in the single turn on the projection commencing at the position 1, is zero, from *o* to *b*, from *b* through *b′* to *c*, the flux diminishing at the rate of 13,000 webers in 0.00433 second, and, therefore, at the rate of 3,000,000 webers (3 megawebers) per second, and since 100 megawebers per second correspond to an E. M. F. of one volt, the E. M. F. in a single turn being—0.03 volt. Assuming 10 turns of wire on each armature projection, the total E. M. F. will be —0.3 volt at this period, and the ordinate *bb* represents —0.3 volt in Fig. 93. At *c′d*, corresponding to the position *CD*, Fig. 90, the E. M. F. is zero, falling again to —0.3 volt from *d′* to *e*, corresponding to a change in flux from *D* to *E*, Fig. 90. After 0.02 second has elapsed the E. M. F. reverses in direction and becomes positive, tracing the curve *ff′ gg′ hh′ jj′ k*.



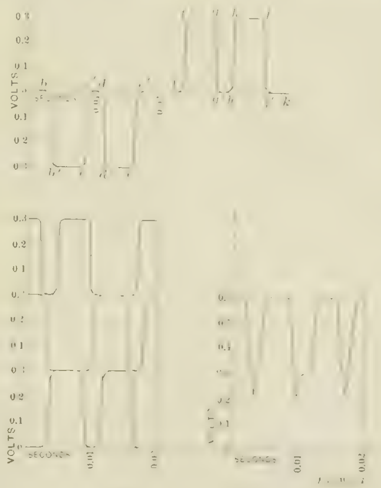
FIGS. 89 AND 90.—DIAGRAMS SHOWING CONNECTIONS OF COIL WITH COMMUTATOR AND FLUX PASSING THROUGH ONE ARMATURE PROJECTION DURING A COMPLETE ROTATION.

By the aid of the commutator, the E. M. F.'s in the coils, as soon as they change their direction, are reversed relatively to the external circuit, and, therefore, preserve their external direction, as can be seen by an examination of Fig. 89.

109. We have thus far traced the E. M. F. as developed in a single polar projection, and as resulting from the variation of flux passing through it. During the time that the E. M. F. is being generated in this coil, a smaller E. M. F. is being generated in the other coils, displaced, however, in time, by portions of a revolution. As shown in Fig. 92, the six coils on the armature have E. M. F.'s developed in them, being connected with the external circuit through the brushes in two parallel series, of 3 series-connected coils. Each coil is, therefore, acting in its circuit for one half of a revolution before it is transferred to the opposite side, and while Fig. 93 represents the E. M. F. generated in any half revolution of one coil, we have to consider the E. M. F.'s coincidently being generated in its next neighbor on either side. This is shown in Fig. 94, where the E. M. F. of all three coils is developed independently on parallel lines one above the other, each E. M. F. being a repetition of that in Fig. 94, but displaced the 1-6 of a complete revolution. Fig. 95 represents the effect of combining or summing these three separately generated E. M. F.'s in the same circuit and it will be seen that the E. M. F. pulsates between 0.2 and 0.6 volt.



FIGS. 91 AND 92.—DISTRIBUTION OF FLUX AND E. M. F. AT POSITION SHOWN.



FIGS. 93, 94 AND 95.

110. If the resistance of the wire on each coil be *r* ohms, then the resistance of the three coils on each side of the armature will be 3 *r*, and the resistance of these two sides in parallel will be generally 1.5 *r*, so that, neglecting the resistance of the brushes and brush contacts, the resistance of the armature will be 1.5 *r* ohms.

The current strength which should be maintained by the generator, when on short circuit, would, therefore, be $\frac{0.6}{1.5r}$ amperes, but in reality, the current will not reach this amount, owing, among other things, to the effect of self-induction in the armature, which, under load, tends to check the pulsations, and consequently renders them more uniform, thus reducing the mean E. M. F.

(To be continued).

Laboratory of Houston & Kennelly, Philadelphia, Pa.

Practical Notes on Dynamo Calculation—XXII.

BY ALFRED E. WIENER.

PART III. DIMENSIONING OF FIELD MAGNET FRAME.

1. General Construction Rules.

a. Forms of Field Magnets.

With reference to the type of the field magnet frame modern dynamos may be classified as follows:

I. Bipolar Machines.

1. Single Horseshoe Type.
   - *a.* Upright single horseshoe type (fig. 67).
   - *b.* Inverted single horseshoe type (fig. 68).
   - *c.* Horizontal single horseshoe type (fig. 69).
   - *d.* Vertical single horseshoe type (fig. 70).
2. Single Magnet Type.
   - *a.* Horizontal single magnet type (figs. 71 and 72).
   - *b.* Vertical single magnet type (fig. 73).
   - *c.* Single magnet ring type (fig. 74).
3. Double Magnet Type.
   - *a.* Horizontal double magnet type (figs. 75 and 77).
   - *b.* Vertical double magnet type (figs. 76 and 79).
   - *c* Inclined double magnet type (fig. 78).
   - *d.* Double magnet ring type (fig. 80).
4. Double Horseshoe Type.
   - *a.* Horizontal double horseshoe type (fig. 81).
   - *b.* Vertical double horseshoe type (fig. 82).
5. Iron Clad Type.
   - *a.* Horizontal iron clad type (figs. 83 and 84).
   - *b.* Vertical iron clad type.
     - Single magnet vertical iron clad type (figs. 85 and 86).
     - Double magnet vertical iron clad type (fig. 87).

II. Multipolar Machines.

1. Radial Multipolar Type.
   - *a.* Radial outerpole type (fig. 88).
   - *b.* Radial innerpole type (fig. 89).
2. Tangential Multipolar Type.
   - *a.* Tangential outerpole type (fig. 90).
   - *b.* Tangential innerpole type (fig. 91).
3. Axial Multipolar Type (fig. 92).
4. Radi-tangent Multipolar Type (fig. 93).
5. Single Magnet Multipolar Type.
   - *a.* Axial pole single magnet M. P. type (fig. 94).
   - *b.* Outer-innerpole magnet M. P. type (fig. 95).
6. Double Magnet Multipolar Type (fig. 96).
7. Multipolar Iron Clad Type (fig. 97).
   - Horizontal four-polar iron clad type (figs. 98 and 100).
8. Multiple Horseshoe Type (figs. 101 and 102).
9. Quadruple Magnet Type (fig. 103).
10. Four-polar Double Magnet Type (fig. 104).

a. Bipolar types.

The simplest form of field magnet frame is that resembling the shape of a horseshoe. Such a horseshoe-shaped frame may be composed of two magnet-cores joined by a yoke, or may be formed of but one electro-magnet provided with suitably shaped polepieces. The former is called the *single horseshoe type*, the latter the *single magnet type*.

A *single horseshoe frame* may be placed in four different positions with reference to the armature, the two cores either being *above* or *below* the armature, or situated *symmetrically*, one on each side, in a *horizontal* or in a *vertical* position.

The *upright single horseshoe type*, fig. 67, is the realization of the first-named arrangement, having the cores above the armature, and is therefore often called the "*overtype.*" This form is now used in the Edison dynamo, built by the General Electric Co., Schenectady, N. Y., in the motors of the C. and C. Electric Co., New York, and is further employed by the E. G. Bernard Company, Troy, N.Y.; by the Detroit Electrical Works, Detroit, Mich. ("King" dynamo); the Commercial Electric Co. (A. D. Adams), Indianapolis. Ind.; the Novelty Electric Co., Philadelphia, Pa.; the Electron Manufacturing Co. ("Perret"), Springfield, Mass.; by Siemens Bros., London, Eng.; Mather & Platt (Hopkinson), Manchester, Eng.; the India-rubber, Gutta-percha & Telegraph Works Co., Silvertown, Eng.; and by Clarke, Muirhead & Co., London.

The *inverted horseshoe type*, fig. 68, having the cores below the armature, is also called the "*under-type.*" Of this form are the General Electric Co.'s "Thomson-Houston Motors," the standard motors of the Crocker-Wheeler Electric Co., Ampère, N. J.; further, machines of the Keystone Electric Co., Erie, Pa.; the Belknap Motor Co., Portland, Me.; the Holtzer-Cabot Electric Co., Boston, Mass.; the Card Electric Motor and Dynamo Co., Cincinnati, O.; the La Roche Electrical Works, Philadelphia, Pa.; the Excelsior Electric Co., New York; the Zucker & Levett Chemical Co., New York (American "Giant" Dynamo); the Knapp Electric and Novelty Co., New York; the Aurora Electric Co., Philadelphia, Pa.; the Detroit Motor Co., Detroit, Mich.; the National Electric Manufacturing Co., Eau Claire, Wis.; Patterson & Cooper (Esson), London; Johnson & Phillips (Kapp), London; Siemens & Halske, Berlin, Germany; and Ganz & Co., Budapest, Austria.

Machines of the *horizontal single horseshoe type*, fig. 69, in which the centre lines of the two magnet-cores and the axis of the armature lie in the same horizontal plane, are built by the Jenney Electric Co., New Bedford, Mass. ("Star" Dynamo), by the Great Western Manufacturing Co. (Bain), Chicago, Ill., and by O. L. Kummer & Co., Dresden, Germany.

Fig. 67

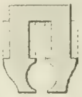


Fig. 68

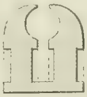
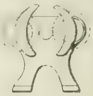
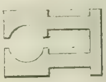


Fig. 69





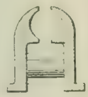


Fig 72

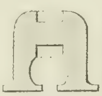


Fig. 73

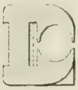


Fig 74

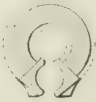


Fig. 75

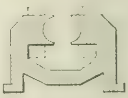


Fig 76

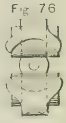


Fig 77

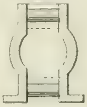


Fig 78

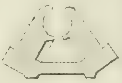


Fig 79

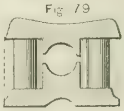


Fig 80

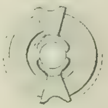


Fig 81

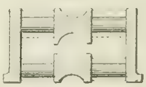


Fig 82

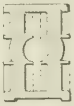


Fig 83

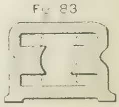


Fig 84

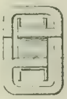


Fig 85

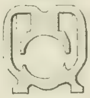


Fig 86

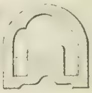
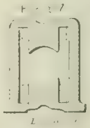


Fig 87



The *vertical single horseshoe type*, fig. 70, finally, having the axes of magnet-cores and armature in one vertical plane, is employed by the Excelsior Electric Co. (Hochhausen), New York, and by the Donaldson-Macrae Electric Co., Baltimore, Md.

Single core horseshoe frames may be designed by placing the magnet either in a *horizontal* or in a *vertical* position, or by joining two polepieces of suitable shape by a magnet of circular form. The types thus obtained are the *horizontal single magnet type*, the *vertical single magnet type*, and the *single magnet ring type*.

In the *horizontal single magnet type*, figs. 71 and 72 respectively, the armature may either be situated *above* or *below* the core. Machines of the former type (fig. 71) are built by the Jenney Electric Motor Co., Indianapolis, Ind.; the Porter Standard Motor Co., New York; the Fort Wayne Electric Co., Fort Wayne, Ind.; the United States Electr. Co., New York; the Holtzer-Cabot Electr. Co., Boston; the Card Electric Motor and

Dynamo Co., Cincinnati, O.; the Simpson Electr. Mfg. Co., the Chicago Electric Motor Co., Chicago, the Bernstein Electric Co., Boston; and by the Premier Electric Co., Brooklyn. The latter type, fig. 72, is employed by the Electron Mfg. Co., Springfield, Mass.; and by the Riker Electric Motor Co., Brooklyn.

The *vertical single magnet type*, fig. 73, is used by the "D. & D." Electr. Mfg. Co., Minneapolis, Minn.; the Packard Electr. Co., Warren, O.; the Boston Fan Motor Co., Boston; the Elbridge Electr. Mfg. Co., Elbridge, N. Y.; the Woodside Electr. Works (Rankin-Kennedy) Glasgow, Scotland; by Greenwood & Batley, Leeds, England; and by Goolden & Trotter (Atkinson), England.

Fig. 74 shows the *single magnet ring type*, which is employed by the Mather Electric Co., Manchester, Conn.

Two magnets, instead of forming the limbs of a horseshoe, can also be set in line with each other, one on each side of the armature, or may be arranged so as to be symmetrical to the armature, but with like poles pointing to the same direction, instead of forming a single magnetic circuit with *salient* poles; the form will then constitute a double circuit with *consequent* poles in the yokes joining the respective ends of the magnet cores. In both of these cases the cores may be put in a horizontal or vertical position, and in consequence we obtain two *horizontal double magnet types*, figs. 75 and 77, and two *vertical double magnet types*, figs. 76 and 79.

The *salient pole horizontal double magnet type*, fig. 75, is employed by Naglo Bros., Berlin, and by Fein & Co., Stuttgart, Germany; and the *salient pole vertical double magnet type*, fig. 76, by the Edison Manufacturing Co., New York.

The *consequent pole horizontal double magnet type*, fig. 77, is used in the Feldkamp Motor, built by the Electrical Press Co., Newark, N. J., and in the Fan motor of the De Mott Motor and Battery Co.; and the *consequent pole vertical double magnet type*, fig. 79, by the Columbia Electric Co., Worcester, Mass.; the Keystone Electric Co., Erie, Pa.; the Akron Elec. Mfg. Co., Akron, O.; the Mather Elec. Co., Manchester, Conn.; the Duplex Elec. Co., Corry, Pa.; the General Elec. Traction Co. (Snell), England; Mather & Platt (Hopkinson), Manchester, England; Immish & Co., England; Oerlikon Works (Brown), Zurich, Switzerland; and Helios Co., Cologne.

If in the latter form magnets are made of circular shape, the *double magnet ring type*, fig. 80, is obtained, which is built by the "C. & C." Electric Co., New York, and which has been used in the Griscom Motor of the Electro-dynamic Co., Philadelphia.

The *inclined double-magnet type*, illustrated in fig. 78, forms the connecting link between the double magnet and the single horseshoe types; it is employed by the Baxter Electrical Mfg. Co., Baltimore, Md.; by Fein & Co., Stuttgart; and by Schorer, in Darmstadt.

(To be continued.)

The National School of Electricity.

In accordance with the policy of THE ELECTRICAL WORLD to present in its columns all sides of a question of public interest, we print below the result of inquiries among those connected with the National School of Electricity, concerning recent criticisms directed at the management of that enterprise:

PROF. J. P. BARRETT, President of the School:—"If you will stop and consider a moment, you will see that the conduct of the school has been in strict accordance with all our promises and authorized representations. In the first place, we have never claimed to be a philanthropic enterprise, pure and simple. We are philanthropic to the extent of giving our students the benefit of carefully-prepared and carefully-taught lessons at the rate of thirty-nine cents a lesson, and this figure represents practically the actual cost. As to the character of the lessons, if the leaves themselves are not ample, you can determine by writing the different members of the Faculty just how they are prepared and revised. No member of the Faculty joined the school on our misrepesentation. We told each member what we intended to do, nothing less, nothing more, and if some of them have seen fit to express dissatisfaction, they have done it without any justification in fact. So far as the conduct of the school is concerned, we have redeemed every pledge, and will go straight forward. It is true that some members of the Faculty joined simply as honorary members, and still remain so. Others joined with the understanding that they would have practical detail work to do in perfecting the educational features of the establishment. Up to date they have lived up to their conception of what was necessary in the preparation of lessons, and express themselves as pleased with the results attained. The school [illegible] beyond our best hopes. We now have fifty-three classes with an average membership of thirty-one, and new ones are being [illegible] right along. And that reminds me that the best proof of our [illegible] is that the majority of our classes have been established by students who have actually taken lessons. So you see the people think we are all right. But if you want proof, and I suppose you do, just investigate for yourself. Ask the "active" members of the Faculty, ask the students or their instructors. Perhaps their opinions will be worth reading."

PROF. D. C. JACKSON, of the University of Wisconsin:—"Before my name was placed on the list of the Faculty of the school, the objects of the school, and the duties of the Faculty, were thoroughly explained to me. The objects seemed to be praiseworthy and honorable, and as far as I know they have been properly carried out according to the original plan. It was the intention, as explained to me, to have members of the Faculty write lessons in the various courses of the school, and the proof-sheets of these lessons were proposed to be sent to each member of the Faculty for his revision and correction. This plan has been carried out, and has apparently proved satisfactory. A number of proof-sheets of lessons written by others have been sent to me for examination and revision, and I have received corrected proof-sheets from other members of the Faculty covering the various lessons written by me. The lessons may therefore be accepted as having been examined and revised by at least a considerable number of the Faculty. It was never proposed to me that the members of the Faculty should do any actual instruction, and no case has been brought to my attention where such a suggestion was made by the managers of the school. It is absurd to expect that men tied down by university and business duties should be able to travel about the country to teach the classes, however much support they are otherwise willing to give to the school. As I have understood the matter, it has always been the intention to have a local instructor for each class, and this arrangement has be carried out. Several classes have been organized at points where members of the Faculty reside, and these members have usually participated in the organization and sometimes in the teaching of the classes of their own volition. The methods outlined for the school are ideal ones for giving instruction to the large number of people who hunger for knowledge, and who especially desire some knowledge regarding electricity and the way in which it is used. That people who wish to learn for the sake of learning are very numerous is shown by the remarkable success of Chautauqua "literary circles," which have proved a source of literary information and pleasure to many thousands of people. For such people the classes of the National School of Electricity are "electric circles," led by instructors who are chosen because of special knowledge and aptitude. The methods outlined also seem to me to be very good for the purpose of giving professional men or electrical artisans either a general or a special knowledge of the electrical industries. For instance, the course in electro-therapeutics, which the managers of the school have proposed to carry on under the general direction of Dr. Herdman, fills a place where a decided want is felt. The course which is intended to give instruction in the best methods of handling electric railway apparatus, should also be of much service to the motormen, linemen and repairmen of electric railways, especially if such classes are led by a instructor who has knowledge of the requirements of electric railway operation. Proper electrical and mechanical instruction of the electric railway employees should be as advantageous to the railway companies as to the employees, and I understand the course has been planned with the assistance of the superintendents or electricians of two or more large roads. As I am located a hundred or more miles from points where classes are likely to be demanded, I have seen comparatively little of the class work, but the activity of Professors Carhart, Shepardson and Thomas, who are near to class centres, gives me confidence that the methods are working out all right. There are others besides myself, who support the school, who would have nothing to do with the plan, did they not believe it to be useful."

PROF. GEO. D. SHEPARDSON, of the University of Minnesota:—"I am preparing the weekly lessons for the special course for street railway employees, being engaged at present with the preparation of Lesson XXIII. Proofs of these lessons are sent to other members of the honorary Faculty and each week I receive copies returned with suggestions and criticisms by various professors. The lessons are revised in accordance with these suggestions and are then returned to Chicago, where permanent plates are made for printing the copies which are sent out to the classes. Each week I also receive copies of the lessons for the general course, prepared by Prof. Jackson, upon which I am invited to make criticisms. Regarding the work of the school, I have assisted in the organization of classes in Minneapolis, St. Paul and Cincinnati. At each of the meetings for organization of classes in these cities the methods and purposes of the school were fairly presented. At each meeting I attended, it was distinctly emphasized that the school did not claim or expect to produce trained electricians, but that it did intend to give the students a thorough grounding in the elements of the subject and open the way for them to grow into a better knowledge. In no case were the people led to believe they could become famous inventors or engineers because of the knowledge imparted by the lessons. Such statements may have been made in some places by enthusiastic local speakers, but I do not believe they have been made by parties officially connected with the school. As to the work done by the classes, I hear from the classes in Minneapolis and St. Paul that the students are extremely well pleased and more than satisfied. I have learned directly from the employers of some of these men that as one result of their study they do much better work in the shop and some have become efficient workmen who have been in imminent danger of discharge for incompetency.

PROF. HENRY S. CARHART, of the University of Michigan:—"I see no reason to withdraw my confidence from the managers of the National School of Electricity. Very likely they have made some mistakes and their plans need some revision after the experience thus far obtained. But there is every reason to believe that they intend and are prepared to give the best possible satisfaction to all those who have joined the classes in different parts of the country. The object and purposes of the school are good. It is not expected that one or two courses of lessons can make electrical engineers of young men who have not the necessary technical training, but a good foundation of practical principles can be taught which will be of great service. The classes in electro-therapeutics promise the best results. Respecting my own share of the work, I have read the proof of all the lessons up to date and have made many suggestions. I have also interested myself in procuring suitable teachers for classes in Detroit, Toledo and Philadelphia, and the men whom I have nominated have all been appointed. Many are thoroughly competent to give instruction, not only in theory, but in the practical applications of electricity. Two of them have had wide experience in electrical engineering and electrical design. The school is handicapped with all the difficulties besetting a new enterprise, but there is no foundation, so far as I can see, for the attacks made upon it in certain quarters."

PROF. W. J. HERDMAN, of the University of Michigan: "I have been convinced from the time the plan of this school was first promulgated that, if it was properly managed, it would occupy a very wide field of usefulness. I was confident that it could be made useful, among other ways, in meeting the needs of a great many professional men, who would find electricity of much service to them in their work if they knew how to use it intelligently. The great obstacle in the way of a more general use of electricity as a curative agent has been a want of knowledge on the part of physicians, surgeons and dentists of the fundamental principles of electric action. Many of these professional men have for years recognized the advantages which would accrue to them from this information, but in the midst of their professional duties they could neither take the time to go away from home in search of it, nor could they find many schools where the instruction was adapted to meet their peculiar needs. The plan of the National School is such as to provide in a most satisfactory manner for meeting the requirements in this direction of such professional men. Already there are seven classes in various parts of the country, numbering in all about one hundred and forty physicians, engaged in pursuing the course arranged by the National School. This course for physicians consists of (1) lessons in electro-physics, (2) lessons in the fundamental principles of electro-therapeutics, and (3) lectures demonstrating the application of electricity to special fields of practice in medicine and surgery. The course as outlined is quite comprehensive and thorough, and, so far as I can learn, has given entire satisfaction to all who are pursuing it. The great advantage to the physician of this method of instruction is, that it furnishes him an opportunity to gain a knowledge of electricity that will be helpful to him in prosecuting his professional work, without any interruption in his business, so that he incurs neither loss of time nor means. The eagerness with which physicians have sought this opportunity furnished by the National School is sufficient proof of the demand there is for it. As a member of the Faculty, all lessons in process of preparation are sent to me with the request that they be examined and criticised and returned to the central office for rearrangement. I am directly responsible for the educational part of the electro-therapeutic work, so far as the general supervision of it is concerned. I have seen nothing during my connection with the school that caused me to doubt the honesty or efficiency of its managers. They are men of character, accustomed to affairs comprehensive in their nature, which they have always conducted to a successful issue. I have found them redeeming their promises in every instance, and have yet to hear a complaint from any one connected with the various branches they have organized to the effect that they have not complied with the terms of their agreements."

PROF. M. O'DEA, of the University of Notre Dame: "To indorse the published instruction matter of the school is somewhat similar to endorsing the maxims of Euclid. The lessons consist of standard electrical physics, similar and equal to those found in the latest text books. To this are added simple and precise details of applications and operations, with shop terms and examples of the best shop practice. Keeping in mind the class of students for whom they are prepared, the lessons are undoubtedly superior to any text book that has yet been published. This, I think, will be most readily acknowledged by those who, like myself, twelve or fifteen years ago, were earnestly searching for similar matter in the text books and in the first numbers of THE OPERATOR and ELECTRICAL WORLD. I have had correspondence and interviews with various people who are using the lessons and all expressed satisfaction and praise." Another member of the honorary Faculty states that he is not well enough posted in regard to the worth of the school or its methods to say anything, and that he has requested to have his name withdrawn, though, he adds, he does not care to advertise the fact of his withdrawal.

A list of the school's instructors furnished to us is printed below. These gentlemen are stated to be, in nearly every case, graduates of some technical institution, but in the hurry of preparing the list it was impossible to ascertain the name of the Alma Mater in every case:

CHICAGO: H. G. Brownell, Rose Polytechnic; Locke Etheredge, Cornell University; Glen Wray, Cornell University; C. E. Sturtevant, Institute of Technology; J. J. Green, Ohio State University; George Foster.—ST. LOUIS: A. J. O'Reilly, City Electrician.—JOLIET, ILL.: George B. McClelland.—BELVIDERE, ILL.: J. A. Parkhurst, Rose Polytechnic.—AURORA, ILL.: E. H. Richardson, Aurora Electric Co.—MINNEAPOLIS and ST. PAUL; George B. Morse, Pillsbury Co.—FORT WAYNE, IND.; A. L. Hadley, Thomas Duncan, Fort Wayne Electrical Corporation.—ELKHART, IND.: H. G. Brownell, Rose Polytechnic.—TOLEDO, OHIO: H. P. Doge.—DETROIT, MICH.: H. R. King, University of Michigan, Electrical Engineer.—COLUMBUS, OHIO: James E. Boyd, N. H. Brown, Instructors in Ohio State University.—CINCINNATI, OHIO: Thomas J. Creaghead, Electrical Engineer; Prof. Thomas French, Professor of Physics, Cincinnati University.—NEW YORK and STAMFORD, CONN.: Max Osterberg, Columbia College.—SCHENECTADY, N. Y.: Alfred E. Wiener, of the General Electric Co.—BOSTON and FALL RIVER, MASS.: John W. Sears, Jr., Massachusetts Electric Supply Co.—JERSEY CITY, NEWARK and PATERSON, N. J.: Newton Harrison.—PLAINFIELD, N. J.: A. J. Clemens.—WISSAHICKON, PA.: S. A. Tatnall, of Queen & Co., Philadelphia, Pa.—PHILADELPHIA, PA.: Elmer G. Willyoung, of Falkenau Engineering Co., Philadelphia, Pa.

Fly-Wheel Accidents in Power Houses.

To the Editor of The Electrical World:

Sir—Mr. M. P. Ryder, in his letter printed in THE ELECTRICAL WORLD of December 29, 1894, is correct in saying that the automatic cutout, suggested by me in your issue of December 8, should be in series with the armatures. This was intended, but at the moment of writing, I overlooked the fact that while if connected to both terminals of the armature it would be in series when the dynamo was generating, it would be in parallel when running as a motor. I did not lose sight of the fact that the polarity of the dynamo would not be reversed. Had I taken time to read over what I had written, or noticed that it had been published, I should have noticed and corrected the mistake myself.

Somerville, N. J. A. H. BURNETT.

Static Electricity and Printing.

To the Editor of The Electrical World:

Sir:—I seek information on a subject which I feel sure interests many readers of your most valuable paper, viz.: the presence of static electricity in paper during the process of printing on cylinder presses, and a means of getting rid of the same. I trust that yourself or some of your readers can suggest a way of partially eliminating, at least, that which is the cause of so much annoyance and loss to printers.

New York, N. Y. S. WALLACE.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 927 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Influence of Current Curves.—Referring to the recent paper of Dr. Duncan, read at the May meeting of the American Institute of Electrical Engineers, Mr. Kolben, of Oerlikon, in a brief paper discusses the subject of the influence of the form of the curve of the alternators on the running of motors, his paper being published in the "Elek. Zeit.," Dec. 20. He gives the conclusions arrived at from observations with several hundred alternating current motors. A correctly constructed single or multiphase motor, he claims, is entirely independent of the construction of the generator and of its current form, that the motor will always run well and that any differences in the current consumption at starting, at no load and at full load, as also the watt consumption and the power factor, are practically negligible; he gives the results in tabulated form for a motor run with two different alternators, the results showing that the curve form has practically no influence on the running of the motor. A matter of much greater importance, however, is the influence of the motor on the curve form of the generator; for high voltages, curves with points whose maximum values are double the mean should be avoided; in certain cases a generator having a very good curve may have it changed to a very dangerous one by the motor; several curves of this kind are shown for a 300 hp, three phase generator loaded with a 200 hp non-synchronous motor which drove a factory together with a well regulated steam engine, the generator being driven by a turbine (the curve is very jagged and has the character of numerous saw teeth); besides the resulting increased iron losses in the generator, transformer and motor, the maximum voltage is very high, being in this case 13,000 volts, the self induction of the line, and the impedance factor will be appreciably increased, and the charging current of the line will become greater, causing an increase in the line loss.

Dynamo Without Iron.—A paper by Prof. Pietzker is published at considerable length in the "Elek. Zeit.," Dec. 20. He discusses theoretically the construction of a dynamo without iron, consisting of two armatures, one revolving inside of the other. The system is the same as that described in the Digest, Aug. 11. He concludes that the weight would thereby be reduced to ¼ or even ⅕ of that of a dynamo with iron; the volume and the cost would also be reduced and the machine would not have the objections which in the present forms are caused by the magnetization of the armatures; one objection is that the external resistance cannot be increased beyond a certain value as the machine would then die out. (The machine has not been constructed and the article appears to be of no practical interest.)

Starting Motors.—In a communication to the "Elek. Zeit.," Dec. 20, Mr. Egger describes a system of especial use for smaller motors. When at rest the magnets are short circuited by the starting resistance and the armature, and therefore when stopped there is no spark due to the field magnet circuit; at starting there is no resistance in the field circuit, but it is all in the armature circuit, under which conditions the motor will run at the lowest speed; for full speed the total resistance is in the field and none at all in the armature circuit. He discusses also the objections raised by Mr. Manges to his proposed system described in the Digest, Sept. 15.

Transformer Chambers.—A report of another conference of the Board of Trade is published in the Lond. "Elec.," "Elec. Rev." and "Elec. Eng.," Dec. 21; it is also discussed editorially in the former.

LIGHTS AND LIGHTING.

Projectors.—The second part of the long serial by Messrs. Tchikoleff, Klasson & Turin, is begun in "L'Eclairage Elec.," Dec. 8. They attack very severely the recent publication of Mr. Blondel, stating that his results are absurd and contrary to what really exists, etc.; to this Mr. Blondel replies briefly in a foot-note stating that they do not appear to have given his publication sufficient attention nor that they have considered the recent publications of other authors, as, for instance, those of Mr. Nerz; he states that the experimental data agree with his statements. In the present article the authors treat of the visibility of objects illuminated by electric projectors, and the solution of some practical problems concerning lighting by projectors; they give a large table containing practical data, under various circumstances, for lighting and for seeing objets; this data, if reliable, would probably be of use to the interested in this subject. Among other things they state that for parabolic projectors, with short focal distances, the horizontal position of the carbons is indisputably the best; even for the Mangin projectors recent measurements have shown that the horizontal position is the best; in view of which fact the French government has recently ordered 100 of them to be fitted up in this way; they consider that the advantage of parabolic reflectors over the Mangin mirrors of the same dimensions has been demonstrated; with projectors 90 cm in diameter, large white buildings were visible at a distance of 9 km by a person stationed at the projector; large vessels were visible at a distance of 6,000 metres, especially when they have sails or when smoke issues from the chimneys, but it is difficult to see black vessels at a distance of 5,000 or even 4,000 metres, while small boats can be seen at 2,000; but all these figures depend on the state of the atmosphere and other conditions; with field glasses, persons can be seen at a distance of 3,200; all these figures refer to the most transparent condition of the air and apply almost equally well to the Mangin and the parabolic reflectors; with projectors 60 cm. in diameter, the visibility diminishes from 10 to 15 per cent. The article appears to be well worth the attention of those interested and does not admit of being abstracted.

Incandescent Lamp.—The long serial by Mr. Bainville, mentioned before in these columns, is concluded in "L'Elec.," Dec. 15. It will be remembered that a translation of this series is being published by the Lond. "Elec. Rev."

Scott Flashing Lamp.—The Lond. "Elec. Rev.," Dec. 21, states that after a trial for over two years the Admiralty has decided that this lamp is not suitable for naval service.

Explosion of an Incandescent Lamp.—In "La Nature," Dec. 22, Mr. Bleunard states that a workman recently held an incandescent lamp near a belt, when suddenly it exploded; the explanation of it is that the lamp forms a Leyden jar and was charged by the static electricity generated by the belt, the charge increasing to such an extent that it pierced the glass, after which an explosion naturally followed; the experiment can readily be repeated with an influence machine.

POWER AND HEAT.

Transmission from Coal Fields.—A paper by Messrs. Thwaite & Swinburne from the "Nineteenth Century," of December, is abstracted briefly in the Lond. "Elec. Eng.," Dec. 21. The project is to supply electric power from central stations built in the centre of the coal fields and transmit it to the great industrial centres, including London, where transforming and storage stations could be erected; the electric energy could be sold to the different distributing companies at a little over two cents per kw hour and to the small factory owner for about $25 per 3,000 working hours for one hp; in London this costs at present about twice as much; the system enables valuable chemical constituents to be recovered from the coal, which at present cannot be done in the small steam power plants; one of these constituents is sulphate of ammonia; it is estimated that one hp hour can be obtained for ¾ pound of coal, the average consumption at present being 5 pounds; the loss in transmission from the coal fields to London is about 33 per cent.; for transmitting 10,000 hp, three bare conductors for the positive and three for the negative would be used and run on oil insulators; 30,000 volts are to be used; the London stations can then sell their current from 6 to 8 cents per kw hour instead of the present amount, which is about double this.

Utilization of Wind Power.—Mr. Kennedy in the Lond. "Elec. Rev.," Dec. 21, calls attention to the difficulty inherent to the fact that the windmill runs at very variable speeds, while the dynamo in charging a storage battery requires a nearly constant speed; he therefore proposes as the only solution to store the wind itself in the form of compressed air, a scheme which he thinks is practicable, the windmill of the horizontal type would compress air into steel reservoirs up to a pressure of 10 atmospheres; this air would then be used to run an engine driving a dynamo, with or without accumulators; the plant would cost considerable, but the working expenses would be low. Where an elevated reservoir for water can be readily formed, the windmill may be used to pump water into this reservoir, which in turn would drive a turbine and dynamo, but in this case frost might interfere.

[illegible] "L'Energie Elec.," Dec. 16, publishes an illustrated description of a lighting installation in Paris. The description contains but little data; the windmill has 10 vanes and the diameter is about 17 feet. It will develop about 2 hp with a wind of 5 to 7 metres per second and 8 to 9 hp with a wind of 12 to 15 metres per second. The illustration includes the windmill and the automatic electric cut out.

Niagara Power Works.—A photograph of the interior and exterior views of the power house is published in the Lond. "Engineering," Dec. 21.

Operating Machine Tools by Electricity.—The "Eng. Mag." for Jan. contains a paper by Mr. Richmond including a number of illustrations of shops and tools. He states that experiments on a variety of tools have shown that 1 hp applied directly is sufficient to remove about 40 pounds of cast iron, 33 pounds of wrought iron, and 23 pounds of steel. He gives a table which contains the total hp, and that required to drive the shafting in 10 large establishments in this country, from which it appears that the power lost in the shafting varies from 15 to 80 per cent., the average being 38.6; but these conclusions are only very general. He discusses the driving of tools by individual motors; with light travelling cranes running over all the tools and with direct driven machines in which the variations of the cut can be followed up with changes of speed, more work could be gotten out of a machine tool "than had ever been dreamed of." He admits that there are many applications of the direct driven machine tool which fully justified the claims, but for an ordinary machine shop he states that "in the present state of the art it can hardly be seriously claimed that such a shop could be run with a less expenditure of motive power than one fitted up with reasonable efficient transmission." As the coupled motor must furnish the maximum power required, one question is, whether the safety fuse can be depended on to the same extent as the slipping of the belt, to avoid disastrous results of carelessness or inattention. He gives as the average efficiency of such motors 60 to 70 per cent., because they are usually run below their rated capacity; and for the generator 85 to 90 per cent., making a total of about 50 to 70 per cent.; on account of the time required to take care of the motors he believes that in point of economy the advantage remains with shaft transmission; the fact that the motor stops when no work is done he thinks is not as important a fact as is usually believed, as the majority of the tools in an ordinary shop run with short intermissions, but for larger tools subject to intermittent use, and distributed over a large area, the advantage may be in favor of electric transmission; besides, there is the advantage of a clear headway. He describes such an installation in the shop of the De La Vergne refrigerating machine company, including a full page table giving the results of trials extending over five weeks, including the time run by each motor, the machine driven by it and the average hp as recorded by a wattmeter; the average electric hp was 9.63, while the indicated was 23.98; he suggests using a smaller plant in connection with storage batteries. An equipment of direct coupled motors is undoubtedly more expensive than shaft transmission. The number of men employed per hp varies very much in different shops, the average of 10 shops being about 3 men; he deduces the conclusion that 1 per cent. increase in the efficiency of the tool would compensate a doubling up of the total hp now used in these 10 shops, and "hence the money value in any possible difference in the cost of transmission sinks into insignificance before only a small percentage of increase in the efficiency of the tool;" the principle proposition is, does direct driving increase the efficiency of the tool, if so, to what extent?

Water Wheels.—"Industry" for January, in an article on Constructive Engineering on the Pacific Coast, describes and illustrates a Pelton water wheel in connection with dynamos.

Mine Hoist.—A mine hoist of 125-hp constructed by the General Electric Co., is illustrated and briefly described in "Industry" for January.

Selection of Motive Power.—The "Eng. Mag." for January contains the first paper of a series on this subject, by Dr. Emery, parts of which may be of interest to the electrician.

TRACTION.

Accumulator Traction.—The discussion of Mr. Gibbings' paper (see Digest, Jan. 5,) is published in the Lond. "Elec. Eng.," Dec. 21. Mr. Manville discussed the destructor plant; regarding accumulator traction he stated that he was running the only system in use in that country, and that the company has never yet been able to make both ends meet, the cost of running by this system being under most circumstances prohibitive; this was not due to the depreciation of the accumulator plates, which cost 3.5 cents per car mile, whereas the total cost of running exceeded 18 cents; by the trolley system it would be only 9 cents; adding the renewal of the plates to this, there still remains the balance of about 6 cents, which was absorbed in the extra cost of labor in handling, cleaning, etc., of the accumulators and the extra depreciation of the car bodies due to the fumes from the accumulators; even if the accumulator plates cost nothing, the cost of handling them and the cost of repairing the damage they did would prohibitively raise the cost above that of other systems; they found that they used about 1-kw hour produced at the generating station for every car mile running, so that the energy cost less than half the expense of handling the accumulators and repairing the cars. He favors the use of accumulators at the station where there is no extra expense in handling them and none for car repairs; such a system was recently installed on the Isle of Man. He suggests that an alternating current motor with a continuous current generator attached would make an almost ideal motor generator when run in connection with accumulators. Mr. Ferranti stated that even if the batteries could be charged by current cheaply obtained from the lighting station, it must be remembered that the latter plant could be relied on only for a short number of hours out of the 24, as a sufficient margin must be allowed for the continuous heavy load for a few days in the winter of every year; if it were not for this difficulty he believes that batteries for assisting the ordinary supply stations would have been largely introduced. Mr. Hesketh stated that on one of the Continental lines, on which accumulator traction was used, there were about 100 men in the station charging and attending the batteries for only 20 cars.

In a communication to the Lond. "Elec. Rev.," Dec. 21, Mr. Epstein replies to some criticisms of that journal regarding the recent paper of Mr. Gibbings. Referring to the editorial criticism he states that the premises, the facts, and, therefore, the conclusions are utterly wrong; regarding the depreciation of certain accumulators he states that it is covered by a small fraction of a penny (2 cents) per car mile run; the fact that several lines were financially unsatisfactory, he states was due to circumstances with which the batteries had absolutely nothing to do; traction by means of accumulators if properly managed is not dearer, but in many cases cheaper than by any system of long distance transmission; regarding the payment for the capital sunk in batteries, he states that this is true also for that sunk in other electrical systems, and as the first outlay in accumulator traction is considerably less, the balance is in its favor; he states that the batteries can be charged as rapidly and as economically as they are discharged, also that two sets per car are sufficient, besides a reserve of one set for two cars; regarding the additional weight he states that it is not quite three-quarters of a ton more for a 10 ton car for 52 passengers, or about 8 per cent. of the total weight.

Traction.—The discussion of the recent Institution paper is continued in the Lond. "Elec. Rev.," Dec. 21 (see Digest, Dec. 29). It contains very little of technical interest; Mr. Lea discussed the subject of rack railways; Mr. Wain stated that the failure of storage batteries in England for traction purposes was due to a variety of causes and not necessarily to the batteries themselves; he has tried accumulators of a number of different types, and is about to try the Theryc-Oblasser cells on the Birmingham road; the side trolley system at South Staffordshire was very satisfactory from both a pecuniary point of view and to those who objected to overhead wires from the aesthetical standpoint.

Alpine Road.—According to the Lond. "Elec. Eng.," Dec. 21, the Swiss Council of State, by a large majority, has granted a concession for the construction of the mountain railway to the top of the snow-clad Alp, Jungfrau (described in the Digest, March 17); the assent of the National Council is assured, and it is stated that the capital for this bold undertaking has already been found chiefly in England and America.

The "Elec. Tech.," Dec. 15, states that there is a project, which will probably be carried out, for the construction of an electric road in the heart of the Alps, extending from the town of Zermatt to the Gornergrat (a favorite point, from which one of the finest views in the Alps can be obtained); it will be a rack and pinion line 6 miles long and is to cost about $700,000, the highest point reached being about 10,000 feet above the sea.

Surface Contact System.—In a report in "L'Eclairage Elec.," Dec. 8, Mr. Wuilleumier states that in his system, which is in use at Lyons, France (described in the Digest, Oct. 13 and 20), a distribution box complete costs about $64, and that in general the cost of his system is the same as that for the overhead wire, giving the figure $4,200 per km (or about $7,000 per mile) for an installation in Paris.

South Staffordshire Railway.—According to the Lond. "Elec. Eng.," Dec. 21, the cars on this line have stopped running and it is uncertain whether the service will be renewed (it will be remembered that on this line a side trolley system was used); it is stated that the stoppage is due to a failure of the tramway company to pay the contractors for running the cars.

Coupled Wheels on Cars.—The question whether the wheels of electric cars should be coupled or not, is briefly discussed in the Lond. "Elec.," Dec. 21; with coupled wheels the traction friction and stiffness are increased considerably; if one motor starts racing, all the trains and tractive effort are thrown on the other motor, which then has all the work to do and therefore starts racing too; but if the motors are coupled the chances of a general slipping are reduced very considerably.

Light Railways.—A report concerning some railways in Belgium is published in the Lond. "Elec.," Dec. 21.

Flying Machine.—A lecture by Prof. Wollner on his flying machine is abstracted in the "Elec. Tech.," Dec. 15. He states that the reported failure of the machine was premature and that his experiments had to be discontinued temporarily on account of other reasons; from the experience which he has had he is convinced that the solution of the problem is possible.

New York Rapid Transit Railway.—The "Eng. News," Dec. 27, publishes in full the report of the chief engineer, Parsons. No mention is made of any of the electrical features. Among the objections to the provisionally adopted plans are that the cross section is entirely too small, as it is necessary to provide more accommodation for inspectors and trackmen; a width of 50 ft. is given as the minimum; the standard car of the Manhattan Railway has been adopted and requires a clear height of tunnel of 13 feet; the provisional plan did not consider the question of sewers; the only practical method by which such a road can be constructed would be by open cut; he does not approve of the double deck plan and suggests the construction of express lines under other streets to City Hall; he suggests, however, an alternative plan, of which a good illustration is given, for a two track road in a masonry tunnel and two single circular tunnels of iron, beneath it, for the express line; the construction of the line involves the tearing up of only half of the street at a time; estimates are given of the cost of each of the various sections of the lines as also for the alternative plan.

Accumulator Traction.—According to the "Eng. News," Dec. 27, cars are now being equipped with the Waddell-Entz alkaline storage battery for use at Hagen, Berlin and Vienna, at which latter place they are to run on a regular steam railway between ordinary trains on which, therefore, high speeds must be obtained

The first part of Mr. Gibbing's paper (see above) is published in the "St. Ry. Gaz.," Dec. 29, in which it is also discussed editorially.

Power Plant of the Steinway Ry.—An illustrated description of the power house is published in the "St. Ry. Gaz.," Dec. 29; the article includes the results of a test in detail made at the power house, most of the data referring to the boilers and engines; there was a total average hp of the engine of 425, the average electrical hp was 340.6, the ratio of the electrical to the indicated hp. was 80 per cent., 2.77 pounds of coal were used per electrical hp per hour; the test lasted 6 hours.

Traction.—A part of the discussion of the recent Institution (London) paper, which has been abstracted in these columns, is reprinted in the "West. El.," Dec. 29, particularly the remarks concerning American practice by Messrs. Keith and Parshall. The article on Mr. Preller's paper from the Lond. "Elec. Rev." is also reprinted in the same journal.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Train Lighting.—"L'Elec.," Dec. 15, abstracts from "Genie Civil" a description of the lighting of the German post office cars; oil lamps were abandoned because of the danger of fire; experiments have shown that the electric lighting is successful in every way and is even cheaper than lighting by oil gas; at present 445 cars are lit electrically with 6 to 12 lamps of 12 cp and 30 volts, each car containing from 4 to 8 cases of 4 accumulators each which will run the lamps for 26 to 32 hours; the charging of the accumulators requires 15 hours and the capacity is 120 ampere hours; at one station 864 cells are charged at one time.

Rules and Regulations.—A system of rules proposed by the German Electrical Society to guard against fire risks is published in the "Elek. Zeit.," Dec. 20; they are about to be discussed at a subsequent meeting of the Society; they do not admit of being abstracted. Installations are divided into four different groups, different rules being given for each group.

Central Stations of Great Britain.—The Lond. "Elec. Rev.," Dec. 21, publishes a supplement containing a list of the central stations in Great Britain with a brief description of each one; the data are not tabulated nor are any general conclusions given.

Cologne.—A well illustrated description of this station is concluded in Lond. "Engineering," Dec. 21.

Central Stations in Europe.—The table with some descriptive matter from "L'Ind. Elec.," recently referred to in these columns, is reprinted in the "West. El.," Dec. 29.

WIRES, WIRING AND CONDUITS.

Insulated Cables.—According to the "Rev. Ind.," Dec. 15, Mr. Snedekor has suggested the following process: After coating the conductor with vulcanized India rubber, it is covered with a paste formed of 40 parts by weight of magnesia, 28 of talc, 15 of finely pulverized asbestos, 30 of liquid glue, 15 of glycerine and 0.25 of bichromate of potash or of soda; the cable is then passed through a bath containing 180 litres of water, 27 klg. of silicate of soda and 13.5 of alum; it is then dried and covered with a coating of 40 parts of sulphide of carbon and 80 of asphalt.

ELECTRO-PHYSICS AND MAGNETISM.

Tesla Effects With Influence Machines.—The conclusion of the lecture by Dr. Toepler (see Digest Dec. 29) is contained in the "Zeit. f. Elek.," Dec. 15. He showed the experiment in which an incandescent lamp was brilliantly illuminated, although shunted by a thick wire bent in the form of a loop, and to show that it was due to surface conduction he added a thin but wide sheet of metal bent like the wire and connected to it, which, therefore, greatly increased the surface but scarcely affected the cross section, the lamp in this case diminished greatly in candle power. With such high frequency currents iron has the opposite effects in a transformer than with the usual currents, which he showed with the aid of a lamp run from a high frequency transformer in which the iron could be introduced or withdrawn; a core of insulated copper wires produced no effect but a glass rod covered with tin foil almost extinguished the lamp. He gives the data for 4 coils and describes various experiments with them; he showed that there was a very appreciable repulsion between the coils of a transformer; by transforming the high frequency current to another of lower voltage and greater current, iron wires were melted and a sort of arc light consisting of a point of carbon resting on another could be lighted; other experiments were shown by transforming the high tension currents still higher. He performed the experiment of illuminating a Tesla single pole lamp, in which case, however, the glass opposite the filament soon became very hot; in one case the voltage was so high that the whole transformer was surrounded with light in the form of a brush discharge; he estimates that the voltage was 500,000; although of considerable intensity, these high tension currents give off comparatively little heat. Geissler tubes placed near two condensor plates, but not in contact, were so brightly illuminated that the experiment could readily be shown in daylight. In conclusion he states that almost all the Tesla experiments can be shown with his large 60 plate machine, but perhaps not on such a brilliant scale, the difference, however, is not as great as would appear from the difference in the amount of power used (concerning which, however, he unfortunately gives no data).

Tesla's Researches.—A lecture of Dr. Tuma on Tesla's researches is briefly abstracted in the "Elek. Zeit.," Dec. 20. According to Prof. Puluj there are two chief drawbacks against the use of this "light of the future," one being that with such high tension currents there is a generation of ozone which is as dangerous to breathe as chlorine gas; and the second is that a sufficiently durable insulation cannot be obtained; he also stated that Prof. Puluj showed similar lamps as early as 1880; they were run from a Ruhmkorff coil, and are said to have had a greater candle power than those of Tesla; references to the description are given; he states that long ago, in the eighties, Mr. Von Marxow showed experimentally that the physiological action of alternating currents is less, the higher the frequency.

Temperature of the Arc.—A paper by Mr. Violle from "Comptes Rendus," Vol. 114, page 949, is published in "L'Eclairage Elec.," Dec. 8. He used currents up to 1,000 to 1,200 amperes; from photographic observations he finds that the brilliancy of the positive crater is still exactly the same with these currents as with 10 amperes, and he believes, therefore, that what takes place in the crater is the physical phenomenon of the vaporization of the carbon, which is characterized by a constant temperature and which is the same as that which he has measured up to 400 amperes. In conclusion he states that the temperature of the arc is generally higher than that of the positive carbon and that it increases with the energy.

Origin of Frictional Electricity.—A translation of Mr. Christiansen's paper mentioned in the Digest Dec. 22 is given apparently in full, with illustrations, in the Lond. "Elec. Rev.," Dec. 21.

Slow Changes in the Permeability of Iron.—In reply to the article on the open circuit loss in transformers (see Digest, Dec. 29 and Jan. 5), Mr. Mordey, in the Lond. "Elec.," Dec. 21, states that he has been investigating this subject and has obtained some interesting results which he has communicated to the Royal Society, and he can, therefore, not discuss the matter at present, but he gives the conclusions to which he has been led, which are as follows: "1. The effect is not fatigue of the iron caused directly by repeated magnetic reversals; it is not progressive magnetic fatigue. 2. Neither magnetic nor electric action is necessary to its production. 3. It is a physical change resulting from long continued heating at a very moderate temperature. 4. It is greater if pressure is applied during heating. 5. It is not produced when the iron is allowed to rise more than a few degrees above the ordinary atmosphere. 6. It is similar to the effect produced by hammering, rolling, or by heating to redness and cooling quickly. 7. The iron returns to its original condition on reannealing. 8. It does not return to its original condition if kept unused and at ordinary atmospheric temperatures, whether the periods of rest are short or long." The practical outcome of the matter is that transformers should be made larger, more costly and less efficient, if this effect is to be avoided, or that the increase, if it occurs, should be endured; the latter is, in his opinion, the preferable course; the importance of the effect may be over-estimated on account of the low values of the magnetizing losses; a 40 per cent. increase really means an increase of only 0.388 per cent., as it is 40 per cent. of 0.97 per cent.

Mr. Wilson, in the same journal, states that he has made a long series of experiments with a 2-kw Westinghouse transformer, which results bear out some of Dr. Fleming's remarks; after 6 hours running the losses were smaller than at the commencement by about 4 per cent.;

he also states that the form of the current is most important and that for the same alternator it is a function of the load.

Modern Theories as to Electricity.—An article with this title by Prof. Rowland is contained in the "Eng. Mag." for January. The article should be read in its entirety, but the following will give a general idea of its contents. He states that it is now certain that electricity no longer exists, meaning electricity in the old sense of the word, in which it refers to a fluid; "there is nothing more certain to-day than that electricity is not a fluid." He describes Faraday's magnetic and electrical lines of force, specially the latter; if the two poles of a battery terminate in two balls, the battery generates lines of force which "crowd together around it and push each other sideways until their ends are pushed down the wire and many of them are pushed out upon the balls," thus charging the balls with electricity; "the motion of the ends of the lines of force over and in the wire constitutes what is called an electric current," which is accompanied by magnetic action around it and by electromagnetic waves which pass outward into space. When glass is rubbed the glass can be supposed to take hold of one end of the lines of force and the rubber the other end, and it is only necessary to pull the bodies apart in order to fill the space with lines; all electrification is originally produced by separating the atoms of the bodies either by breaking contact or by chemical action; these electrostatic lines must always begin and end on matter, and they cannot end in or pass through a vacuum which is a perfect non-conductor; very little is known of the nature of resistance or conduction; neither electrostatic nor magnetic lines of force can move without being accompanied by the other. Regarding variable currents, he states that the electrical vibrations must be very violent before waves carrying much energy are given out; the velocity of these waves is nearly 300,000 kilometers per second, which is exactly the velocity of waves of light, and there is no doubt at present that these waves of radiation are electromagnetic waves. He then discusses at some length the properties which ether must have in order to account for these and other phenomena; to account for the earth's magnetism the rotation of matter in the ether must produce magnetism; to account for gravitation, two masses of matter in it must tend to move toward each other according to the known law, but without any loss of time in the action of the force; the moving electric or magnetic bodies, however, require a time represented by the velocity of light before they can attract each other. The theory of electricity and magnetism reduces itself to the theory of the ether and its connection with ordinary matter; he discusses what the ether must explain in order that one may imagine its nature; he concludes that ether is not matter but something on which many of the properties of matter depend; to explain magnetism physicists usually look to some rotation in the ether; a smoke ring gives to some extent the modern idea of a magnetic line of force; electrostatic action is more difficult to explain, but there is a vague idea that it is due to some sort of elastic yielding of the ether.

Mirrors of Magnetism.—The recent paper by Prof. Thompson and Mr. Walker mentioned in the Digest, Dec. 22, is abstracted briefly in the "West. El.," Dec. 29.

ELECTRO-CHEMISTRY AND BATTERIES.

Accumulators.—The Boese system (which the compiler believes is used on the German postal cars) is described and illustrated in the "Zeit. f. Elek.," Dec. 15; the object is to combine a number of glass cells in one retaining box and mount them rigidly, but with sufficient elasticity to prevent them from being injured when used for portable or traction purposes; a set of glass cells are inserted in a box, into which is then poured a melted mass of some insulating material, of which he mentions a large number, which when cold are rigid, but elastic, and will retain the liquid even if the glass cell should break.

Preparation of Magnesium and Lithium.—A laboratory apparatus for obtaining these elements electrolytically in a furnace, devised by Mr. Borchers, is described and illustrated in "L'Eclairage Elec.," Dec. 8, the elements, together with beryllium, are obtained from their fused haloid salts. The same journal describes and illustrates Chaplet's electric furnace, in which an inclined retort containing the material is heated by means of arcs, the molten metal being collected in the bottom and drawn off.

Electric Tanning.—As was stated in these columns a number of times, the Groth system has been introduced on a large scale in the town of Orbe, Switzerland. According to the "Elek. Anz.," Dec. 20, the process has been abandoned, as it was found to be too expensive.

Cyanide Process of Extricating Gold.—"L'Eclairage Elec.," Dec. 8, contains another article by Mr. Andreoli on this subject, in which he refers more particularly to the recent litigation in England.

Electro-Chemical Works.—The "Elec. Tech.," Dec. 15, gives a list of the electro chemical works which have been installed in Germany and Austria during the past year; chlorine and alkali works were installed at Bitterfeld and Vienna, the Kellner process being used in the latter; zinc works at Duisburg, where the Dieffenbach process is used; carborundum works at Iserlohn, Germany, where the Acheson process is used.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Central Station Instrument Equipment.—An article on this subject by Mr. Nalder is published in Lond. "Lightning," Dec. 20. For insulation he recommends a highly sensitive galvanometer, with shunts, etc., and with a sufficient number of cells to equal the working voltage; he recommends the use of an indicating apparatus for recording any change in the insulation; in the Wallis-Jones method a clock connects one side or the other of the mains alternately to earth through a recording galvanometer; for keeping a record the Cardew indicator is in use for alternating current systems, and consists of a recording galvanometer of the moving coil type in circuit, with a reactive coil of low resistance but of high inductance, and a battery of cells which is attached to one side or the other of the mains and earthed at the other ends; the battery current is, therefore, used independently of the alternating leakage current. For a standard ammeter he recommends the Kelvin balance; for direct currents only a potentiometer is often preferred. He describes and illustrates such an instrument, one of the features of which is that there are two cells, one of which is used in measuring, while the second can be compared with it by connecting them in series through a galvanometer, but opposed to each other. For direct currents he recommends permanent magnet volt meters; the deterioration of the magnet has recently been overcome "by making the control wholly due to the field which in the coil moves; any change thus effects the control and turning moment alike and the reading remains constant;" for alternating currents of about 100 volts he recommends a static volt meter of the electromagnetic type, when calibrated for the proper frequency; for low voltage, static instruments usually give too small readings; to free an ammeter from disturbance on the switch board it should be astatic; when very large direct currents are to be measured a fall of potential method and a reflecting D'Arsonval galvanometer give the widest possible range.

Measuring Small Resistances.—The Lond. "Elec.," Dec. 21, abstracts briefly from "L'Elettricista" a description of a new method by Dr. Pasqualine. It requires no special apparatus and consists in using a coil composed of a few turns of wire wound double so that there are two similar circuits; it is fixed to the case of an ordinary galvanometer so as to act on the needles; the main current which passes through the resistance to be measured passes through one of the circuits on this coil; a shunt circuit to the resistance is formed by the second circuit of the coil, the galvanometer and the resistance box; the main and the shunt current tend to turn the needle in opposite directions, and the resistance of the shunt circuit is varied until the deflection is zero, in which case the resistance is equal to that of the shunt circuit divided by the galvanometer constant and multiplied by the "constant which expresses the effect of either of the circuits in the auxiliary coils on the needle;" the ratio of these two constants can be obtained by performing experiments with a known resistance. With an auxiliary coil containing two circuits of four turns each and a Wiedmann galvanometer of 8 ohms, he can measure a resistance of .002 ohm within 0.004 x C (?), in which C is the total main current; a standard ohm was used to determine the ratio of the constants.

Simple Student's Apparatus.—A Physical Society paper by Prof. Ayrton and Mr. Haycraft on such an apparatus for determining the mechanical equivalent of heat, is abstracted briefly and discussed in the Lond. "Elec.," Dec. 21; the same issue also contains an editorial on this subject. This apparatus enables the student to find the mechanical equivalent, correct to 1 per cent., without having any corrections to make. A current is passed through a strip of manganin ¼ inches wide, 0.03 in. thick and 5 ft. long bent into zigzags; it is immersed in 2,000 cb. c.m. of water, the current, the difference of potential, the temperature and the time being measured; a certain minimum time is required and "the ratio of the heat lost to the heat generated must be kept equal to the probable error in the time or temperature measurement;" calculations show that the error is proportional to the 6th root of the mass of the water; the time adopted was 2 minutes, during which the rise of temperature is about 3.87°, the resistance was less than ⅓ ohm, the current 30 amperes and the heating surface about 60 sq. in.; an example is worked out; the result obtained being 779 foot-pounds. In the discussion Mr. Griffiths disagreed regarding the educational value of such an apparatus, as it failed to familiarize the student with the intelligent application of corrections. Prof. Foster objected to the use of direct heating instruments by students, as they give no scientific information. Prof. Thompson stated that this was a good example in choosing the proper dimensions for an experiment; he denied that the use of direct heating instruments was harmful, and asked where the line should be drawn between old-fashioned and new instruments. Dr. Sumpner described an apparatus which he had been using for a similar instrument; it consisted of a length of flexible tubing through which a current was passed while it was kept cool by a stream of water passing through it, the difference of temperature of water at the two ends being measured; he believes that fully as good results could be obtained; the correction for cooling could be eliminated by having the temperature at one end as much greater than that of the air as the other end was lower; he thinks that young students should be given simple instruments in which corrections could be neglected; they could proceed to take corrections into account afterwards. Prof. Ayrton, in replying, stated that the object of the present instrument was not to learn how to make corrections, but to learn what was meant by the mechanical equivalent heat.

Large Wheatstone Bridge.—A view from Dr. Edelmann with five decimal resistance coil groups, is described and illustrated in the "Elek. Zeit.," Dec. 20.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone System.—An improvement described and illustrated in the "Elec. Zeit.," Dec. 20, consists in the combination of the induction coil with the call; the usual spools for the call bell are coils wound with primary and secondary windings, which are then used as the induction coils, the results being economy in material and simplification of the system, also that the call is always in circuit, it being then possible to call the subscriber even if he has forgotten to hang up the telephone.

Constructing Relays.—In an article by Mr. Schebesta in the "Zeit. f. Elek.," Dec. 15, he discusses in detail and at some length the best construction of relays, giving the results of numerous measurements and deductions; the article does not admit of being abstracted.

Carbonelle Microphone.—"L'Ind. Elec.," Dec. 10, contains an article of some length, describing the advantages of the system of Mr. Carbonelle, in which the microphone has a very great resistance, about 1,000 ohms at rest, and from 6,000 to 8,000 during a conversation; the system is said to be much more economical and to increase considerably the limits of the transmission. In the ordinary system in which an induction coil is used, the increase of the resistance due to the variations in the contact does not even double the resistance of the primary circuit, but even admitting that it is doubled, it is shown that the energy utilized is only 2 per cent. of that furnished by the battery; another serious inconvenience due to the use of the induction coil is that the battery is required to be maintained at the subscriber's end of the line; in the present system the induction coil itself is rendered unnecessary, and the battery is placed at the station end; the magneto is used for the call; for network of 3,000 subscribers, ten times as many batteries are required in the present system used in France than would be required for this new system; detailed calculations are given, showing that 112 times as much energy is used with the ordinary microphone and induction coil than with the Carbonelle system, which latter requires 0.01 watt for two subscribers, assuming that three cells are required for two subscribers in the ordinary system. He shows the application to long distances, and states that the limit stated by Mr. Preece does not apply, as experiments with this telephone on artificial lines have shown that the product of the ohms and microfarads exceeds 100,000; with the Carbonelle system the transmission is still very good for limits at which transmission by the ordinary system is impossible; the instrument itself (which is not described) is said to be robust and does not require repeated adjustments; for long distances it is only necessary to increase the electro-motive force; the operating cost is said to be considerably cheaper and the changes from the old to the new system are said to be very simple.

Telephone System in Paris.—A well illustrated description by Mr. Hospitalier is begun in "La Nature," Dec. 15.

Storage Battery in Telegraph Offices.—An article on this subject is begun in the "Tel. Age.," Jan. 1; it is quite elementary in character, the present portion being devoted mainly to an elementary description of accumulators.

MISCELLANEOUS.

Treatment in Case of Accidents.—An editorial in the Lond. "Elec. Rev.," Dec. 21, discusses Dr. Gibbon's offer to test the question of whether criminals executed in New York are really killed by the current. Such experiments on criminals as he proposes to make would probably prove nothing; they would show simply that the execution had not been carried out properly. It claims that it is reasonable to suppose that D'Arsonval's treatment would be successful in cases where lesions have been set up. The College of France recommends in cases of suspended respiration the application of the faradic current on both sides of the larnyx under superficial incision in the skin; amongst other remedies there is a use of nitro glyceirne in 1 per cent. solution, in two drop doses, dropped at intervals on the tongue; this is the most powerful heart stimulant known to the medical profession; failing this, stimulants, such as alcohol, ammonia, etc., are recommended, for the purpose of arousing the cerebro-spinal system to action.

Carbide of Calcium.—Prof. Henry Morton of Hoboken in a communication to Lond. "Engineering," Dec. 21, refers to a production of this material in the Moissan electric furnace, from a mixture of lime and coal dust, and states that it has the remarkable property that in contact with water it develops a large amount of gas which appears to be chiefly acetylene; if a fragment is sprinkled with drops of water, gas will be given off which will continue to burn until this stone is entirely converted into lime; by introducing this material in a closed vessel connected with an automatically regulated reservoir of water, illuminating gas can readily be obtained. Whether the cost of producing this compound is too great for industrial application remains to be shown.

Utilization of Ozone.—The paper of Dr. Froelich abstracted in the Digest, Nov. 17, is abstracted in the Lond. "Elec.," Dec. 21.

Biographical.—The biography of Hertz, of some length, is published in "L'Eclairage Elec.," Dec. 8.

New Book.

On the Development and Transmission of Power From Central Stations. Being the Howard Lectures delivered at the Society of Arts, in 1893, by Wm. Cawthorne Unwin, F. R. S., London and New York: Longmans, Green & Co. 308 pages, 81 illustrations. Price, $3.50.

The author needs no introduction to his now extended American audience, in adding another valuable book to the engineers' library and a pioneer production in its field. The subject is here treated as a whole; at the same time it is recognized as a very wide field and as touching many different departments of engineering.

The opening chapter of 18 pages treats briefly of "the conditions in which a system of distribution of energy is required, and general considerations on the sources of energy." The author acknowledges more familiarty with mechanical than electrical methods of distribution; but believes this disadvantage may be offset "in approaching the subject for once with the bias of an engineer rather than that of an electrician." The sources of mechanical energy are given consideration somewhat disproportionately to their practicability: wind power; water power; tidal action; solid, liquid and gaseous fuels; with a third of the chapter on the production of power by burning town refuse in "destructors."

The generation of power by steam engines, the cost of steam power and the distribution of power by steam are treated in chapters II., III., and XI., respectively: 58 pages in all. The six valuable tables of engine and boiler performance are followed by smaller compilations of results; but, one must read the context to determine the intrinsic value of many tables,—whether calculated from assumed conditions or the results of experiments. The efficiency of the steam jacket, superheating and multiple or "stage" expansion, with reference to cylinder condensation; the relations of mechanical efficiency, back pressure, type, speed, and mode of regulation of steam engines under varying loads, are followed by a presentation of Willan's law of steam consumption. Under steam turbines the velocity of efflux of steam is calculated by the hydraulic formula, when it has been established by many repeated experiments, that steam does not, like water, flow from an orifice with a velocity due to its gravity head. The velocity is represented by its discharge as calculated by Napier's formula, when the final pressure is less than 3-5 the initial, as it must be in all steam turbines. The cost of steam power is from an English view point; while Dr. C. E. Emery's contributions are entirely drawn upon and acknowledged as containing "nearly all the information available on the subject of steam distribution," as developed in New York City.

The storage of energy forms the subject matter of the 12 pages of Chap. IV. Fly-wheel, gas-holder, hydraulic, compressed air, and "accumulator" storage are all too briefly treated. Half the chapter is taken up with "thermal" storage, the proposed plans of whose chief exponent, —Mr. Druitt Halpin—"appear to be practicable and to promise considerable economy in stations where the load fluctuates greatly; but, they are untried."

Water power, hydraulic motors and hydraulic transmission are more fully considered in chapters V., VI., and VIII., respectively; 62 pages in all. The development of natural water powers in Switzerland and America are satisfactorily treated, in a general way; and, the more important cases in detail. Dr. Thurston's paper, before the American Society of Mechanical Engineers is drawn upon for the description of the Holyoke testing flume. Two pages on the "storage of water power" belong under a former chapter. Turbines are described and classified (to the exclusion of the Pelton type); and, treated as to efficiency, regulation and choice of type. "The limit turbine" must be a typographical error, for the book has had very careful proof reading. High and low pressure transmission, with their respective accumulator and reservoir methods of storage are described, with English examples of the former and Swiss of the latter.

Telodynamic transmission receives a share of consideration, in the 21 pages of chapter VII. It is confined entirely to wire-rope transmission on the Continent, with the exception of the plant at Gokak, India, installed by Swiss engineers. The Schaffhausen wire-rope transmission is very fully treated, as being a typical adaptation to complex conditions, side by side, with an elcetrical system lately installed for similar work at the same place. The differential gear (an epicyclic box train), equalizing the rope tensions of the Schaffhausen plant, is not in similar use elsewhere, to the author's knowledge; but, is very extensively used in American cable railway work, and known as Whitton's compensator.

Transmission of power by compressed air is given the lion's share of attention, in the 82 pages of chapters IX. and X. The latter is mainly a reprint of Prof. Unwin's paper, on the "Calculation of a Compressed Air Transmission when the Subsidiary Losses of Energy are taken into account." The Theory of isothermal and a diabatic workings are treated analytically and graphically. The "false hydraulic analogy," regarding flow of air, is pointed out and avoided. The thermodynamic questions involved in working air are ably presented, as well as the economics of this method. Descriptions of the various English and Continental compressed air installations are given, beside the chief example of its extensive use in Paris. Prof. Unwin and Prof. Riedler could not but come to different conclusions, as stated; we await some agreement regarding frictional losses in mains, etc., between two such advocates of air transmission.

The distribution of gas for power purposes is considered in the 8 pages of chapter XII., and the combined electric lighting and gas plant of the Dessau central station taken as typical. Dowson gas is most largely noted; Mr. Carnegies' contributions to the development of Pittsburg natural gas are alone drawn upon; and, the author's own formula alone given for the flow of gas in pipes, notwithstanding the development of high-pressure transmission of natural gas by American engineers, especially of Prof. S. W. Robinson.

Electrical transmission receives attention in Chap. XIII., and, together with the examples of power transmission by electrical methods of Chap. XIV., and the utilization of Niagara Falls described in Chap. XV., constitute 45 pages. "The striking Lauffen-Frankfort experiment" is dismissed too briefly. The analogous "hydraulic flow" is now considered as if in place, followed by an analytical treatment of size, heading and cost of conductors, with Lord Kelvin's formula for the most economical sectional area. Several "calcu ated" tables follow; in them "pressure in volts" is referred to in the text as "potential difference at the terminals of the generator" and designated by E; and "intensity of current" is otherwise referred to as "current I in amperes." Diagrams show series, parallel and multiphase distributions; of the latter, the Westinghouse and "Drehstrom" are given. The Genoa installation receives fullest consideration of several continuous current transmissions at home and abroad. Of the actual transmissions by alternating current the Lauffen-Heilbronn and Telluride (Colorado) are selected, and acknowledgments for the latter made to Mr. C. F. Scott's paper before the American Society (?) of Electrical Engineers. While the utilization of Niagara is popularly treated and some note taken of the then developed work of the Niagara Falls Paper Co., still we expected a somewhat fuller treatment, considering Prof. Unwin's early connection with and continued interest in the engineering features of the same.

The book is fairly indexed, considering the vast amount of valuable engineering data presented; well printed, but the cuts of several installations are disappointing to the engineer; structural details and diagrams are clearly shown. It is not too largely descriptive; but, we looked for the author's well-known discriminating treatment of theory and happy selection of practical examples and details shown in the make-up of his other works. We feel that he has left a great deal unsaid in directions where we were justified in looking for more detailed treatment. In the study of the generation, transmission, distribution and utilization of power, Prof. Unwin has supplied a long-felt want; and the up-to-date features of his other works we may expect to be maintained in successive editions of this one.

Moonlight Tables for February, 1895.

Herewith we give Mr. H. W. Frund's table of lighting hours for the month of February, under his modified form of moonlight schedule:

TABLE NO. 1,
Standard Moonlight
System.

Date.	Light.	Date.	Exting
1	11.10 P. M.	2	6.10 A. M.
2	.....	..	.....
3	12.10 A. M.	3	6.10 A. M.
4	1.20 "	4	6.10 "
5	2.30 "	5	6.10 "
6	3.40 "	6	6.10 "
7	4.50 "	7	6.00 "
8	No light.	8	No light.
9	"	9	"
10	6.00 P. M.	10	7.50 P. M.
11	6.00 "	11	9.10 "
12	6.00 "	12	10.30 "
13	6.00 "	13	11.40 "
14	6.00 "	15	12.50 A. M.
15	6.00 "	16	1.50 "
16	6.10 "	17	3.00 "
17	6.10 "	18	4.10 "
18	6.10 "	19	5.10 "
19	6.10 "	20	5.50 "
20	6.10 "	21	5.50 "
21	6.10 "	22	5.50 "
22	6.10 "	23	5.50 "
23	6.10 "	24	5.50 "
24	6.20 "	25	5.40 "
25	6.20 "	26	5.40 "
26	6.20 "	27	5.40 "
27	6.20 "	28	5.40 "
28	9.00 "	1	5.30 "

TABLE NO. 2,
Frund's New Moonlight
System.

Date.	Light.	Date.	Exting
1	5.50 P. M.	2	6.10 A. M.
2	" "	3	6.10 "
3	" "	3	12.00 M.
4	1.20 A. M.	4	6.10 A. M.
4	5.50 P. M	4	12.00 M.
5	2.30 A. M.	5	6.10 A M.
5	5.50 P. M.	5	12.00 M.
6	5.50 "	6	12.00 "
7	5.50 "	7	12.00 "
8	5.50 "	8	12.00 "
9	5.50 "	9	12.00 "
10	6.00 P. M.	10	12.00 "
11	6.00 "	11	12.00 "
12	6.00 "	12	12.00 "
13	6.00 "	13	12.00 "
14	6.00 "	15	12.50 A. M.
15	6.00 "	16	1.50 "
16	6.10 "	17	3.00 "
17	6.10 "	18	4.10 "
18	6.10 "	19	5.10 "
19	6.10 "	20	5.50 "
20	6.10 "	21	5.50 "
21	6.10 "	22	5.50 "
22	6.10 "	23	5.50 "
23	6.10 "	24	5.50 "
24	6.20 "	25	5.40 "
25	6.20 "	26	5.40 "
26	6.20 "	27	5.40 "
27	6.20 "	28	5.40 "
28	6.20 "	1	5.30 "

NOTE.—These schedules are made up on sun time. Where standard time is used and it varies considerably from sun time, the proper deduction or addition must be made to all the times here given.

A Swiss Mountain Electric Railway.

The Swiss Federal Government has recently granted a concession for the construction of a mountain electric railway, starting from near Lauterbrunen. The line will be about 12½ kilometres long, and is to be finished within five years.

The Callender Telephone Exchange System.

Hitherto the conception of an automatic telephone exchange system has been of one in which each subscriber would have an individual switching mechanism at the central station or exchange. Statistics show that the maximum number of telephones in use at one time rarely exceeds 20 per cent., and that in large cities 10 per cent. may be a safe maximum.

Mr. Romaine Callender, whose name is widely known in telephone circles will soon give an exhibition at the Decker Building, Union Square, New York, of a system telephonic intercommunication based on these statistics, and planned to eliminate all unnecessary mechanism and connections by providing connecting capacity enough to receive the maximum number of calls arriving at the exchange during any portion of the day.

The aim of the system is to divide the telephone exchange apparatus in two groups, proportioned to the length of time they will be in use when active; it being understood that as soon as the various mechanisms in the several divisions have performed their functions they revert instantaneously to common use.

The apparatus for enabling the subscribers to interconnect themselves automatically at will is divided into two principal portions; first, apparatus at the subscriber's station, and second, apparatus at the exchange station.

Before describing the electrical and mechanical features of the exchange apparatus, it may be well to refer to the apparatus at the subscriber's station. This consists of a telephone transmitter, receiver, battery and call-bell, together with a signaling transmitter of special form. This signaling transmitter, Fig. 1, is provided with means for transmitting electrical impulses in series or sets to the exchange station. It consists of an insulated rotatable cylinder, Fig. 2, carrying ten contact strips of varying length. Held against the cylinder are ten contact rushes. One of these is adapted to make electrical connection successively with each one of the contact strips on the clyinder, when the said cylinder is rotated. Another of the contact brushes connects with only nine of the contact strips, while the next brush connects with only eight strips, and so on to the tenth brush, which makes electrical connection with only one of the contact strips. This circuit making and breaking cylinder has electrical connection with a series of hand operated indicator switches, Figs. 3 and 4, located on the front of the signaling transmitter case. Each of these switches is adapted for indicating any one of a series of numerals, 0 to 9 inclusive.

The number of the switches is equal to the number of numeral places in the value of the highest numbered line in the system—that is to say, in a system of not more than two numeral places, up to 99, two switches are necessary. In a system of three numeral places, up to 999, three switches are required, and so on. The impulse transmitting cylinder revolves as many times as there are indicator switches on the outside of the case. In a system of not more than 99 telephones the cylinder is caused to revolve two complete revolutions, together with an extra preliminary revolution for a purpose that will be described later. In a system of not more than 999 telephones it revolves three times. The preliminary revolution just referred to is for transmitting a preliminary impulse to the exchange station for the purpose of seizing some unused portion of the percentage apparatus; the succeeding revolutions being for transmitting the signaling impulses representing the thousands, hundreds, tens and units in the number of the telephone with which connection is desired.

The mechanism of the signaling transmitter includes a controlling commutator for changing the circuit through the several indicator switches in succession. To illustrate its working it will be necessary to suppose that a call is just being turned in for connection with some other telephone, say number 684. Three of the signaling transmitter indicator switches would be set in numeral order, from left to right, so that the left hand switch would indicate 6, the middle switch 8, and the right hand switch 4. The controlling commutator, by changing the circuit through the indicator switches from left to right successively for each rotation, causes impulses the equivalent of 684 to be transmitted to the exchange station.

Although one of the indicator switches may be arbitrarily designated as the hundreds switch, and another as the tens, etc., it is not necessary that this should be done. A signaling transmitter for a system of not more than 999 lines has three indicator switches. Should it be desired to signal for connection with telehpone number 6, only one of the indicator switches is required to be set. It does not matter which one of the switches is set, the result will be six impulses transmitted. Should connection be desired with telephone number 59, two of the indicator switches will be required to indicate this two numeral value. This may be indicated on the first and second dial, on the second and third, or on the first and third, the only conditions being that the numbers must be set so as to read from left to right, to correspond with the present system of expressing numeral values. The impulses as they arrive at the exchange are automatically classified into hundreds, tens, etc., in a manner to be described later. The signaling transmitter is set in operation by a lever which projects from the side of the transmitter case. The lever when drawn down stores up energy in a coiled spring. The coiled spring operates a wheel train and fan, with which are connected the circuit making and breaking cylinder and its controlling commutator. This controlling commutator revolves only once at each operation, but the circuit-making and breaking clyinder revolves as many times as there are numeral places in the value of the highest numbered line in the system, as has already been explained.

Before entering on a detailed description of the apparatus at the central station it will be well to outline the mode of operation. It will be remembered that in connection with the description of the signaling transmitter, mention was made of a preliminary impulse. Whenever a signal is transmitted to the central station, the preliminary impulse precedes it and causes the seizure and isolation of one of a number of connecting strips controlling access to mechanisms for registering the number of the telephone with which connection is desired. The signaling impulses, as they arrive at the exchange, are registered on one or more instruments designated "Numerical Receivers," Fig. 5. Each series of impulses, corresponding to hundreds, tens, etc., is registered on a separate receiver.

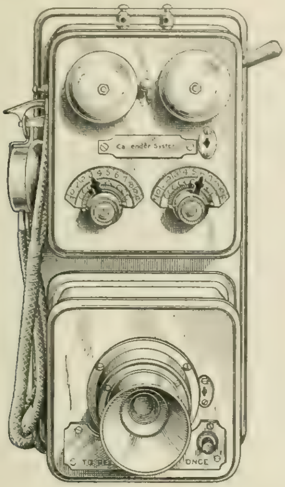


FIG. 1.—SIGNALING TRANSMITTER.

In series with each group of numerical receivers is an instrument designated the "Numerical Separator," Fig. 6. The office of the separator is to distribute the different sets of impulses to their respective receivers, so that if a call is turned in, for say number 36, the separator divides the first set of impulses from the second, and causes them to be registered on two different receivers—the tens on one, the units on the other.

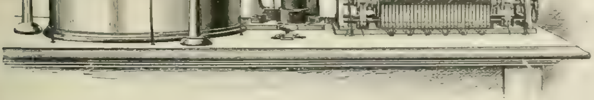


FIG. 2.—CIRCUIT SELECTOR.

An instrument known as the "Numeralizer," Fig 7, now comes into play and totalizes the indications of hundreds, tens, etc., and then selects the circuit of equivalent numerical value. The signaling telephone is then connected to the telephone signaled for, and at the same time a copper ball, which has been released over a signaling track, runs along it by gravity and causes the call-bells of both subscribers to be operated, notifying them of their interconnection. Each of the foregoing divisions reverts to common use as soon as it has done its share in the making up of the complete connection; the connector only remaining in use during the time that conversation is being held over the connected lines.

Returning now to the apparatus at the central station, the construction and specific functions of the circuit selector, Fig. 2, will first be noticed. This consists primarily of a series of metallic conducting rings, insulated from each other and held concentrically on the same plane. Around each ring is arranged a series of armature-headed plungers. These plungers are normally electrically disconnected from the conducting ring, but are adapted to be moved into engagement with the said ring under the influence of electromagnets carried by revolving arms; each ring of plungers lying in the path of one of these electromagnets. Each conducting ring represents a distinct percentage division, and each controls access to the mechanism of its division. The plungers are terminals of branch conductors from each telephone line and they serve as connectors for establishing a circuit from a signaling telephone to the signal-receiving mechanism of the division seized and held for the time being by the said signaling telephone.

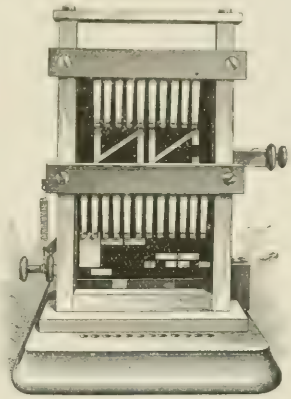


FIG 4.—PROGRESSIVE SWITCH.

The branch conductor just referred to may be connected at will to any one of the conducting rings through the instrumentality of the plunger and the controlling electro-magnet. It will be understood that one electromagnet controls one ring of plungers, and the selection of any one plunger is governed by an auxiliary mechanism, about to be described. This consists of one or more revolving cylinders carrying oblique contact strips. These strips are insulated from each other, and each strip has electrical connection through a commutator, with its corresponding electro-magnet revolving over its appropriate ring of plungers. Held against the revolving selector cylinder is a series of contact brushes, representing terminals of branch conductors, adapted to complete a circuit through the selector under certain conditions to be described later. The cylinder and the revolving arms carrying the plunger-selecting electromagnets are geared together and are revolved by a constantly operating electro-motor. By this means the brushes against the revolving cylinder are brought into electrical connection with the oblique contact strips successively, and one at a time. As each contact brush engages with an oblique strip the arrangement is such that the plunger-controlling electro-magnet, electrically connected with the said oblique strip, will be immediately over the plunger of that line corresponding to the number of the brush in engagement with the oblique contact strip. There are as many oblique strips on the cylinder as there are sets of conducting rings and plungers.

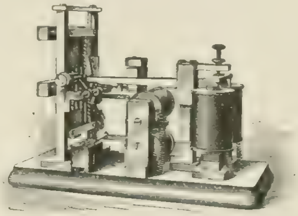


FIG. 3.—PROGRESSIVE SWITCH.

The whole action of the preliminary impulse already referred to is to raise the plunger of the signaling line into electrical connection with some one of the conducting rings. As soon as this is done the circuit is so changed that no other signaling telephone can obtain connection with the conducting ring just seized; the oblique conducting strip, although it will pass under other brushes representing lines over which signals are being received, will not be affected. Should two adjoining brushes be in condition to complete a circuit through the selector at the same moment of time there will be no interference, as the first unused oblique strip will be presented to one brush and become individualized to it instantaneously, while the next brush immediately following will not be affected until some other unused strip is presented to it. From this it will be noted that the effect of the preliminary impulse is prolonged for one complete revolution of the selector cylinder, so that should the greater part of the percentage system be in use at the time of the reception of such impulse, the rotation of the selector cylinder will eventually present an unused strip to the waiting brush.

The progressive switch, Figs. 3 and 4, is one of a group of instruments controlled by the circuit selector. The preliminary impulse in seizing a percentage division for the reception of a signal, seizes at the same time one of the progressive switches. The seized division of the circuit selector, which is only used for a few seconds, soon reverts to common use, but the progressive switch remains individualized for the use of the signaling line, until the connection is established. As soon as this step has been effected the progressive switch also reverts to its normal condition, ready for use by any of the remaining lines. The action of the preliminary impulse translated through some one division of the circuit selector is to seize some one of the progressive switches, to individualize it to the signaling line, and in so doing to step the progressive switch forward one degree. This isolates the signaling line and prevents any other line from interfering with it in any way thenceforth until the progressive switch passes from under the control of the said signaling line.

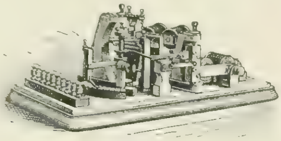


Fig. 5.—Numerical Receiver.

The signaling impulses which now follow are registered on the receivers in a manner to be described later, and as soon as this registration has been effected the progressive switch is automatically stepped forward another degree. In this position the switch is connected to one of the signaling tracks, a description of which shortly follows. A constantly operating alternating current generator is then put in circuit with the signaling line, through the signaling track and progressive switch, for the purpose of ringing the call-bell at the outlying station; one long ring if connection is established, or two disconnected rings, a "busy" signal, if the line called for is in use. The progressive switch is then stepped forward another degree, leaving the connected lines in condition for telephonic communication, or if the line called for is in use the signaling line is placed in condition for turning in other calls. The switch is restored to normal condition either by the act of the signaling subscriber releasing, or by a time limit apparatus at the central station, where such apparatus is used.

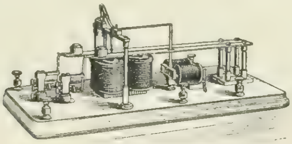


Fig. 6.—Numerical Separator.

The foregoing action is that of a signaling subscriber using a progressive switch for the purpose of effecting a connection with the line of some other subscriber. These progressive switches work in pairs, the other switch being seized also by the signaling subscriber as soon as a registration has been effected of the number of the telephone with which connection is desired. The seizure of the second progressive switch individualizes it to the use of the telephone signaled for, and prevents any other telephone from connecting with it from that time until released. This seizure also puts the switch in condition for sending a call-bell signal over the line of the subscriber called. It is then automatically instrumental in establishing a talking circuit through an apparatus designated the "Connector," a description of which follows later.

The circuits are so arranged that when a call arrives at the exchange for connection with a telephone already connected and in use, no progressive switch can be individualized to the use of the busy line until it goes into disuse. An automatic change is effected on the proper signaling track, representing the division in which the signal is registered, and as a result of this change a busy signal is sent over the line of the signaling telephone, while the busy telephone is left undisturbed.

The numerical receiver, Fig. 5, registers the signaling impulses as they arrive at the exchange. They are assembled in percentage groups, the number of receivers in a group depending upon the number of lines in the system. In a system of not more than 99 lines, two numerical receivers are required in each percentage group. In a system of not more than 999 lines, three receivers form a group, and so on. In a three numerial place system, one receiver of a group registers hundreds, another receiver in the same group registers tens, while the remaining receiver of that group registers units. The number of receivers used in any group by an incoming signal depends upon the numerical value of the signal being registered. If a signal is received for connection with a telephone whose number may be expressed by one numeral place, as for instance number 8, then only one receiver is used in the group, the others remaining unaffected. If a signal is received for connection with a telephone whose number may be expressed by two numeral places, as for instance number 65, then two receivers are used, and so on.

The receivers are distinguished as being of the first, second or third order in a three numeral place system. In any group, the receiver of the first order is first to be used, the others being brought into use sequentially, if required. If a signal is registered for connection with a one numeral place value, say number 8, the receiver of the first order then indicates the complete registration, which may be termed a units register. Should two sets of impulses be registered, as would be the case in a signal for connection with a two numeral place value, say number 65, the numerical receiver of the first order would register the first set of impulses, and the receiver of the second order would register the second set. The receiver of the first order, in this event, registers tens, while the receiver of the second order registers units. In the event of a signal arriving for connection with a three numeral place value, say number 926, the receiver of the first order would register the first set of impulses, while the receivers of the second and third order would respectively register the second and third sets of impulses. In this event, the registrations of the receivers of the first, second and third orders would be respectively hundreds, tens and units.

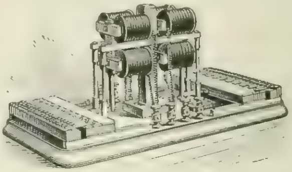


Fig. 7.—Numeralizer.

The receiver is a step-by-step apparatus of special construction for recording accurately the sum of the impulses received. It is adapted to take ten forward steps, corresponding to the numbers 0 to 9 inclusive. The various series of impulses are distributed to their proper receivers by an instrument designated the "Numerical Separator," a description of which shortly follows. One receiver can register nine indications, two receivers can register 99 indications, while three receivers can register 999 indications. Each receiver directly controls ten fractional branch circuits, and the varying combinations are totalized or integrated by an instrument described later under the caption of "Numeralizer."

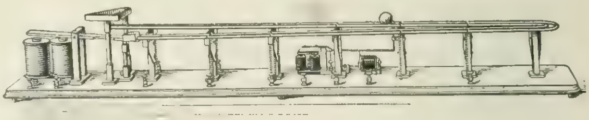


Fig. 8.—Signaling Track.

A numerical separator, Fig. 6, is included in series with each group of numerical receivers. It consists of a controlling electro-magnet having two vibratory reed armatures. The reeds are adapted to be put into vibration for a predetermined length of time on the closure of a circuit through the controlling electromagnet. These reeds have different vibratory periods. After being put into vibration by the first series of signaling impulses, the shorter reed first comes to a position of rest and closes a circuit for switching the succeeding series of impulses through the numerical receivers sequentially.

The separator is normally in series circuit with the receiver of the first order, and its action, after each series of impulses, is to prepare a new circuit leading the next succeeding series of impulses to the corresponding order of numerical receiver. The longer vibratory period reed comes to a position of rest immediately after the shorter reed and closes a shunt circuit through a releasing device, which places the separator in condition for further use. It is necessary to state here that the signaling impulses are so controlled by the signaling transmitter at each subscriber's station that each series of impulses is separated from the succeeding series by a time interval. It is during this short time interval, of about two-fifths of a second, that the separator reed comes to a position of rest and closes the switching circuit, preparing a new path for the next series of impulses immediately following.

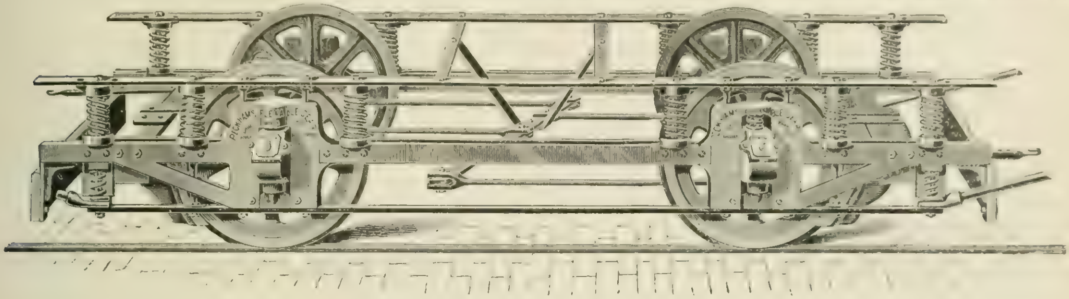


FIG. 1.—NEW PECKHAM TRAILER TRUCK.

The numeralizer, Fig. 7, is a compound switch for giving electro-mechanical effect to the combined indication of the several numerical receivers constituting a percentage group. It is put into operation after each complete signal has been registered. It combines the fractional circuits controlled by the numerical receiver indications of hundreds, tens, etc., and selects an integral circuit equal in numerical value to the sum of the combined indications. It is based on the theory of decimal control, aided by a system of transforming circuits, and its method consists in causing one circuit to control tens, a hundred, a thousand, or ten thousand circuits, by eliminating decimally all values of the thousands, hundreds, tens orders, etc., not indicated by the compound registration of the numerical receivers.

The signaling track, Fig. 8, consists of an inclined runway having two copper rails insulated from each other. On one side the rail is continuous, and acts as a feeder for current supply. On the other side the rail is broken into sections having electrical connection with various parts of the percentage apparatus. The arrangement is such that when a circuit-closing ball is discharged over the track it runs along it and closes circuits between the rails and the apparatus electrically connected thereto. Each percentage division of the system includes one signaling track. As soon as a call is registered in any division of the signal receiving apparatus a circuit-closing ball is discharged along the signaling track of that division for the purpose of signaling to the calling subscriber a "busy" signal if the line required is in use. If connection has been established it is made known by a long continuous ring on the call-bells of the connected subscribers. At that part of the signal track where the circuit-closing ball is caused to ring the call-bells of the outlying stations, three disconnected sections of track are found.

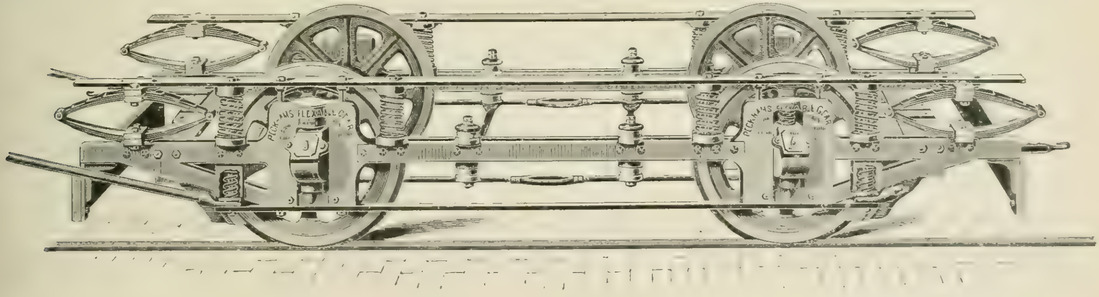


FIG. 2.—NEW PECKHAM TRUCK.

The electro-mechanical connections to these track sections are such that when a calling subscriber has signaled for connection with a telephone already in use, the second section of track is made neutral so that the circuit-closing ball will ring the call-bell or bells on only the first and third sections of track; the second or neutral track being utilized for causing a time element between the call-bell signals turned in by the passage of the ball over the first and third sections of track. On the other hand, if connection has been established, the three sections of track are conerted electrically into one long section, so that when the circuit-closing ball passes over the three sections of track a long continuous signal is caused to be sent over the lines of the two connected subscribers.

The connector is a counterpart of one portion of the circuit selector. It consists of a series of conducting strips pluralized on a percentage basis. By a process similar to the selection of the percentage connection for signaling purposes, the plungers of the calling and called subscriber are connected to one of the percentage strips, and left in that condition while communication is being held. The apparatus contributing to the final connection has all reverted to common use and the percentage connecting strip eventually becomes free for other users as soon as the conversation is terminated. Any of the connecting strips may be brought into operative relation with each of the subscriber's lines, the arrangement being such that when one is seized it is held by the signaling subscriber until he allows it to revert to common use by the transmission of a "release" impulse from his signaling transmitter.

The invention comprehends other features of novelty, such as the storing of calls for lines in use at the time of the call arriving, and an automatic recording system for registering the number of connections had by any subscriber.

The call storing system acts as follows: When a call is received for connection with some other telephone then in use that call is stored and a busy signal is sent over the line of the signaling telephone. The busy telephone is not interfered with until its user releases it from connection. As soon as this is done the stored call becomes effective, and a "connected" signal is sent over the lines of both parties to the new connection then made. Many calls may be stored for the same telephone.

A New Motor Truck.

We illustrate herewith a new truck now being placed on the market by the Peckham Motor Truck & Wheel Company, 26 Cortlandt street, New York, and designed by its president, Mr. Peckham, to meet the requirements of certain roads that favor a cheaper construction than its all-steel, machine-fitted trucks. The new "Excelsior" trucks are constructed upon the same general principle as Peckham's cantilever extension truck. The pedestal and spring supports are cast in one piece and secured by hot-driven rivets, no bolts being used in its construction. It is provided with a steel top frame connecting the different springs. It is so constructed that it can be used as a "trailer" truck, as shown in cut, Fig. 1, or as a motor truck with all the spiral springs, or as a motor truck with both spiral and end elliptic spirngs, as shown in Fig. 2. Its yokes are provided with Peckham's flexible gear, which supports the truck frame upon the journal boxes by graduated spiral springs; it is also provided with Peckham's dust-tight, self-lubricating journal boxes, and with truss extension for open cars, when so desired. Although somewhat lower in price than its all-steel, machine-fitted trucks, the new form is made with the same degree of care as to details, as is used in the construction of all Peckham trucks.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Jan. 5, 1895.

ELECTRICAL STOCKS continue to be handicapped by the sustained depression in stock market values. The financial horizon is streaked with gloomy hues, and the rays of coming brightness are as yet not strong enough to dispel the clouds of gloom. The complications of the currency question are again exercising a malignant influence on the nation's trade, and all branches of business are again feeling the evil results of distrust and lack of confidence.

GENERAL ELECTRIC'S quotations, accordingly do not show any life or buoyancy. There is no justification for the sagginess, all the cirumstances really warranting quotations continuing favorable. In fact were it not for a sympathetic reaction with the whole market depression, General Electric would rise as there is a distinctly bullish feeling on the security, a good many people formerly inimical to the property now manifesting a most friendly spirit towards it, but while the stock fails to respond to this change of sentiment, the bonds of the General Electric Company are acting very well. With the company's affairs nowadays in a comparatively comfortable and easy condition, these bonds are again becoming regarded as a good investment, and since the first of December they have advanced over 5 per cent., the coupon on that date having been a good deal more than recovered. And, when one looks into the recent record of the General Electric Company, it is no wonder that there should exist a demand of such proportions as has of late come to light. During the year the company purchased $1,000,000 of its bonds calling for an expenditure at an average price of 85 or $850 000. It also has $600,000 cash in bank arising out of profits from sales. This makes a surplus earned during the year of $1,450,000 above interest charges on the entire issue of debenture bonds, a sum equalling 7 per cent. on the preferred stock and nearly 4 per cent. on the common stock, a pretty good showing for a bad year. This has been made possible by the introduction of conservative methods in the matters of sales and collections. The $1,000,000 bonds in the company's hands were not retired, but are held in the treasury as an investment, the interest money being regularly put aside. The intention is to continue the present policy of retiring the bonds until such time as the reconstruction of its finances will allow the company to resume dividend payments on both classes of stock. Business continues good, the gross output of apparatus being above $1,000,000 per month.

WESTINGHOUSE ELECTRIC issues are quiet pending the complete removal of the company's works to the new Brinton plant. The Westinghouse people in this city decline to discuss the report that they are figuring on the cost of electrically equipping the Manhattan Elevated Railroad Company, of New York, although previous reports had it that the General Electric would get the contract. The Manhattan people will not say with whom they are treating in the matter, but both companies are understood to be eagerly bidding for the chance. There has been some unlooked for delay in the operation of removal to Brinton, but the officials say it is now progressing satisfactorily, though they cannot say when the whole Westinghouse plant will be housed in the new shops.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	127	130
Cleveland General Electric	100	80	90
East River Electric Light Co.	100	—	50
Edison Electric Ill., New York	100	101	102
" " " Brooklyn	100	110	112
" " " Boston	100	120	124
" " " Philadelphia	100	120	125
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	35	40
Electric Construction & Supply Co., com.	15	7½	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	1½	2
General Electric	100	34	34½
General Electric, pref	100	67	70
Westinghouse Consolidated, com.	50	32½	33½
" " pref	50	50	50½

BONDS.

	Par.	Bid.	Asked
Edison Electric Ill., New York	1,000	108	109
Edison Electric Light of Europe	190	75	85
General Electric Co. deb. 5's	1,000	92½	92½

TELEGRAPH AND TELEPHONE.

	Par.	Bid.	Asked
American Bell Telephone	100	190	191
American District Telegraph	100	35	40
American Telegraph & Cable	100	91	92
Central & South American Telegraph	100	102	105
Commercial Cables	100	130	145
Erie Telephone	100	51½	52
Gold & Stock Telegraph	100	103	105
Mexican Telegraph	100	180	190
Mexican Telephone	100	75	80
New England Telephone	100	67	69
New York & New Jersey Telephone	100	97	98
Postal Telegraph-Cable	100	50	55
Western Union Telegraph	100	86½	87

FORT WAYNE CORPORATION issues are exciting interest anew. Mr. R. T. McDonald confirms the rumors published that the Wenstrom Electric Company will soon bring suits against the users of apparatus furnished by the leading electrical companies as infringers on Wenstrom patents. Mr. McDonald says a number of suits will be entered at once, the users of trolley apparatus furnished by other companies to be prosecuted first. The suits will be started on Wenstrom armature patent infringements, and they are expected to be filed within a week or two. The Wenstrom works now controlled by the Fort Wayne Corporation are reported to be running on full time and filling a good amount of orders.

STANDARD UNDERGROUND CABLE stock is still advancing, 94 being recently bid for 100, buyers 60. Insiders appear to be very bullish on this stock. The regular quarterly dividend of 1½ per cent. has been declared payable January 10. The company had, it is reported, an exceptionally good year in 1894, and prospects for even material improvement in 1895 are reported as being very bright.

AMERICAN BELL TELEPHONE stock is still in the dumps. Nothing new develops regarding the recent stock subscription fiasco, it is stated that only 1,500 shares of the 5,000 issue were taken.

EASTERN ELECTRIC CABLE preferred stock has received a semi-annual dividend of 3 per cent.

TRACTION STOCKS act sluggishly. The usual January investment demand is not cutting much of a figure this year, and street railway issues are not being helped along much by the January disbursements. A new traction security now offered to investors is an issue of $2,500,000 5 per cent. forty-year bonds, put out by the Second Avenue Traction Company, of Pittsburg. These bonds are for the purpose of improving and extending the company's system.

ELECTRIC TRACTION STOCKS.

	Bid.	Asked
Union Ry. Co. (Huckleberry)	115	120
Brooklyn Traction, pref	66	69½
" " com	14½	15½
Long Island Traction	14	14
Rochester St. Ry	30	40
Columbus St. Ry	45	50
Louisville St. Ry. pref	87	88
" " " com	37	39
Cleveland Electric Ry.	45	47
Cleveland City Ry.	68	70
North Shore Traction.	23½	25
New Orleans Traction.	63½	65
Worcester Traction pref.	80	82
" " com.	13	14
Metropolitan Traction, Philadelphia.	103	104
Philadelphia Traction.	98	100
People's Traction	51½	52
Binghamton R. R. common	100	—

BONDS.

	Bid	Asked
*Union Ry. 1st. mtge 6s.	105	108
*Westchester Electric 1st. mtge. 5s.	98	101
Rochester St. Ry. 1st. 5s.	95	97
*Columbus St. Ry. 1st 5s.	95	97
Columbus Crosstown 1st. 5s.	95	97
*Binghamton Railroad Co. 5s	99	100

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*With accrued interest.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD.
253 Broadway' NEW YORK, Jan. 5, 1895.

MESSRS HOWARD C WHITNEY, formerly with the Crocker & Wheeler Electric Company, New York, and Lewis O. Brewster, formerly manager of the New York office of Almond & Sargent, of Boston, have associated themselves with the sales department of the New York Insulated Wire Company. The office of business manager of the company has been abolished.

MR. JAS. F. KELLY, formerly manager of the United States and Wire Cable Company, of New York, has associated himself with the sales department of the New York Insulated Wire Company. Mr. Kelly is well known to the trade, among whom he has many friends, and is exceedingly popular, and we congratulate the New York Insulated Wire Company upon its acquisition of his services.

MR. JEFFERSON YOUNG has been appointed manager of the New York office, at 112 Liberty street, of the Stilwell-Bierce & Smith-Vaile Company, whose extensive factories are located at Dayton, O. Mr. Young will give his entire attention to pushing the sale in the New York market of its specialties in pumping and hydraulic machinery, feed-water heaters and purifiers, filter presses for all purposes, water columns, tank valves and jacks, and enters upon his responsible position with the determination of meriting and winning success.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, January 4, 1895.

TELEPHONE PEOPLE are much interested in the new wiring system for exchanges by the National Telephone Manufacturing Company, this city. It is claimed to be the most economical and simple, as well as the most desirable system placed upon the market. This company has been quietly selling telephones and switchboards for exchanges in different parts of the country. We have just learned of a shipment of nearly 200 instruments to the West to replace telephones of other makes. Some twenty or more of the beautiful desk sets made by this company are now used in the New York City Court buildings, to say nothing of the new palace hotel "Majestic" which alone is using 500 instruments. The new State House annex here, one of the most magnificent buildings in the country, has just been completed, and the National Company has installed in it a large plant connecting the President of the Senate, Speaker of the House, and also all the other principal officials. The War Department at Washington is now testing the "National" instrument, with a view to its adoption and use in all the various depots and posts throughout the country. We understand the "National" has been in use for some time at the Military Academy, West Point.

THE AMERICAN TOOL AND MACHINE COMPANY, of Boston, is now located in its new offices and works at 302 Federal street, that city, and it may be truthfully said that it is a fitting home for a deserving company—now for nearly fifty years before the public, the confidence of which it has enjoyed to an extensively liberal extent and still possesses. In the line of engineering and machinery work its reputation is of the highest order. In its new home, which practically embraces two buildings, it is surrounded by the best facilities for good and quick work, to say nothing of its large and well-equipped factory at Hyde Park, Mass. Mr. M. H. Barker, who has been identified with the company for twenty-three years, has been made its general manager, and Mr. M. M. Whipple, whose connection extends to over a period of sixteen years, has been elected as assistant general manager, positions both of these gentlemen are thoroughly competent to fill creditably to themselves and profitably for the company. Mr. W. O. Lincoln remains with the company as treasurer, a position he has held for upward of ten years.

THE BOSTON MOTOR COMPANY, 17 Batterymarch street, reports an excellent business, of course, during the holidays. The demand for its motor and battery outfit for toy purposes was naturally quite large, but its business generally, for some time, has been exceptionally good, particularly in the line of its larger motors, adapted especially for sewing machines, ventilating fans, dental drills, jewelers, lathes, etc., and, in fact, all kinds of light work. Its medical coil has also received its share of recognition. The *Youth's Companion* is one of its most liberal patrons. It has been awarded first prize by the Massachusetts Charitable Mechanics' Association, and the Harvard University uses several of its motors, and says of them that they work splendidly. It may be said that all the motor manufactures of this company are thoroughly efficient, to which may be added cheapness. Mr. John J. O'Lalor, proprietor of the company, is a deserving young man, and is winning his success entirely by personal effort and hard work. He understands thoroughly his business, and before branching out for himself did good and faithful work for other electrical corporations, being identified with the Sprague Motor Company and the Bernstein Electric Company.

THE PETTINGELL-ANDREWS COMPANY, of Boston, with the commencement of the year, has assigned their well-known and popular traveling representative, Mr. J. E. Wilson, who has been connected with the company for a number of years, always securing good success, to the territory embraced in the western part of New England, New York State and Eastern Pennsylvania. Mr. T. G. Smith, a young man of ability and energy, who started as a boy with the company, and latterly has had charge of its sales department, has been assigned to the territory formerly covered by Mr. Wilson—the western part of New England.

IN THE LINE OF CALENDARS for 1895, the electrical corporations and firms of Boston may refer with pride to their productions. Those thus far received at this office are the Pettingell-Andrews Company, W. S. Hill Electric Company, J. Bradford Sargent, Ziegler Electric Co., and the Anchor Electric Company. The Anchor calendar is really a beautiful and artistic production, the engravings being particularly handsome and attractive.

C. H. M'KENNEY & CO., of Boston, whose reputation in the manufacture of gas and electric fixtures is second to none, may congratulate themselves upon having such a capable representative as is Mr. Fred. G. Rogers. He is a "hustler," and if business is to be had he will get it.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
936 Monadnock Building, Chicago,
January 5, 1895.

THE SUNBEAM LAMP MANUFACTURING COMPANY, now that the oppressive yoke of litigation has been removed, is preparing to push ahead with vigor. Sunbeam lamps will soon be seen in every part of the country again, as they were not so long ago.

THE CENTRAL ELECTRIC COMPANY has taken inventory, and says that the figures would surprise people who have no adequate idea of the magnitude of the electrical supply business.

THE NUTTING ELECTRIC COMPANY has distributed its new printed matter, and is beginning to find that people have a genuine interest in the "Wax Wheel" arc lamp.

THE CHICAGO INSULATED WIRE COMPANY reports everything as highly satisfactory—a condition of things that but few firms can boast of these days. Its factory is unusually busy for this season of the year.

ERNEST WILLIAM COOKE, one of the ablest and best-known men in Western electrical circles, is on an Eastern trip. He is arranging for several important agencies.

THE AMERICAN ELECTRIC MANUFACTURING COMPANY, of St. Louis, reports an interesting fact in reference to the good [illegible] the order books of [illegible] been supplying of late. Every now and then it receives an order from some out of the way place where it never had any idea the "American" lamp was known.

THE DEARBORN ELECTRIC COMPANY seems to have made a good start if indications count for anything. Its store is one of the busy places of town.

THE WASHINGTON ELECTRIC COMPANY is busy with annunciator and other work, and has no reason for fearing a lack of business in 1895.

THE METROPOLITAN ELECTRIC COMPANY says its orders for the Allen soldering stick are something immense. In nearly every other department it is particularly busy.

General News.

NEW INCORPORATIONS.

THE ROCK HILL TELEPHONE COMPANY, Rock Hill, S. C., capital stock $5,000, has been organized by J. G. Anderson and A. E. Smith.

THE DETROIT RAILWAY, Detroit, Mich., capital stock $1,000,000 has been incorporated by Green Pack, Albert Pack, Chas. L. Pack, Henry A. Everett and Chas. W. Wason.

THE NATCHEZ ELECTRIC RAILWAY COMPANY, Natchez, Miss., capital stock $100,000, has been incorporated. The promoters are R. F. Leonard, W. A. S. Wheeler and J. A. Clinton.

THE CORSICANA MUTUAL TELEPHONE COMPANY, Corsicana, Tex., capital stock $10,000, has been incorporated by James Garrity, A. N. Drane, S. A. Pace, C. E. Jester and James L Autry.

THE POTTS MACHINERY SUPPLY COMPANY, Columbus, O., capital stock $10,000, has been formed by Wm. B. Potts, Walter B. Page, I. N. Hansbrough, Chas. I. Scheaf and Isaac B. Potts, to manufacture electric specialties, etc.

THE CHARLES F. BURNS COMPANY, Rochester, N. Y., capital stock $5,000, has been formed to manufacture and sell all manner of supplies for electrical railways. C. F. Burns, E. M. Higgins, Alfred Creen, Rochester, are the promoters.

THE EMPIRE LIGHT AND POWER COMPANY, Quincy, Ill., capital stock, $25,000, has been incorporated to generate electricity for light, heat and power. Isaac L. Faucett, Harry O. Channon and John P. Wheeler, are the organizers.

THE BOSTON SWITCH MANUFACTURING COMPANY, Portland, Me., capital stock $1,000, has been formed to manufacture and deal in electrical apparatus. Wm. L. Haven, Robert W. Frost, Boston; and Chas. H. Clark are the interested persons.

THE COLUMBUS ILLUMINATING COMPANY, Columbus, O., capital stock $25,000, has been formed to establish and operate eletric light, heat and power plants. R. J. M. Danley, Columbus, O.; W. D. Park and W. A. Hardesty are the interested parties.

THE ACME ELECTRIC COMPANY, East Palestine, O., capital stock $10,000, has been incorporated by Geo. E. Sebring, R. N. Chamberkin, D. H. Mackintosh, Chas. Beyer and R. S. Chamberkin, to erect and maintain an electric light and heat plant.

THE ANTHONY COMPANY, Cincinnati, O., capital stock $200,000, has been formed to make and deal in electrical and magnetic appliances, and to construct and operate telephone lines, etc. The promoters are Mark O. Anthony, Louis Feder and Max Silberberg.

THE KINGS COUNTY ELECTRIC LIGHT AND POWER COMPANY, Jersey City, N. J., capital stock $1,000,000, has been incorporated by Edwin Lowe, of Brooklyn, and others to do a general business in generating electricity for light, heat and power.

THE FARQUHAR ELECTRIC COMPANY, Suffolk, Mass., maximum capital stock $1,000,000, has been formed to manufacture and lease electrical machinery and appliances, etc. Donald H. Farquhar, Chas. H. Whitcomb, and Frank L. Whitcomb, Boston, Mass., are interested.

THE NEW MARTINSVILLE AND MANNINGTON TELEPHONE COMPANY New Martinsville, W. Va., capital stock $20,000, has been formed. The promoters are W. S. Barrack, Burton; John E. Poe and A. M. Crow, of Littleton, and Amos Jolliffe, of Uniontown, W. Va.

THE CALIFORNIA ELECTRIC LIGHT AND POWER COMPANY, California, Mo., capital stock $6,000, has been incorporated to build and operate an electric light and power plant. The organizers are E. B. Crane, W. H. Mengel, Henry Herfurth and J. P. Gray.

THE W. J. DAVIS ELECTRIC COMPANY, Pittsfield, Mass., capital stock $6,000, has been formed to manufacture electrical apparatus, electric and gas fixtures, and other mechanical apparatus. Jacob Crinlich, Wm. P. Wood, W. J. Davis and John White are the incorporators.

THE BUFFALO ELECTRICAL TRANSIT COMPANY, Buffalo, N. Y., has been incorporated to construct and maintain an electric telegraph and telephone company. T. B. McMahon, Charles Oishei, W. W. Read, and T. C. Brown, Buffalo, N. Y., are the interested parties.

THE NASHOLD CLEAT COMPANY, Chicago, Ill., capital stock $10,000, has been formed to manufacture and sell electrical appliances and supplies, and to buy and sell goods and patents relating thereto. Elias Nashold, M. W. Cresey and Luther E. Ellison are the interested parties.

THE PARKESBURG ELECTRIC LIGHT, HEAT AND POWER COMPANY, Parkesburg, Pa., capital stock $10,000, has been formed to generate and supply electricity for light, heat and power. Horace A Beale, Thos. C. Young and Enoch P. Moore, Parkersburg, Pa., are the promoters.

THE LOOP CONSTRUCTION COMPANY, Chicago, Ill., capital stock $1,000,000, has been incorporated to build and construct elevated and electric railroads, and to furnish materials and appliances for same. Douglas Hotchkiss, Geo E. Newlin, and Wm M. Johnson are the promoters

THE BUCKEYE GAS COMPANY, Circleville, O., capital stock $300 000, has been incorporated by J. B. Bradley and others for the purpose of building and operating electric light and electric street railways, manufacturing electrical supplies; also drilling for, producing and piping natural gas and petroleum.

THE CARTERVILLE LIGHT AND POWER COMPANY, Carterville, Ga., maximum capital stock $100,000, has been formed to generate and supply electric light and power; illuminating or fuel gas, etc. Peter W. French, Weymouth, Mass.; T. Putnam Symonds, Salem, Mass., and Wm. E. Merill, Haverhill, Mass.

THE TRENTON TRACTION COMPANY, Trenton, N. J., capital stock $500,000, has been incorporated to buy, acquire, lease and operate street or surface railways. E. J Moore, Philadelphia, Pa.; Thos. C. Barr, East Orange, N. J., Francis M. Eppley, West Orange, N. J., and George B. Jenkinson, Newark, N. J., are the promoters.

TELEGRAPH AND TELEPHONE.

KNOXVILLE, TENN.—The People's Telephone Company started business on January 1 with a large list of subscribers, leaving the old Bell Company but 38.

DANVILLE, KY.—L. Eddy will establish a telephone exchange.

ORANGEBURG, S. C.—The Southern Bell Telephone Company, of Atlanta, Ga., will establish a telephone exchange in Orangeburg.

READING, PA.—Mayor Shanaman has signed the resolution passed by councils providing for the appointment of a committee of five to confer with the Pennsylvania Telephone Company officials, and urge them to take steps to place their wires underground. Should the matter be favorably regarded, it is proposed to ask other companies to place their wires underground before street paving is begun on an extensive scale.

PRESTON HOLLOW, N.Y.—A company has been formed to put into operation a telephone line from Middleburg to Oak Hill. The officers elected are as follows: President, E. Dutton; secretary, Dr. E. S. Shaffer; treasurer, W. P. Elsbree; directors, W. E. Nassler, Middleburg; W. Case, Livingstonville, and others. Application for a charter will be made at once, and it is expected that the line will be in full operation by April 1.

ELECTRIC LIGHT AND POWER.

CAMBRIDGE, ILL.—Hillman & Co., of Peoria, who were granted a franchise for putting in an electric light plant for the village, commenced to break ground for the power house, which will be a brick structure 40x40 feet and 13 feet high. They will use a Ball dynamo for the street lights and a Royal dynamo of their own manufacture for incandescent lights. Their engine will be 100-hp.

STOUGHTON, MASS.—At a special town meeting in Stoughton to consider the matter of the rebuilding and widening of Park street, a proposition was received from the Brockton and Stoughton Electric Railway Company offering to share the expense of doing the work, so as to enable the railway company to at once build the new Stoughton extension. This will undoubtedly result in the early laying of rails to connect Stoughton and Brockton.

BALTIMORE, MD.—The scheme to use the Susquehanna River as a means of generating electric power has taken a definite shape. A certificate of the Susquehanna River Electric Company has been filed for record, the incorporators being Moses H. Houseman, George K. McGaw and Winfield J. Taylor, of Baltimore, and Charles R. McConkey of Beach Bottom. The capital is $100,000. It is proposed to dam the river near Conowingo, Md., and to erect a large electric power house, similar to that in operation at Niagara Falls.

PEORIA, ILL.—In pursuance to the provisions of a resolution adopted by the City Council of the city of Peoria, Ill., at its regular meeting, held Dec. 18, 1894, propositions are solicited for the establishment of plants and the furnishing of the city of Peoria, Ill., and its inhabitants, with gas and electric light for light and fuel purposes, for a period of 10 or 20 years. All propositions must be received at Peoria, Ill., on or before Feb. 1, 1895. Address all communications and propositions to John H. Hall, Chairman of the Committee on Lights and Lamps of the City Council.

ATHENS, GA.—Athens has near at hand an immense water power that can be utilized at small expense, and a movement is on foot to make use of it at once. Mr. Rice, an electrical expert from Dayton, O., came to Athens a few days ago, and had a consultation with a number of citizens of Athens in regard to this subject. The result is that the citizens have resolved to use the water power off Tallesee shoals, eight miles from Athens, for the purpose of generating sufficient electric power to run the street car line and any other manufacturing interests that may desire to purchase this power.

DES MOINES, IA.—Sealed proposals will be received by the Board of Public Works until January 10 for lighting the streets, alleys and public grounds for the term of two years from and after March, 1895. Bids will be received for 225 arc lights, or a greater number as may be ordered by the Board of Public Works.

BARTOW, FLA.—A local paper says that it is understood that some gentlemen are about perfecting arrangements to put in an electric light plant in Arcadia, which brings to mind again the fact that Bartow needs lighting, and it would make a good investment for one who wishes to install a plant. There can be no reasonable doubt, it says, but that an electric light company can make good money from the start.

THE ELECTRIC RAILWAY.

AUGUSTA, ME.—Augusta people are pleased with the scheme for an electric railroad to Waterville, and argue that it would pay and boom the business of both cities.

SIDNEY, O.—An electric railway of considerable proportions is just now interesting the people of this city. Articles of incorporation in the sum of 100,000 have been taken out, and stock is being rapidly subscribed. The road is to be 20 miles in length, traversing the entire western part of the county, taking in the towns of Hardin, Wynert, Loremies, terminating at Minster, in Auglaize county.

PHILADELPHIA, PA.—The now famous Suburban Trolley bill, which grants to the Philadelphia Traction Company the exclusive use of over 100 miles of streets in the upper section of the city, nearly all of which exist at present only on paper, was boldly pushed to a final vote and passed in the Common Council. The bill was passed by the upper branch on December 6, and it now goes to the Mayor for his signature or veto.

HAMILTON, O.—The Cincinnati, Hamilton, Middletown & Dayton Railway Company is the name of a new corporation authorized by the Secretary of State. The company is organized for the purpose of building an electric line between Cincinnati and Dayton. The incorporators are Messrs. Hickenlopper, Chas. Fleischmann, H. H. Hoffman, H. B. Morehead, O. B. Brown and L. C. Weir. They have a capital stock of $500,000.

NEW HAVEN, CONN.—An unknown company has made application to use the streets of the city for the purposes of an electric railway. It is a sort of blanket petition, and covers pretty much of the whole of New Haven and a good part of the outlying districts. Jacob B. Emery, lawyer, with an office in Room 16, Exchange Building, can probably give further information. He was treasurer of the old State Street Horse Railroad.

ATLANTA, GA.—Atlanta is to have a summer resort next season. The Hale Investment Company has purchased land and will transform it into a pleasure resort. The new electric railroad to the grounds will be known as the Atlanta Electric Railway, and will run from a central point of the city. Mr. Dayton Hale has arrangements in charge. The improvements and the electrical road will be completed in time for the coming season.

ATLANTA, GA.—The Atlanta Consolidated Street Railway Company and another strong company now forming, will extend electric traction here. In addition to the new line, which has a strong backing, and which will furnish a magnificent service, the service of the Consolidated will be greatly improved upon by the building of power houses, new arrangement of terminal facilities, the purchase of new cars, and so forth, the improvements to cost about $100,000. Mr. Joel Hurt is president of the Consolidated Company.

BALTIMORE, MD.—The Baltimore and Lehigh Railroad (the old Maryland Central) proposes to substitute electricity for steam on its line, which is now being extended to York, Pa. President Houseman, of the newly chartered Susquehanna Electrical Company, which proposes to develop the power of the Susquehanna River at Conowingo Falls, is prominently connected with the Baltimore and Lehigh Railroad Company, as are also Winfield J. Taylor and J. Summerfield Bull, directors in the Susquehanna Company. This railroad alone would require a current representing several thousand horse-power. Its route is only seven miles from the proposed site of the dam.

PERSONAL NOTES.

THE NEW FIRM of the Ferris Electrical and Manufacturing Company, has been organized, with its headquarters established at Cedar Rapids, Ia., to take care of the local construction and electrical interests of that enterprising city. The firm will be composed of Mr. Thomas Ferris, formerly connected with the engineering department of the General Electric Company, being one of the original "Edison men" for years, and at present traveling for the General Electric Company in the West, and Mr. Robert Ferris, for seven years a practical electrical worker, and who has held important positions with the Ansonia Electric Company, the General Electric Company, and up to within a recent date has been one of the most successful traveling men in the employ of the Central Electric Company, which boasts of the best corps on the road. In the long ago days he was in the railway department of the Thomson-Houston Electric Company, at Lynn. It is the intention of the firm to carry on a general construction business, handle supplies of all kinds, making a specialty of fixtures. They will also manufacture a line of specialties, such as designs for window displays, and other novelties that are from time to time demanded. They will also have a repair department of considerable proportions. Altogether they will be in a position to install electrical plants complete, both railway and lighting, and supply everything necessary for the running of the same. The members of the firm are young men of high standing in electrical circles and their plan of organization is such as to merit the patronage of every one in search of excellent work.

ROBERT FERRIS.

THOMAS FERRIS.

Trade and Industrial Notes.

J. SCHAWEL & CO., 29 John street, New York, importers and melters of platinum, send us a card containing some useful information relating to platinum. The Troy weight of platinum wire and sheet foil per foot and square inch respectively are given for sizes of wire from No. 6 to No. 4 B. & S. Gauge and thicknesses of foil from .162 to .003 inch.

THE WHITNEY ELECTRICAL INSTRUMENT COMPANY'S Canadian works at Sherbrooke, Canada, were badly damaged by fire on Saturday night, December 29, at 12 o'clock. The damage on the plant and stock is $10,000, on which the insurance is $5,000. The company intends to rebuild at once, and in the meantime Canadian orders are promptly attended to at its Penacook, N. H., factory.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., is building a new power house for the Sing Sing Electric Light Company, at Sing Sing, N. Y. The building is 550 ft. wide and 100 ft. long, the roof being covered with anti-condensation corrugated iron. The New England Pin Co., at Winsted Conn., have placed a contract for the bridge connecting the two departments of heir works with the same company.

DIETERICHS, WARWICK & COMPANY, Cleveland, O., have succeeded to the business of P. B. Warwick, who remains with the new concern. Mr. Warwick was for several years with the late Ford-Washburn Storage Battery Company, and is now electrician of the P. W. Storage Battery Company. The new company has been formed to put on the market the latest types of slow-speed dynamos and motors, the invention of Mr. Warwick. The winding of the armatures of these machines is done by machinery, and each coil is capable of being removed without disturbing the remaining ones, thus curtailing a large reduction in first cost and repairs.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., in a recent announcement states that phosphor-copper and phosphor-bronzes are being more and more extensively used. The peculiar change which copper and bronzes undergo when fluxed with phosphorous is not well understood, but the effects are fully appreciated, strength and toughness are increased, and liability to corosion decreased. For these reasons phosphor-bronzes are being used very largely in marine and railway construction. The charging of the phosphorous into the molten metal must be done with considerable system and care. This part of the operation may be safely and easily accomplished by the aid of phosphorous chargers or phosphorizers made of plumbago. The Jos. Dixon Crucible Company, which makes plumbago goods in great variety for metallurgical purposes, also makes these phosphorizers in different sizes, suited to the size of the crucible in which the fluxing is to take place.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., reports a very bright outlook for the year of 1895, and, in fact, has at no time during its existence had so many orders on its books as it has to-day. The company now have in course of construction in their works at Manchester the following apparatus on orders: five 200-kw, twelve 100-kw, one 80-kw, eight 60-kw, three 45-kw, three 30-kw, belted generators of its new multi-polar type; also three 100-kw, one 80-kw, two 65-kw, two 50-kw, and one 30-kw, direct connected generators of its new multi-polar type; and, also, thirty-one ring type dynamos and seventy Manchester motors of various sizes. Notwithstanding the extensive additions in the way of new tools and facilities recently made to its Manchester plant, the company has found it necessary for the last two months to operate its entire plant twenty-four hours a day, with two shifts of men, but so far have been unable to keep up with its orders. The first three days of January the Mather Company closed contracts for ten generators aggregating 300 kilowats, for railway and power work.

THE ELLIOTT TELEPHONE COMPANY, manufacturers of the Elliott telephone, has removed from Atlanta, Ga., to Nos. 27 and 29 West Morgan street, Martinsville, Ind., where it has superior facilities for handling its rapidly growing business with promptness and dispatch. Having moved from Martinsville to Atlanta one year ago, the company is now acquainted with the advantages and disadvantages of both the North and the South, and finds that the cost of manufacturing its apparatus is reduced to a minimum, at its present location, which, with the low rates, superior shipping facilities, and the fact that it is near the center of population, enables a superior instrument to be offered for less money than ever before. The Elliott [illegible] as well as the magneto telephones of this company, have made for themselves a reputation to be justly proud of, as a choice collection of unsolicited testimonials to their credit, from physicians, merchants, manufacturers and business men attests. The number of instruments sold in 1893 was more than four times those of 1892, and the sales for the nine months ending September 30, 1894, more than trebled those of 1893.

MR. ROMAINE CALLENDER will give on and after January 2[illegible] an exhibition at the Decker building, New York, of the Callender Telephone Exchange system. Several years have been spent by the inventor in perfecting his system, in which he dispenses entirely with operators, and discards the expensive switchboard with its numerous connections. Subscribers make their own connections automatically by the use of a simple device attached to each telephone. Its use obviates extra wires and multiple connections, and does not require an individual apparatus at the exchange for each subscriber. By a simple arrangement the connecting mechanism at the exchange is common to all of the subscribers, and ninety per cent. of the installation expense is saved by providing only sufficient apparatus to meet the maximum demands of the subscribers at one time, it being a well-known fact that only a percentage of the total number of telephones is ever in use simultaneously. The new system provides means for registering the number of connections had by each subscriber, so that, where desired, payment for actual use may be arranged for on an equitable basis. It takes only twelve seconds to establish a connection, no matter how high the number called. These improvements, it is claimed, make the construction so much less expensive than existing systems, that telephones can be supplied to subscribers at from thirty to sixty per cent. less than present rates; the exact saving depending upon local conditions.

THE PECKHAM MOTOR TRUCK & WHEEL COMPANY, New York, reports that its business in 1894 showed a decided increase over the preceding year. The company found no difficulty in running its works at full capacity during the entire year, showing the increased demand for Peckham's trucks as they become better known by street railway companies. More than 2,000 of the Peckham trucks are now in use on the cable and electric roads in New York City, Brooklyn, Jersey City, Hoboken and Philadelphia, where they have been adopted as standard, after a thorough trial. Among these ten roads on which the Peckham trucks have been adopted as standard, may be mentioned the Atlantic avenue road in Brooklyn, the Consolidated Traction Company's lines in Jersey City, the People's Traction lines in Philadelphia, and the Metropolitan Street Railway Company's lines in New York City. The Peckham Company has brought out during the year their new "Excelsior" trucks, including the "Trailer" truck, designed especially for "trailer" cars; the "Spiral Spring" extension truck, designed for 16 ft. closed or 26 ft. open cars; the "Elliptic Spring" extension truck, designed for the same size cars as the "Spiral Spring" truck, and also their No. 10 "Swivel" truck for long cars. The chief feature of the company's work during the past year, however, has been the care given to the small details of construction. Many improvements have been made where the varying requirements of street railway service indicated that changes or improvements were desirable. The main design of the Peckham truck has not been changed, as this has been found to be entirely satisfactory. During the year 1895 other new features will be added where they may be found to be desirable, and judging from the present prospects, the Peckham truck will be adopted during the year by a large number of electric railways as their standard.

Business Notices.

WOVEN WIRE BRUSHES.—The Belknap Motor Company, of Portland, Me., are the patentees and manufacturers of the best woven wire commutator brush on the market.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JANUARY 1, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

531,650. TELEPHONE INDICATING APPARATUS; J. I. Sabin and W. Hampton, San Francisco, Cal. Application filed January 25, 1894. The combination with a self restoring visual indicator, of a non-restoring indicator, and means for actuating the non-restoring indicator when the self-restoring indicator is actuated.

531,651. ELECTRIC BLOCK SIGNAL; C. H. Salada, Pittsburg, Pa. Application filed April 9, 1894. This consists of an apparatus arranged along the line of track capable of sounding an alarm in the locomotive cab.

531,657. TRANSMUTER FOR ELECTRICAL CURRENTS; W. J. Still, Toronto, Canada. Application filed April 5, 1893. This consists of securing on a shaft a cylinder of insulating material around which is secured metal rings with lateral toothed projections which are arranged to coact with a series of brushes, the cylinder being rotated by a motor arranged in a fixed relation to the transmuting cylinder.

531,663. BASE FOR INCANDESCENT ELECTRIC LAMPS; G. C. Thomas, South Framingham, Mass. Application filed November 28, 1893. This consists of a vitreous disk having its edge of varying thickness.

531,677. PRINTING TELEGRAPH; S. V. Essick, Yonkers, N. Y. Application filed April 20, 1892. This comprises a type wheel, feeding carriage, and train of gear, in combination with mechanism for releasing the carriage at any time, and means for returning the carriage to its starting position when released.

531,698. ELECTRIC ARC LAMP; C. A. Pfluger, Chicago, Ill. Application filed April 5, 1894. This comprises a pivoted lever controlled by the series coil, a second pivoted lever controlled by the shunt coil, an elastic connection between the two levers, a clutch associated with one of the carbons of the lamp and connected to the lever controlled by the shunt coil, whereby the clutch is moved only by the movement of the shunt coil lever.

531,702. CLEAT FOR ELECTRIC WIRING; J. H. Swift and W. F. Maintien, Plainville, Mass. Application filed March 17, 1894. A cleat having the meeting faces of its parts non-level and having transverse wire holding notches, the notches being rounded.

531,707. BRUSH FOR DYNAMO ELECTRIC MACHINES; J. B. Wallace, Ansonia, Conn. Application filed April 30, 1894. This consists of a body of conducting material and a surrounding covering of gauze or cloth of high resistance material.

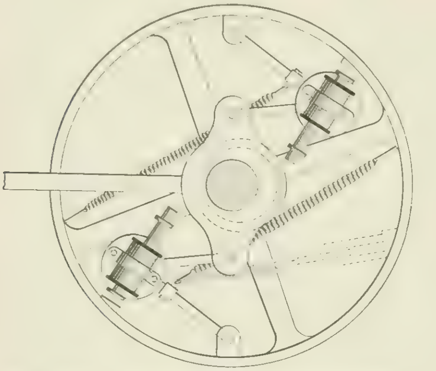
531,708. ELECTRIC SIGNAL; W. J. Wessenberg and H. J. Wilbur, Meriden, Conn. Application filed August 12, 1893. This comprises two stationary lenses and a swinging diaphragm having a smaller and an elongated opening, and mechanism for operating the diaphragm.

531,751. ELECTRIC ARC LAMP; A. Schweitzer, Allegheny, Pa. Application filed June 22, 1894. This comprises a pair of curved carbon holding tubes suspended in a support provided with set screws, whereby the carbons can be adjusted laterally in relation to each other.

531.761. CUT OUT BOX, G. H. Alton, Lynn, Mass. Application filed February 7, 1890. The combination with a base having a binding block provided with a turn button of a lid having an electrode provided with an extension.

531.764. ELECTRIC CAR LIGHTING APPARATUS W. Biddle, Brooklyn, N. Y. Application filed May 8, 1894. The combination with a dynamo adapted to be run at varying speeds and having reverse wound helices and a secondary battery and working circuit, of circuit connections and a polarized compound switch having contacts in a circuit through one of the field helices of the dynamo when the electromotive force of the armature falls below that of the secondary battery.

531.765. CIRCUIT REGULATING DEVICE IN ELECTRIC CAR LIGHTING APPARATUS W. Biddle, Brooklyn, N. Y. Application filed May 28, 1894. The combiation with the secondary battery and its working circuit and a dynamo driven at different speeds, of a three point switch in the circuit between the dynamo and the battery, electro-magnets for moving the same and changing the circuits automatically, and springs for automatically breaking the circuit when the electromotive force sinks as low as the battery.


No. 531,849. Electric Steam Engine Indicator.

531,790. METHOD OF OPERATING OR CONTROLLING ELECTRIC MOTORS OR DYNAMOS, R. Eickemeyer, Yonkers, N. Y. Application filed November 2, 1891. This comprises an armature, a mass of iron affording pole cheeks appropriately located with reference to the armature, and a rotative field magnet, located within the mass of iron, and provided with a core which, when axially varied in position, will variably switch the magnet flow, and cause it to pass from either pole cheel to the other, for driving the motor in either direction.

531,821. CONSTANT CURRENT DYNAMO: J. J. Wood, Fort Wayne, Ind. Application filed July 3, 1894. This comprises a pedestal constructed with opposite hand poles combined with hand hole covers for closing the holes, and means for fastening them to the pedestal.

531,837. TROLLEY; T. Cooper, Providence, R. I. Application filed September 7, 1894. This comprises circular side plates, an annular contact to prevent the independent rotation thereof.

531,840. ADJUSTING MECHANISM FOR ARC LIGHT CARBONS, and means adopted to interlock with portion of the contact; E. F. G. H. Faure, Schenectady, N. Y. Application filed August 22, 1894. This consists of clamping jaws support upon a center, means for holding the jaws together, or releasing them, and means for turning them about their center.

531,849. ELECTRIC STEAM ENGINE GOVERNOR; C. B. Melott, Rondout, N. Y. Application filed July 21, 1894. The combination of a steam engine, fly wheel and a valve adjusting mechanism, the said mechanism being moved by magnetic attraction.

531,854. TELEGRAPHIC TRANSMITTER. J. J. O'M. Neil, New York, N. Y. Application filed February 28, 1894. This comprises keys and contact points, a sliding carriage, a track for the carriage, a motor for moving the carriage in one direction and a spring for moving it in another direction, means for locking and releasing the motor, and means for controlling the return movement of the carriage.

531,866. METHOD OF AND MEANS FOR MEASURING ENERGY OF ALTERNATING ELECTRIC CURRENTS; O. B. Shallenberger, Rochester, Pa. Application filed September 19, 1894. This comprises a supporting frame horizontal arm and coils, and an adjuatible support for the coils carried upon the arm.

531,867. METHOD OF AND MEANS FOR MEASURING ALTERNATING ELECTRIC CURRENTS: O. B. Shallenberger, Rochester, Pa. Application filed September 19, 1894. A current controlling device made to automatically vary the current in one of the actuating circuits in inverse proportion to the periodicity.

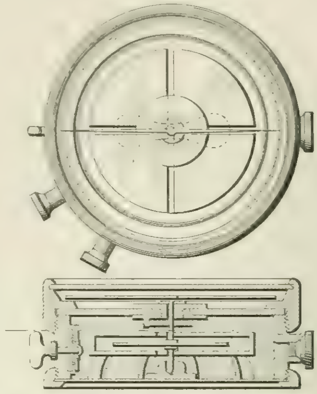
531,868. INDICATING WATT METER FOR ALTERNATING ELECTRIC CURRENTS; O. B. Shallenberger, Rochester, Pa. Application filed September 19, 1894. The combuation of a moving scale and damping device mechanically connected therewith to uphold the oscillation of the scale.

531,869. WATT METER FOR MULTIPHASE ALTERNATING ELECTRIC CURRENTS; O. B. Shallenberger, Rochester, Pa. Applcaton filed September 19, 1894. This comprises an actuating device responding to the currents transmitted over two or more circuits consisting of an armature and two independently operating sets of actuating coils, each set comprising a series coil connected in one circuit and a shunt coil connected across another circuit.

531,870. ALTERNATING CURRENT MEASURING INSTRUMENT; O. B. Shallenberger, Rochester, Pa. Application filed November 24, 1894. This comprises an armature, an actuating circuit and actuating coil and an inductance coil, a second actuating circuit includng an actuating coil and a non-inductive resistance, the actuating circuits being connected in parallel.

531,913. TELEPHONE SWITCH; A. G. Davis, Baltimore, Md. Application filed November 23, 1893. The combination with the main line of a telephone circuit and the electrogenerator and the bell operating magnet, of the horizontal longitudinally movable shaft carrying the main driving gear wheel, the contact points against which the wheel may be brought to bear, and connections whereby the generator and magnet are placed in the main line.

531,919. ELECTRIC RAILWAY SYSTEM; J. Frank, New York, N. Y. Application filed November 27, 1893. This comprises magnets connected on one side to a common rail and on the other side in divided circuits to rail sections in front and rear of the magnets, and a vehicle carrying a signal controlling armature and in turn adapted to close the circuit of the magnets.


No. 531,970.—Electrostatic Voltmeter.

531,962. DISTRIBUTION OF ELECTRICITY; T. Parker, J. H. Woodward and S. G. Rees, Wolverhampton, England. Application filed February 24, 1892. This comprises high tension mains and distributing mains with transformers between the high tension mains and distributing mains, a switch station or station pilot or volt meter wires from the distributing mains to the switch stations, and switches controlled through the pilot wires to cut the transformer in and out.

531,970. ELECTROSTATIC VOLTMETER; H. A. Rowland, Baltimore, Md. Application filed February 24, 1894. A meter having a hollow movable needle immersed in a non-conducting liquid, of high specific inductive capacity.

531,978. ELECTRIC ARC LAMP; C. E. Scribner, Chicago, Ill. Application filed May 7, 1891. This consists of a vertically movable clutch by which the upper carbon is carried, and intervening mechanism controlled by the regulating mechanism, for feeding the carbon downward.

531,980. ELECTRIC RAIL BOND; G. E. Somers Bridgeport, Conn. Application filed May 7, 1894. This consists of a series of strands of wire laid together and given a half turn so that strands of equal length may be used, the strands being retained in place by tapering ferrules, the upper ends of which are pressed into the strands and which are adapted to engage the rails in setting the bond in place.

No. 531,980. Electric Rail Bond.

531,986. RAILWAY SIGNAL; D. H. Wilson, Chicago, Ill. Application filed February 10, 1894. This comprises an electric fence, a system of signals, a combined motor and generator having three armatures on one shaft and connections whereby the two generator armatures supply current for the fence and system of signals.

531,996. ELECTRIC CONVERTER; R. H. Hassler, Pittsburg, Pa. Application filed April 30, 1894. This comprises a core and separately wound and insulated coils thereon, the coils having projecting ends which are spread or arranged fan-wise.

532,003. ELECTRIC SIGNALING APPARATUS; G. E. Miller, Saugus, Mass. Application filed January 24, 1894. Means for automatically signaling between trains on the same track when within any predetermined distance as may be desired according to the length of the trains.

532,009. ELECTRIC SEMAPHORE SETTING DEVICE; H. A. Parrish, Jackson, Mich. Application filed February 10, 1894. This consists in arranging the parts so that the closing of the signal circuit moves the signal from an almost perfect condition of balance to a slightly unbalanced position, sufficient to restore the signal by gravitation as soon as the circuit is opened.

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DEATH FROM ELECTRIC SHOCK.

In another column we print a letter from a correspondent at Demerara describing the circumstances of a death from an electric shock, received from a 52-volt alternating circuit. The lack of insulation found between the primary and secondary could not have had anything to do with the case, as if the secondary had been subjected to the voltage of the primary, even for a short instant, the fuses would have instantaneously been blown, and, unless very momentary, the lamps burned out and the conductors perhaps melted. The death might have been caused simply from the effect of the shock due to the 52 volts of the secondary circuit, either from the victim suffering from some predisposing organic trouble, or, if an ignorant man, from the fright of the sudden shock alone. Or the cause might have been that described by Dr. Hopkinson some years ago in a paper in *The Philosophical Magazine*, entitled "An Unnoticed Danger in Certain Apparatus for the Distribution of Electricity." It is here stated that danger exists in a certain electrostatic action, and if a transformer has a large electrostatic capacity a shock may be received that will certainly kill regardless of the voltage of the secondary. In Europe, we believe, it is customary to make provision for this through an earth connection. In a case calculated by Dr. Hopkinson, the electrostatic capacity is assumed at 0.3 microfarads, which figure, he states, may be attained in a transformer; it is then shown that under certain conditions an E. M. F. sufficient to send 0.3 of an ampere through the human body for a sensible time may be attained, which amount would certainly kill a man. The case cited by our correspondent would have been an excellent one to have applied the D'Arsonval-Goelet method of resuscitation to, and the chances are very good that the victim of the shock could have been revived At any rate, it further emphasizes the necessity to all those having to do with electricity of becoming acquainted with the method of resuscitation to be followed in case of shock. We have still left some of the sheets printed by us containing the necessary direction, which are at the disposition of our readers.

THE BROOKLYN STREET RAILWAY STRIKE.

As we go to press the threatened strike of the employes of the Brooklyn surface railways has just been inaugurated, affecting almost fifty street railway lines, mostly electrical, some six thousand employes and several hundred thousand citizens. The real point at issue seems to be the system of payment for those men who are employed only during the busy hours, or as extras. The men claim that if they have to remain at the companies' call during the entire day they should receive some extra compensation beyond that derived from the few trips they actually make, or that extra compensation should be allowed for the trips during the busy hours in order that their pay may more nearly approach what it would be if the same number of cars were run continuously. The companies, on the other hand, refuse to entertain the demands made for the reason that it would result in an additional expense which the income of their roads does not warrant. At the present writing it appears as if the strike would go against the employes, whose position is not upheld by the State Arbitration Commissioners, and whose places are being eagerly sought by other men. A feature of the strike that will doubtless be watched with much interest is in regard to the attitude that will be assumed by the United States Government with respect to the complication introduced through the running of mail cars, as the strikers do not seem inclined to accord the immunity claimed by the roads from the presence of these cars. The extreme and widely extended discomfort produced will also probably renew the question brought up by the Chicago strike last year, as to the rights of the public and their remedy against such a paralyzation of their means of transportation. (A good purpose will be accomplished if the prominence given to the financial question will, through the claim of the companies as to their restricted funds for operating expenses, direct attention to the disposition of the earnings. The Brooklyn companies have been among the worst sinners in respect to watering stock, and in the case of the largest company it is asserted that but 15 per cent. of the capitalization represents real values. Electric traction has suffered severely everywhere from this cause, and it is well to bear in mind in the present instance in connection with the pleas of insufficient earnings, that the legitimate profits of passenger traffic have been enormously increased by electric traction, but subverted to pay the charges resulting from an inexcusably inflated capitalization.

CENTRAL STATIONS IN GREAT BRITAIN.

Two of our English contemporaries have recently issued lists of the central electric lighting stations of Great Britain, from which we learn that there are now 95 of these in operation, with 20 more in course of construction. In this country there are now more than 2,700 central stations in operation, and although the ratio between the two numbers does not give a correct idea of the relative electric lighting done in the two countries on account of the large size of almost all of the British stations, yet after making all allowances for this, the United States is still vastly in advance; indeed, it is probable that almost any one of our leading States can make a better showing. On the other hand, with few exceptions the British stations have been designed and constructed on true engineering principles, and but few stations in this country will compare favorably on this basis with them. Of the 86 stations now in operation of which information is given, 38 use the continuous current, and 6 of the 13 now in progress of which data are printed, will also generate continuous currents. Of the latter three will employ the three-wire method of distribution, and four the same in conjunction with storage batteries; one will use high tension currents with a secondary distribution from transformers, and another will generate current at 2,000 volts, which will be lowered by means of continuous current transformers in sub-stations and distributed by the two-wire system. All seven of the alternating stations will distribute from transformer sub-stations. Only one station will employ both continuous and alternating currents—that at Edinburgh. We have brought out these details of the stations of latest design to show how widely, in general, British practice departs from our own. Distribution from sub-stations, both with continuous and alternating current, is the method adopted for the majority of the stations, and E. P. S., not the Continental central station type of storage battery, is that which will be employed. The generating machinery in only 7 of the 13 stations will be direct-connected, rope-driving being employed in the others. For the night supply of current the price to be charged will vary from 12 to 16 cents per kilowatt-hour, the average being 13 cents; for the day supply the price ranges from 7 to 14 cents, the average being 9 cents per kilowatt-hour. When we learn the price of gas in Great Britain, the reason of the little advance made in electric lighting in that country appears clear. For example, in 13 towns where stations are now being installed, the price of gas ranges from 43 to 92 cents per thousand, the average being 68 cents. In a town where it is proposed to charge 16 cents per kilowatt-hour for electrical energy, the price of gas is only 62 cents per thousand; or, on the basis of 60 watts of electrical energy generated per lamp and 5 feet of gas per 16-candle-power jet, electric lighting will cost more than three times as much as gas lighting.

TROLLEY RETURN AND UNDERGROUND PIPES.

In another column we give a synopsis of the report by Mr. John A. Barrett to the Brooklyn Subway Commissioners on the corrosion of underground pipes by trolley return currents, which is of particular interest from confirming strongly the conclusions recently put forth by other authorities in regard to the subject. As will be seen, the numerous tests of Mr. Barrett showed that the corrosion was, as a rule, confined to well determined areas, whose limits may almost be determined *a priori*; that while the effects are serious in their nature the remedy is not a matter of conjecture, and its application is merely a question of cost for the necessary return conductors in the danger territory. It is shown that in Brooklyn the conditions are somewhat complicated by the distribution of power houses and the conductive action of bodies of water, and it is well that these factors have been brought forward, as they render the general problem of prevention of corrosion more definite. The principles upon which the problem rests are simple enough and is purely one of the consideration of relative conductivities. The return current will seek the path of least conductivity, but it does not necessarily follow that if underground piping forms part of this path the result must be injurious. The corrosive action occurs through the passage of the current into an electrolyte, which, in this case, is the moisture of the soil, but if suitable metallic connections are made by means of which it instead may ultimately leave the pipes, a harmful effect is avoided. This points to the necessity of having conductors led from the power house throughout the danger territory, there to be connected at intervals to the underground pipes. Of course, in order that the danger territory may be as restricted as possible and the difference of potential kept down, the railway return conductors should be given an ample capacity. While this is a general statement, each case will involve special conditions, and require a special solution, and this is well shown in Mr. Barrett's report in respect to the influence of the Brooklyn water front and the Gowanus Canal, and would apply also where a road passes over ground of varying conductivity, as when portions of the route is over a damp stratum of soil, or when the power house is situated on ground having a path of good conductivity to distant portions of the road. While, therefore, it would always be advisable when building an electric system to install at the beginning the conductors referred to throughout the territory adjacent to the power house, and to study the effect that will result from the neighborhood of bodies of water and take the necessary precautions at that time, in most cases there will still remain a portion of the problem to be studied after the road is completed. It fortunately happens that these later steps are quite simple, and merely necessitate a survey along the line of the road with a voltmeter, and as a rule the indications thus recorded will point directly to a remedy that mostly will be local in character, if the ones determined *a priori* as above have been previously properly applied.

Harmonic Call Bells.

Maj. H. Bagnold, R. E., in the London *Electrical Review* of October 20, refers to an article that appeared in THE ELECTRICAL WORLD of September 22, 1894, by Mr. S. D. Mott relative to harmonic call bells, and states that the principle there described is fully set forth in his British patent specification, No. 860 of 1891.

This patent is still maintained, he says, and a considerable number of "bell repeaters" constructed on this principle, as described in the London *Electrical Review* of November, 1891 (No. 728), have been sold during the last three years. Maj. Bagnold remarks that it is perhaps worth while pointing out that Mr. Mott's bell as designed would not ring. It would only make an unpleasant noise, and to make it ring one of the pole pieces must be removed. This seems to show that a bell does not vibrate in two ellipses, the major axes of which are at right angles one to the other, as stated by the late Prof. Tyndall.

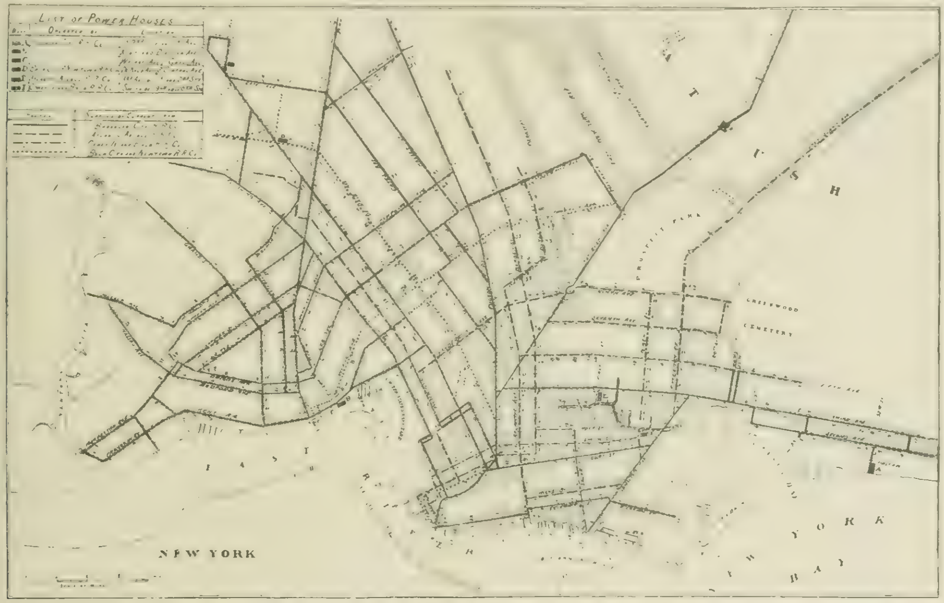
Mr. Mott, in a letter to the same journal replies to Maj. Bagnold, and says that the device referred to was described in THE ELECTRICAL WORLD, not as a fully completed invention, but as a suggestion for theoretical consideration, as he had not the experimental facilities to give such apparatus the scientific investigation on which to base a commercial form. Mr. Mott says it was invented by him in 1886, and a sample bell was made in 1891 by The E. S. Greeley & Co., of New York. The statement "to make it ring one of the pole pieces must be removed," he says is probably correct.

Mr. Mott adds that he was not aware that the device had been patented in England or elsewhere by Maj. Bagnold in 1891, nor that a considerable number had been sold during the last three years.

The Brooklyn Trolley Strike.

The greatest strike of electric street railway employees that has occurred since the commencement of electric traction was inaugurated on the morning of January 14, the strike affecting no less than 47 roads. Only two electric roads in Brooklyn are unaffected, the Jay and Smith street lines, and the West End and Coney Island line. Several hundred miles of road are idle, and fully 6,000 men are on strike. Up to the time of going to press no violence has been reported, but it is said that a plot has been discovered to disable power house machinery.

The strike is the result of the refusal of the street railway companies to accede to the demands of the men, which were three in number: first, an increase of pay from $2 to $2.25 per day; second, part remuneration for the time spent by men waiting for trips, and third, that employees making but a few trips per day during the busy hours be paid more than the proportionate rate for these trips, since, it was claimed, these trips have only netted the men about 25 cents apiece. It is understood that the men would not insist upon an increase of pay if an agreement could be reached upon the two last-named points. The companies have positively declined, with the exception of President Slocum, of the Jay street line, to entertain a single one of the demands, claiming that, in the present dull state of business, they could not afford to increase expenses.



Map Showing Trolley Roads of Brooklyn.

Electric Wires in Brooklyn.

In the report of the Brooklyn Board of Commissioners of Electrical Subways for the year 1894, a summary is given of the work of the Board to date.

The first electric wires laid in underground conduits under the direction of the first Board of Commissioners of Electrical Subways were drawn into the ducts in June, 1886. The work progressed during the summer, and plans were matured for a continuance of it in the spring of 1887. The Board of Alderman, however, passed a resolution on December 17, 1886, directing the Commissioner of City Works to refuse to grant permits for the purposes of constructing electrical subways. No progress was made by the Board during the summer of 1887. An appeal to the courts resulted in breaking the deadlock and work was resumed late in October of the same year. The existence of the Board terminated October 31, 1889, at which time 3,007 miles of conductors had been placed in the ducts and 768 miles carried upon the elevated railroads, making a total of 3,775 miles.

Since the beginning of subway work in 1886 there have been two interruptions to its progress, aggregating about three and one-half years of time. The total length of wire now in underground conduits is more than twice as great as the total of electrical conductors in the city when the first Board was organized.

The wires now on poles and house tops represent in amount only a portion of the growth of the electrical systems within the last few years. Fully sixty per cent. of all the wires within the limits of the city are now provided with spaces in conduits, or are carried by the elevated railroad structure.

It should be mentioned in this connection that a large amount of telephone wire buried in 1887-88 has been removed from the conduits, partly because of injuries incident to the locality and partly because the experience being new at that time the conditions incident to the situation had not been fully measured. Larger conduits were found necessary and gradually a double wire or "metallic circuit" for each subscriber was required to overcome new difficulties that came with the trolley.

Some loss was occasioned at first through a destructive action of one of the constituents of the creosoting compound upon the lead covering of the cables. This difficulty was met by substituting an alloy for the pure lead previously employed.

The latest and most potent cause of loss in the buried cables is the electrolytic corrosion. Fully four hundred miles of telephone wire have from various causes been thus rendered worthless. About three hundred miles have been rendered useless during the past year through the corrosion of the lead covering of the cables.

A notable event of the year just closing was the beginning of the construction of conduits from the high tension arc-light conductors. The Municipal Electric Light Company began the construction of its conduit early in the summer. The Citizens' Electric Illuminating Company began its underground work in September. An aggregate length of 112,000 feet or 21.2 miles of duct is prepared to receive conductors. Cables will be drawn in during favorable weather in the winter and the construction on conduits continued in the spring.

The District Telephone Companies employ only aerial lines, which are mostly supported on housetops. To insist on the burial of these wires would abolish the system. The expense of underground conductors would render its operation at present rates, or at any prices commensurate with the service afforded, impracticable, and the commissioners state that the public interests do not require the burial of these wires. The burglar alarms and the messenger boys cannot be dispensed with, and while citizens demand this simple and serviceable means of electrical communication the wires must remain in the air. Possibly, they state, with a more general use of the telephone, which is certain to come, the two distinct services may be performed by one system of underground conductors. Telephone lines are extended on poles in populous districts under other conditions. These are temporary structures only, and are permitted by this Board in locations where the telephone service is desired by the residents, and where the construction of an underground conduit is not at present warranted by the amount of service called for.

The commissioners argue against a general inclusive subway designed to contain wires and pipes of all kinds except, perhaps, the sewers. Such a construction, they state, to be built in any of the city streets would require the removal of nearly all the present pipe and subway systems and their replacement in the new conduit. Moreover, the space called for by the proposed new scheme would be greater than the space now occupied, inasmuch as a transverse passageway is a part of the plan. On the other hand, for suburban districts destined to become populous and where the underground constructions are not yet begun, the general subway plan is an ideal one, and if it could be adopted would save much subsequent inconvenience. The ownership of such subway should obviously rest with the city.

As to corrosion of pipes from trolley currents, the Board reports that the areas within which injury can be done are clearly defined and that quite certain means of arresting the destruction have been found.

The aggregate length of electric conductors of all kinds within city limits (omitting areas added by last Legislature) is 15,914,688 miles. The length of conductors within new areas is 857.74 miles, or a total of 15,772.428 miles. The mileage of wires underground or on elevated roads is 9389.406.

The total length of aerial systems within the old city limits is 6447.532 miles. Wires buried during the year, including amount suspended as above stated, amount to 2005.43 miles.

A report by Electrician John A. Barrett on the subject of corrosion of underground pipes by trolley currents forms an appendix to the above. Mr. Barrett followed the plan of Mr. I. H. Farnham in mapping out safe and danger territory, taking voltmeter readings for this purpose of the potential difference between street car rails and 660 hydrants along somewhat over 100 miles of street. Since the positive poles of the power house generators are connected to line it was found, as expected, that in general the danger territory was in the vicinity of the power houses. Nevertheless, there are a number of variations from this rule, and the situation in this respect in Brooklyn is described as one of peculiar complexity.

Chief among these peculiar and complicating conditions is the operation of four principal and independent trolley railroads, with seven power stations in irregular and scattered positions, and with intricately crossing and interlacing lines of track. Lack of any common standard as to systems of feeders, supplementary wires, and returns adds to the confusion. The extensive water front of Brooklyn and the situation of two large power stations directly on the shore, and of two other power stations on Gowanus Canal, all with negative plates of considerable capacity sunk in the water, together with the discharge of a heavy amount of current from the cars between Wallabout and Gowanus, constitute an important special factor in the distribution of the earth currents. From the latter combination of circumstances there appears to be an almost continuous line of dangerous potentials upon the water pipes along the shore from the Navy Yard to Erie Basin.

The conditions about Gowanus Canal are also described as seriously compromising to the safety of water pipes in that neighborhood and the problem an intricate one, due to the relative situation of two power stations on the canal and three independent lines of road interlacing with each other in the immediate vicinity. In one case where the danger district was misplaced, the cause seemed to be indicated as due to a negative connection from the generators to a driven well near the canal, together with overloaded return wires from the rail system.

Regarding the question of corrective measurers, it is recommended that the first thing to be done is so far as practicable to keep the pipes clear of current in all those regions where there is a tendency of the current to overflow from the rails to the pipes. The one method by which this overflow may effectually be diminished is to provide a more liberal system of return conductors than at present prevails, at least on some portions of the Brooklyn railways. The limit to which the perfection of the return system should be pushed ought to be fixed only by considerations of reasonable cost.

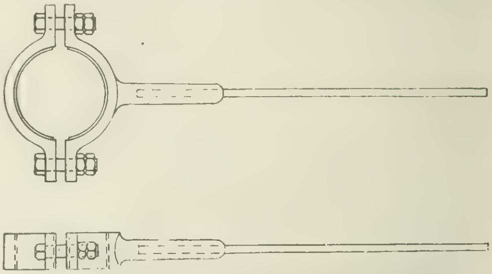
After everything that is reasonable has been done in this direction, there will still be a large overflow of current from the rails which will be collected by the pipes and will be conveyed along the pipe to points where the conditions favor its discharge again into the earth.

The second thing to be done is to locate, by careful investigation, the points where this large and unavoidable residue of earth current tends to leave the pipes; and, by a system of special return wires directly connected at brief intervals to the pipe mains, to draw off as much as possible of the accumulated electricity harmlessly from the pipes, and thus to obviate the electrolytic action which is sure to accompany the passage of the current directly from the surfaces of the pipes into the earth.

It is important to associate the two steps in their proper relations with each other. In general the attachment of special return wires to the pipes in the danger districts should not be undertaken until an adequate system of outlying returns has been provided by the railway companies.

After all that is practicable has been done to convey back the railroad current to the power stations by proper return conductors, then the pipes in the vicinity of power stations may be relieved of the unavoidable overflow by wires correctly applied. Under these conditions the railway companies will be prevented from relying upon the underground pipes—particularly the water pipes—as a material and proper part of their return systems, and the pipes, so far as regards the principal circulation of trolley currents, would virtually be safe.

The remedy for exceptional cases noted would consist chiefly in electrically uniting different lines of pipes at suitable points, in establishing metallic connections between pipes and rails at places indicated by the conditions, and, in general, in drawing the electrical current from the pipes by the direct attachment of negative feed wires at a point wherever a dangerous potential difference is found.



Clamp for Attaching Wire to Water Mains.

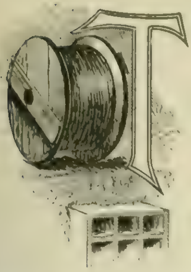
Several of the conclusions above outlined were tested in practice with the aid of the railway companies, and found in each case to be justified. The accompanying cut shows the form of clamp for making attachments to the water mains, made for the purpose under the direction of Mr. M. G. Starrett, chief electrician of the Brooklyn City Railway. The collar is of wrought iron in two parts, five-eighths of an inch thick, and two inches broad. The two parts are drawn together by ¾ inch bolts, with two nuts to each bolt. The collar is previously turned out upon its inner face to one-fourth of an inch larger than the diameter of the pipe to which it is to be applied. Midway in one part is formed a lug into which is brazed a No. 00 copper wire. In applying the connection the pipe is carefully brightened all around with a file. A strip of bright lead 5-32 of an inch thick and 2½ inches broad is laid around the pipe, and the collar is clamped down by the bolts until the lead gasket is meshed into the inequalities of the pipe. The lines of junction between the collar and lead and pipe are thickly painted over with "P. & B." mixture, then completely taped over, and again painted with "P. & B." upon the tape; after which the whole is thoroughly packed in with good cement. Mr. Barrett does not regard the thoroughness of this method as excessive in view of the requirements of the case.

One element in the problem of earth currents mentioned as of great importance is the relation between water and gas pipes. The independence and extent of the two systems of pipe are stated to undoubtedly produce situations where there is a strong localization of current through the earth from one to the other, and where that pipe is being continuously corroded from which the current is flowing.

The final conclusion of the report is that under the present condition in Brooklyn it appears indisputable that earth currents from trolley roads are causing extensive electrolysis of water pipes and other pipes and conductors imbedded in the ground, at an indeterminate but serious rate. It also apppears that there are practicable means at command which are being neglected, and which, if properly organized and applied, would largely abate, if not altogether arrest, the destruction now taking place.

The Making and Laying of Underground Cables.

BY WM. MAVER, JR.



To attempt, in an article of limited length, to describe, in full detail, the various processes of manufacture and construction of all the different kinds of cables now employed for telegraph, telephone and electric light and power purposes, or of the many underground ducts or subways in which these cables are laid and which are now to be found in nearly all the larger cities of this country, would obviously be out of the question. I, therefore, must confine myself to a more or less brief account of the main processes of manufacture and construction of some of the more prominent types of cables and subways now in use.

The term electric cable, whether for underground or submarine use, may be taken to include the conductor, the insulating material and the armor or lead covering, as well as any jute or taping that may be added.

Practically without exception, the metal used for the conductors in all electric cables is copper, on account of its many advantages, such as flexibility, durability and high electrical conductance. The conductor may be composed of one solid wire of any desired diameter or it may be formed of a number of wires into a strand, but it is always of copper. The process of manufacture of the cable may, therefore, be taken up at the wire factory, where the copper is received in bars or ingots. The metal is first formed into rods, and is then prepared for drawing into wire of any desired size.

Wire Drawing.—This process is termed "wire drawing." It consists of pulling, or drawing, the rods or wires, while cold, through a steel die, in the manner indicated in Fig. 1, in which figure R is a reel on which wire has been wound, I is the steel die, and D is a pulling drum by which the rod or wire is drawn through the die. In this figure the wire is shown as having been reduced in size. In practice the copper rod is started through the die by filing the end for a short distance, when a clamp is attached to a chain and the latter to the drum D. D is in turn revolved by suitable machinery. Preparatory to "drawing" the rods and wire are coated with a flour paste which is then dried upon the metal by baking in an oven. In passing through the die the flour acts as a lubricant, and it is a curious fact that the copper wire is thereby prevented from coming into actual contact with the die, which, of course, is the main object of thus coating the wire.

When the wire has been reduced to the desired size, which may entail drawing it through several dies of diminishing diameter, it is then usually annealed to a required degree of "softness," or pliability, by heating. In practice the term "hard-drawn" is applied to copper wire to distinguish unannealed from the annealed or soft copper; the difference being that the "soft" wire is annealed after drawing, while the "hard-drawn" wire is not. For underground cables, hard-drawn, medium hard and soft wire are used, as may suit the desire of the purchaser. Hard-drawn wire is always used for overhead lines.

The question of purity of the copper is clearly an important one, as the slightest impurity in the metal has a very marked detrimental effect upon its electrical conductance. Experiments have shown that mere traces of arsenic in the copper will reduce its conductivity over 30 per cent., and even an impurity consisting of one or two per cent. of silver, which is at least as good a conductor as copper, will reduce the conductivity very appreciably, perhaps 8 or 10 per cent. It is, therefore, customary for purchasers of wire to specify a purity equal to 98 per cent. of that of pure copper; or, what is practically equivalent to that, they specify that the copper shall have a conductivity equal to 98 per cent. of pure copper, which insures the purchaser a practically pure metal.

The treatment during the processes of drawing and annealing the wire may also have a detrimental effect upon the conductance of the metal and may reduce its conductivity two or three per cent., depending somewhat upon the number of drawings through which the wire passes. In some factories, perhaps in the majority of them, chemical tests are made of samples of the copper before drawing to determine its purity, and, after drawing, electrical tests are also made. I am not sure that all purchasers of wire are equally careful, but it is well known that the large telegraph and telephone companies habitually test the copper wire received by them for use on their overhead lines. As a matter of fact, however, it may be remarked that the art of refining the copper and of manufacturing the wire has now reached such a state of excellence that it is an unusual thing to detect by the electrical tests any marked deficiency in the conductivity. Still, the writer has within a comparatively recent period tested samples of copper wire, concerning the purity of which there was a question, and found a conductivity of not over 85 per cent. of pure copper. As a little reflection will show that a 10 or 15 per cent. loss of conductance in a circuit might be a serious matter, the wisdom of making such tests becomes evident. The electrical tests for conductivity are usually made by the Wheatstone bridge method, employing a highly sensitive reflecting galvanometer.

Wire Tinning.—Wires intended for use in underground cables are frequently tinned, avowedly to prevent the sulphur contained in some of the insulating compounds from acting upon the copper, for which sulphur has a marked chemical affinity. The actual necessity for this coating of tin is sometimes questioned. It is true that the untinned metal is quickly blackened by such compounds, but apparently no further action occurs under normal conditions. The method of tinning wires is shown in Fig. 2. The wire is drawn from a reel R, into a vat M, containing a solution of muriatic acid and zinc, which thoroughly cleanses the surface of the wire, and from which it passes into and through a vat T of molten tin on to the reel R'. In leaving the vat T the wire passes between the folds of an asbestos mat A, which removes any superfluous tin that may adhere.

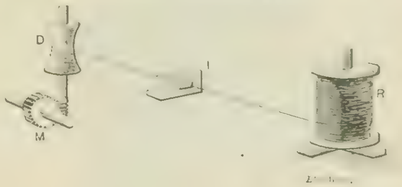


FIG. 1.—WIRE DRAWING.

Wire Stranding.—The wire is now ready to be twisted with other wires into a strand, or, as a solid wire, to be covered with the insulating material. As a rule, the conductors of cables are solid up to a size of No. 2, B. & S gauge; above which size they are stranded; chiefly on the score of flexibility in handling. For the same reason many small cables are also stranded.

One method of stranding wires is shown in Fig. 3. The figure represents a stranding or cabling machine intended for stranding four wires. This particular machine is shown because of its simplicity for purposes of illustration. Machines are made for stranding 100 or more wires at one time. The single wires are placed on the spindles S S, from which they are led over the pulleys shown, up to a cap, or die, C, through which they pass to and through a guide G. Here the revolutions of the spindles twist the wires into the strand, which is seen passing over the "take up" drum P, and thence to the reel T. The machine, as a whole, is driven by the belt B, and the separate parts are, of course, appropriately geared to maintain a definite relative speed and strain, one to the other. It will be understood that the spindles have an axial motion as well as a revolution around a common centre.

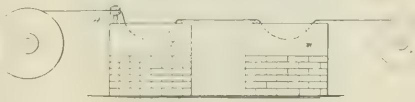


FIG. 2.—TINNING WIRE.

Insulating the Wire.—The conductor is now ready to be covered with its insulating material, the nature of which depends upon the type of cable, and also, to a considerable extent, upon the purpose for which the cable is intended. For instance, if it is to be a telephone cable, a thin paper insulation will most likely be required, owing to the low static capacity of "paper" cables, which is about .07 or .08 microfarad per mile. If the cable is intended for telegraph or electric light or power purposes, the dielectric may be paper or other fibrous material saturated with some resinous or bituminous compound, or it may be covered with some homogeneous material such as a rubber compound.

I may interpolate here that it is now common practice, in this country at least, to cover all underground cables with lead. In the case of fibrous insulating material this is necessary to exclude moisture, which would otherwise ruin the cable, and in the case of rubber compounds the lead casing is essential to prevent the deterioration which would follow a free exposure to the air. The lead covering process will be subsequently described.

The conductors of paper cables intended for telephone purposes are wound very loosely with strips of soft paper, the strips being put on sometimes spirally and sometimes longitudinally; in the latter case the strips are held on by threads. The process by which the paper strips are put on spirally is practically similar to that described in the taping of rubber cables (Fig. 8). The conductors thus covered are then twisted "in pairs," after which the pairs are built up into one large cable of twenty or fifty pairs, more or less, preparatory to being lead covered. I may say in passing that the object of putting the paper on loosely is to reduce the static capacity, which reduction, when thus obtained, is due to the fact that this looseness of the paper permits air to have access in numerous places between the conductor and the paper, while, at the same time, the paper effectually prevents the conductors from coming together in metallic contact. It will be understood that any reduction of static capacity obtained in this way is due to the lower static inductive capacity of air as compared with any solid dielectric.

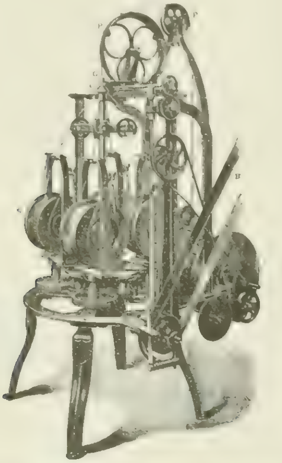


Fig. 3. Wire Stranding Machine.

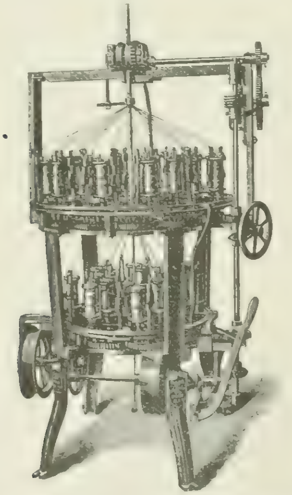


Fig. 4. Cotton Covering or Braiding Machine.

Another form of paper cable used on electric light circuits is made up of paper strips, which are put over the conductor solidly, in layers of any desired thickness. The whole is then immersed for several hours in a hot, resinous oil, after which it is encased with lead.

The proper thickness of the insulating wall of cables intended for high potential circuits is determined, not only by the electrical pressure standing qualities of the material, which quality varies with different materials, and which can only be determined, primarily, by experiment, but also by the mechanical strength which it may be considered necessary to impart to the material, to enable it to properly withstand the more or less hard usage it may be subjected to in winding on reels, hauling into and, possibly, out of, underground ducts, etc.

Another form of cable, commonly termed fibrous cable, which is used extensively for telegraph and electric light and power purposes, is made by winding cotton thread or jute in alternate layers over the conductor.

One means of covering conductors in the foregoing way is shown in Fig. 4. This particular machine covers the wire in two layers, the under layer having 16 threads, the upper layer having 24 threads. The bare conductor is shown passing up through the floor to the machine. The two sets of spindles holding the threads are shown one above the other. Usually the layers are put over the wire in opposite directions; consequently the upper and lower spindles revolve in opposite directions, and as they revolve, the spindles or bobbins move past each other with an in and out motion, thus forming a braid over the wire. The number of layers and the thickness of the cotton or jute threads depend upon the use for which the cable is intended. When the conductor has been covered to the desired thickness, it is then, as in the case of the paper cable just described, placed in a vat where it is boiled in an insulating compound for several hours, or until all traces of moisture have been driven from the fibrous material, when it also is taken to the lead covering machine. This is assuming a single conductor cable, otherwise the several insulated conductors would be built up into cable form as previously described.

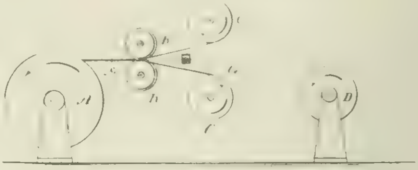


Fig. 5.—Rubber Strip Covering Apparatus—Lapping Process.

The next type of cable which may be considered is one in which the insulating material is a rubber compound, much of which is used on electric light and power circuits and also for telegraph purposes. In this type of cable, as in that of some already described, the ingredients of the insulating compound and the manner in which it is prepared are usually trade secrets, known only to the manufacturers and a few trusted employes. The basic ingredient, however, of all high grade rubber compound cables should be pure rubber. The manner in which the prepared compound is put over the conductor varies with different makers. With some makers the compound is calendered into a sheet of any required thickness, which is then cut into long strips. These strips are then placed

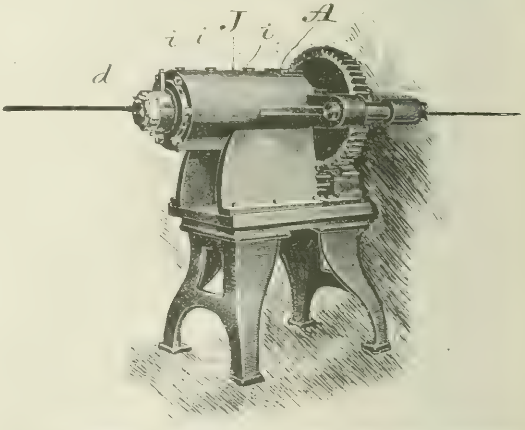


Fig. 6. Rubber Compound Covering Machine—Seamless Process.

over the conductor by a process which is shown diagramatically in Fig. 5. The rubber strips are placed on the reels *CC*, and are then led between grooved rollers *RR*, which are provided with sharp cutting edges. The wire is rolled off from the drum *D* and passes through the guide *G*, to the rollers *RR*, where the rubber strips are pressed closely around it, the pressure causing the respective strips to adhere to each other, and at the same time the surplus rubber is removed by the cutting edges of the rollers. The width and thickness of the strips, of course, depend upon the size of the wire and the purpose for which it is intended. In practice, especially with the larger sizes of wire, it is usual to place a tape over the insulation before the compound is vulcanized to the required degree of hardness, in which case a taping machine is generally placed at a point x between the rollers and the "take up" reel *A*.

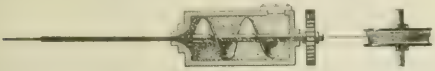


FIG. 7.—COVERING MACHINE.

In other types of rubber cables but one strip of rubber is used, and in others again the compound, while in a plastic state, is placed over the conductor while passing through a suitable die. This latter process, which produces what is termed a "seamless" cable, is shown in Fig. 6. The rubber compound is fed by an attendant into a chamber through an aperture *A*. The material is kept at a proper working temperature by a jacket *J*, over the chamber; steam or hot or cool water, as may be necessary, being admitted to the jacket at the points *iii*. By a suitable worm screw device, outlined in Fig. 7, the compound is forced in requisite quantities towards the die *d*, which is the point at which the compound is placed around the wire. The wire passes from a reel, through the chamber, as indicated in Figs. 6, 7, and in passing out it is held rigidly and accurately in the centre of the die *d*, by which means the compound is distributed evenly over the conductor. After leaving the machine the newly covered wire is drawn slowly along a table on which is placed quantities of powdered talc, or soapstone, to a reel on which it is taken to the vulcanizing chamber, unless a tape is first to be placed over the insulating material, which is usually the case excepting for the smaller sizes of wires. It is found that the taping assists in preventing flattening of the comparatively soft compound, prior to and during vulcanizing; more especially in the case of very heavy conductors.

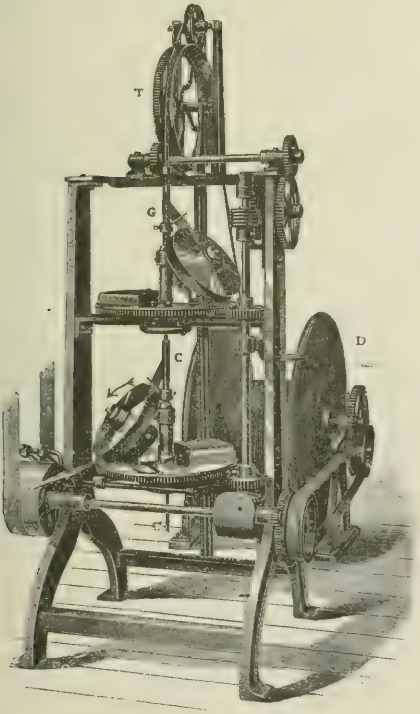


FIG. 8.—TAPING MACHINE.

Taping Machine.—A taping machine is shown in Fig. 8. This is a double, or two reel vertical taping machine. For the case in point a horizontal machine could be employed. The insulated wire is shown as coming up through the flooring to the guides *CG*, in each of which there is a slot through which the tape passes to and around the conductor. The platforms carrying the reels holding the tape revolve in opposite directions, as indicated by the arrows. The taped conductor then passes several times around a take-up drum *T*, and thence to the reel *D*.

FIG. 9.—MEASURING MACHINE.

Vulcanizing. The vulcanizing process consists of placing the rubber covered cable in a large iron chamber which is maintained at a temperature of from 300° to 400° F. Considerable care is required in this process, and the most favorable temperature and the length of time required to bring the compound to the desired degree of hardness and tenacity are matters of experiment, and vary with different compounds. It is well known that sulphur is the chief ingredient which undergoes the chemical combination with the rubber to bring about the marked change in the consistency and color of the compound which occurs during exposure to the high temperatures mentioned. As

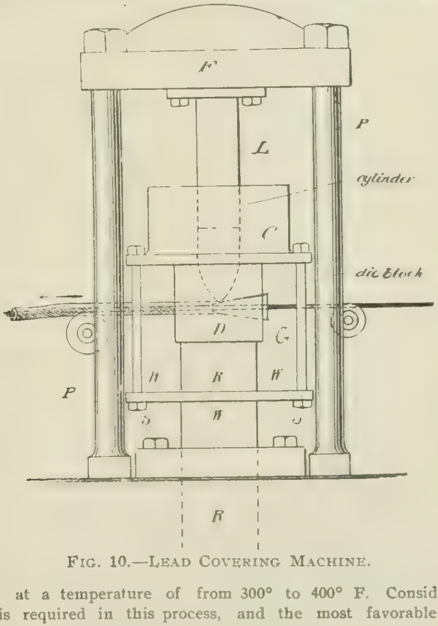


FIG. 10.—LEAD COVERING MACHINE.

may be well known, the compound usually enters the vulcanizing chamber a soft, yellowish compound and comes out a dark blue tenacious substance. This particular color, however, may be varied by the introduction of other ingredients, without injury to the insulating qualities of the compound. One or more differently colored insulated wires are frequently used in telegraph and telephone cables as "markers" to assist in tracing the wires.

In the case of rubber compound cables the next proceeding is to place them in large tanks filled with water, where they are allowed to remain a longer or shorter time to admit moisture to the conductors should any imperfections exist in the insulating material. To ascertain whether any such imperfections exist careful electrical tests are made, usually by the "direct deflection-method," in which the Thomson or D'Arsonval reflecting galvanometer is used. In case any defects are disclosed by the tests the next proceeding is to localize and remove them. Descriptions of such tests are to be found in various text books.

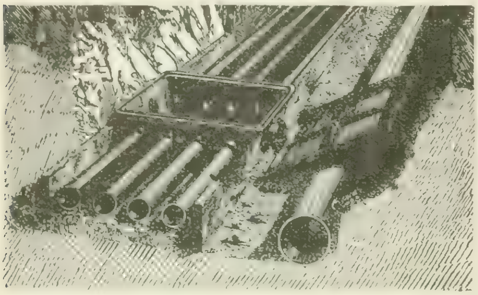


FIG. 11.—WROUGHT-IRON DISTRIBUTING DUCTS—SHOWING HAND-BOXES AND VENTILATING PIPE.

Measuring Machine.—There is an important little machine used constantly in the process of braiding, taping and insulating wires, which I should not omit to mention. It is a device for measuring and recording the length of wire passing through the various machines. Its operation will be readily understood from an examination of Fig. 9. The wire *W* is caused to pass between the wheels as shown, in doing which it causes them to rotate. It is then evident that at every revolution of, say, the larger wheel, a definite length of wire will have passed, and as this wheel is appropriately geared by clockwork with the hands of the dials, the total length of wire or cable passing through is recorded and may be read at a glance. In the figures the lower dial indicates in 100 feet, the upper in 1000 feet, units. The machine is adjustable as to height. As each reel is filled the attendant marks the amount of wire, on suitable tags, whereupon the machine is reset to zero.

Lead Covering.—With the completion of the foregoing processes and tests, fibrous and rubber cables are now ready to undergo lead covering, the operation of which is highly interesting. In Fig. 10 a vertical type of lead covering machine, in which the lead is put on hot, is shown. *F P F* is the iron framework of the machine, which framework, as well as the other parts of the machine, is of massive construction, to withstand the great pressure necessary to properly place the lead over the insulation. The pillars *P P* are of solid iron, about 10 inches in diameter. The following are the parts of the machine: *R R* is the hydraulic ram, which is also of solid iron, and about 15 inches in diameter. It passes down into a vault in the ground several feet, the hydraulic pressure being applied at the lower end. *D* is the die block, *C* is a hollow cylinder into which the lead is placed; *L* is termed the lead ram, or plunger. It is also of solid iron, 5 inches in diameter, and is rigidly bolted to the framework *F*. Its lower end fits snugly into the receptacle in the cylinder *C*, as indicated by the dotted lines. Inasmuch as the die block must be changed to suit the size of cable to be covered, a frame *W W W'* is provided to permit of its easy removal. A ring or flange *W'* is attached to the ram *R*, as shown. The die block *D* rests on the top of *R* and the cylinder *C* rests on *D*, in which respective positions they are held rigidly together by screw bolts *s s*.

It will be seen by the dotted lines that there is an opening in the die block immediately under the opening in *C*, and that this opening tapers nearly to a point where it reaches the cone-shaped guide *G*, through which the cable passes, as shown.

The manner of preparing the lead and the machine for the operation of lead covering the insulation is practically as follows:

The hydraulic ram is dropped down, and as it carries the die block and the cylinder with it, the lead ram or plunger, *L*, is withdrawn from the cylinder. The cylinder is then filled with molten lead, alloyed with three or four per cent. of tin, which operation is termed "charging" the machine. As it is obviously not desirable to attempt to place the lead in a melted state over the insulation, the charge is allowed to chill somewhat before the operation of covering is proceeded with. The time necessary to allow the lead to reach the desired temperature, or, so to speak, the desired plastic condition, is found by experiment. It varies with the size of the cable and may range from three to four minutes. The temperature of the lead may range from 300° to nearly 600° F., when the process is begun. To prevent undue chilling of the lead, gas jets, not shown in the figure, are placed around the cylinder. At the proper time pressure is slowly applied to the ram *R*. The pressure exerted on the end of this ram in some cases amounts to 500 tons. The pressure causes the cylinder to rise up against the plunger with the result that the lead within the cylinder is pressed down into the die, forming a circular envelope, or tube, around the cable. At the same time, by suitable "take-up" drums, or reels, the cable is drawn through the die block, as outlined in the figure.

The die block and the cone-shaped guide may be so adjusted that any desired thickness of lead envelope may be placed over the cable, and also so that it will inclose the insulation, loosely or snugly, as may be desired.

The lead for this purpose was originally alloyed with tin in about the proportions stated, with the design of preventing the effects of gases or acids upon the lead, numerous instances having been found where the lead was converted into a porous and friable carbonate of lead, in creosoted wooden ducts, and it was supposed that this alloy would render the covering immune from such attacks. However this may be, it is also found that the tin adds a certain rigidity to the lead which is useful in drawing the cables into and sometimes out of the underground ducts.

Almost without exception the underground electric light and power cables in this country are made with but a single conductor in one cable. A notable exception is the well-known "Edison" three-wire tube conduit or cable, which consists of a pipe or tube, generally of iron, containing the wires, and into which tube a melted insulating material, which subsequently hardens, is forced. To hold the wires in place should the insulating material soften, a jute rope or other suitable material is wound spirally around them.

Laying Underground Cables.—The final process at the factory after lead covering is the electrical testing of the cable, whether of fibrous or homogeneous material, to insure that no defects exist in the insulation or conductor. In the case of multiple cables, such as are used for telegraph and telephone purposes, the conductors are tested also for crosses and open circuits.

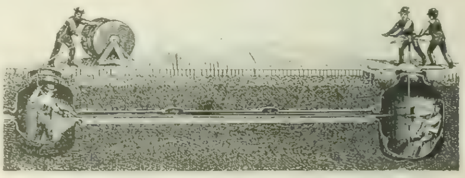


FIG. 12.—HAULING CABLES INTO SUBWAY DUCTS.

The completed cable is then placed on reels and forwarded to the vicinity of the underground duct in which it is to be laid.

The type of underground conduit now being most generally introduced in this country is that known as the "drawing in and out" system. By "drawing in and out" is meant a system in which a substantial duct or ducts are provided, with manholes at regular intervals, and into which ducts cables can be drawn and, if necessary, drawn out, at will. This term is used to distinguish such conduits from those in which the cable or conductor is placed directly in the ground, or in a duct, which is solidly filled with an insulating material which is then placed in the ground and from which the wires or cables cannot be removed without again digging up the streets. The remarks which follow will treat only of the former type.

Drawing in conduits may consist of one or more ducts, as best suits requirements, of from two to four inches in diameter. The ducts may be of wrought iron, earthenware, cement lined with thin sheets of iron, of each of which there is a considerable amount now in actual use. Wooden ducts are also used. The tubes are usually laid in a bed of concrete. The iron pipes are joined together by a screw coupling, the earthenware and cement pipes by a cement joint. The manholes are placed from 200 to 300 feet apart. They average about 7 feet in depth by 5 feet in width.

The general method of laying these ducts in the streets of large cities is shown in Fig. 11, which represents a few lengths of wrought iron tubing, with also a ventilating pipe shown at the right of the figure. The ducts shown in this figure are termed "distributing" ducts, in contradistinction to "trunk" ducts. The distributing ducts are placed as near the surface of the street as possible and are provided with openings termed hand-boxes, about 2 feet square, which give access to the cables for the purpose of making side connections into buildings. The trunk ducts are placed below the distributing ducts, and access to the cables contained in them can only be had at the manholes.

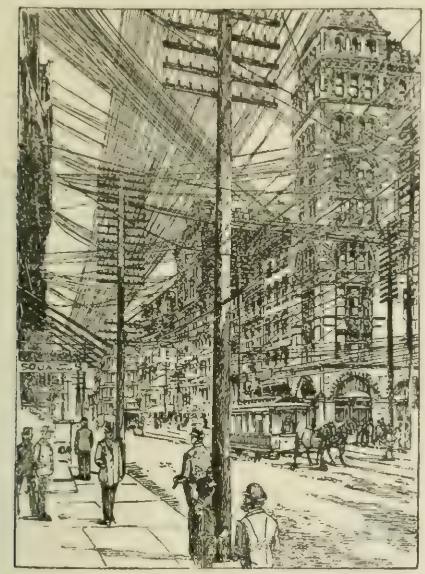


FIG. 13.—VIEW OF CITY STREET WITH OVERHEAD WIRES.

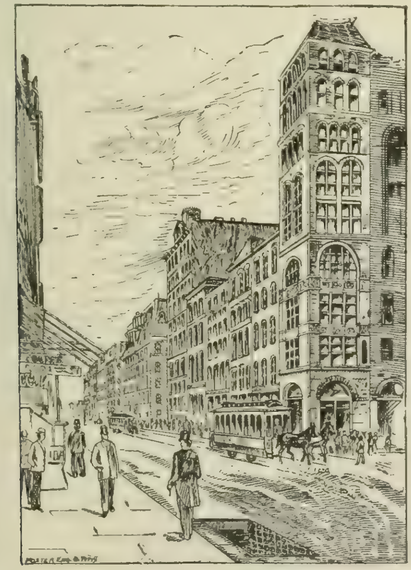


FIG. 14.—VIEW OF CITY STREET WITHOUT OVERHEAD WIRES.

The ventilating pipe is used to force air into the ducts and manholes of the subways, to drive out any gas that may leak into them from adjacent gas mains. These air pipes have small openings made in them by which the air enters the manholes, and they are fed by "blowers" at stated points along the route of the subways. This system of ventilation has not only been found effective in freeing the subways from gas, thereby preventing explosions, but also in measurably tending to keep out dampness from the ducts and manholes.

The specific means by which the cables are drawn into the ducts depends somewhat upon the size and weight of the cable. If a light cable, it may be drawn through the duct from one manhole to another, by means of a rope in the hands of two or three men. If a heavy cable, it will require a windlass or capstan, to provide sufficient hauling power. In Fig. 12 the general method of thus hauling cables into the ducts is represented. It is clear that some means must be provided to get the rope through the duct prior to pulling the cable through. This is now usually done by the plan termed "rodding" the duct. This simply consists of employing a sufficient number of rods, each three or four feet in length, provided with suitable screws at each end. The process begins by pushing one rod into a duct, then another rod is screwed on to the first one, which is then pushed along the duct, when another rod is attached, and so on, until the first rod reaches the distant manhole, at which time a rope is attached to the last rod. The proceeding is then reversed, the rods being drawn out of the duct and unscrewed one after another, until the rope is reached, when the rope is attached to the cable and the arrangements for hauling it into the duct are begun.

An idea of the different aspect of a business street in any of our larger cities before and subsequent to the placing of the wires underground may be gathered from the illustrations, Figs. 13 and 14, which represent a portion of Broadway, down town, New York, prior to and after the overhead wires in that and other main thoroughfares of that city had been placed in the subways.

Surprise is sometimes expressed by the uninitiated that the large mass of overhead wires which formerly existed on such avenues as Broadway, New York, could be disposed of in such a comparatively small number of ducts in the underground subways. The explanation is, however, apparent when it is considered that all the conductors formerly existing on a one hundred wire telegraph or telephone pole line can readily be stowed away into one cable in a three-inch duct in the subways.

A Premature Announcement.

A correspondent sends to us the following interesting item clipped from a Nebraska paper dated July 26, 1879, and which originally appeared in the New York correspondence of the Philadelphia *Ledger*:

"I am informed, on authority almost as reliable as that of Mr. Edison himself, that the inventor, after spending so much valuable time and means on the elaboration of his theory of electric light, has dropped it, or has determined to do so, and has determined to adopt that of Mr. Wallace, of Ansonia, Connecticut, who has already constructed a machine for producing the light, and advanced somewhat in the line of solving the great problem of the division of the same. It is called the 'carbon' theory, while Mr. Edison has held to the platinum theory, whatever these terms may imply. At any rate, the announcement, some time ago, by the New York papers, that Mr. Edison had solved his great problem, was a trifle premature."

The Reporter and a Short Circuit.

Recently the end of a broken section of the trolley wire of a Cleveland railway fell to the ground and a local reporter describes the result as follows: "The entire width of the street was apparently covered by a sheet of blue flame, extending 30 feet into the air above the ground. The approaching motor retreated from the point of contact between the wire and the track and the display ceased. The motor again approached the spot and the flame again shot into the air. Each display was accompanied by a series of explosions similar to a volley of musketry."

The Hatchet Planimeter.

Those interested in this simple little instrument, which has been described and referred to a number of times in our columns, will find a complete mathematical discussion of it by Mr. Poulain in "Cosmos," Dec. 15.

Electrical Power Transmission.—IX.

BY LOUIS BELL, PH. D.

Power Transmission by Continuous Currents.

There are at the present time three companies operating constant current circuits in San Francisco for the distribution of power. The currents employed are of 10, 15 and 20 amperes. Most of the motors are small, a very large proportion of them being under one horse power. The total number of motors in circuit on the various systems is between six and seven hundred. One of the companies is now gradually shifting its motor load on to a 220 volt circuit and abandoning the series distribution; another is planning for a 500 volt power circuit, constant potential, to replace its existing system; while the third, which operates by far the largest number of motors on a 10 ampere circuit, still adheres firmly to its original method.

Except in San Francisco, what few constant current motors are in operation are nearly all on regular arc circuits. Their use is, as a rule, discouraged by the operating companies, and very few new motors are being manufactured or sold; in fact, constant current distribution in modern American practice is almost non-existent and probably will soon pass entirely out of use. Abroad, the conditions are somewhat different, and on the Continent constant current distribution for long distance transmission work has been exploited to a very considerable extent, probably owing to the early and successful establishment of a number of transmission plants for single motors worked on the series system. There are several successful plants operated at constant current, the most considerable of them being that at Genoa, which is by far the best example of the kind and as such is worth more than a passing mention, even although the probability is that it will never be duplicated elsewhere.

It is somewhat singular, indeed, that in Italy, the home of Ferraris, who has done so much in the development of a rational and efficient system of transmission by alternating currents, the first notable transmission plant should have been installed with continuous currents.

The Genoa transmission is derived from the River Gorzente, which about fifteen years ago was developed for hydraulic purposes, artificial lakes being established and a tunnel about 1¼ miles long being built for outlet. Beyond the tunnel, an aqueduct some fifteen miles in length conveyed the water to Genoa, where a considerable amount of power is utilized directly. In this development there was left at the mouth of the tunnel an unused fall of nearly 1,200 feet aside from the head employed in the aqueduct. This has been developed electrically. It was divided into three partial falls of 338, 357 and 488 feet, respectively. At each of these was erected a generating station with its own transmission line. These stations were named after the three renowned electricians, Galvani, Volta and Pacinotti. The first mentioned station was the first installed. It consists of two generators operated in series. Each is of about 50 kw capacity, giving 47 amperes with a maximum pressure of 1,100 volts. Current is kept constant by regulating by hand the speed of the dynamos through the gate which controls the turbine. Each dynamo is provided with an automatic switch short circuiting the machine in case of extreme rise in voltage. This Galvani station was a preliminary or experimental station and was followed up by the establishment of two others which supplied the power to Genoa. One of these stations, which is thoroughly typical of the system employed, is shown in Fig. 23. It consists of four turbines, each driving a pair of dynamos of a little less than 50 kw output at 45 amperes and about 1,000 volts. These dynamos are closely similar to those in the Galvani station, but the regulation for constant current is obtained in a different manner. The dynamos are separately excited, the fields being supplied in parallel from a small dynamo driven by a separate waterwheel. The speed of this exciter is automatically varied by controlling its turbine in response to changes of current in the circuit. All the dynamos are operated in series and like those in the Galvani station direct coupled in pairs. The machines are insulated with enormous care, heavy layers of mica being placed between the magnets and the bed plates, while the windings themselves are very elaborately protected. Carbon brushes are employed, and the commutators are reported to behave admirably. Each dynamo is protected by the same elaborate safety devices employed in the Galvani station. The regulation is said to be excellent, even under considerable changes of load.

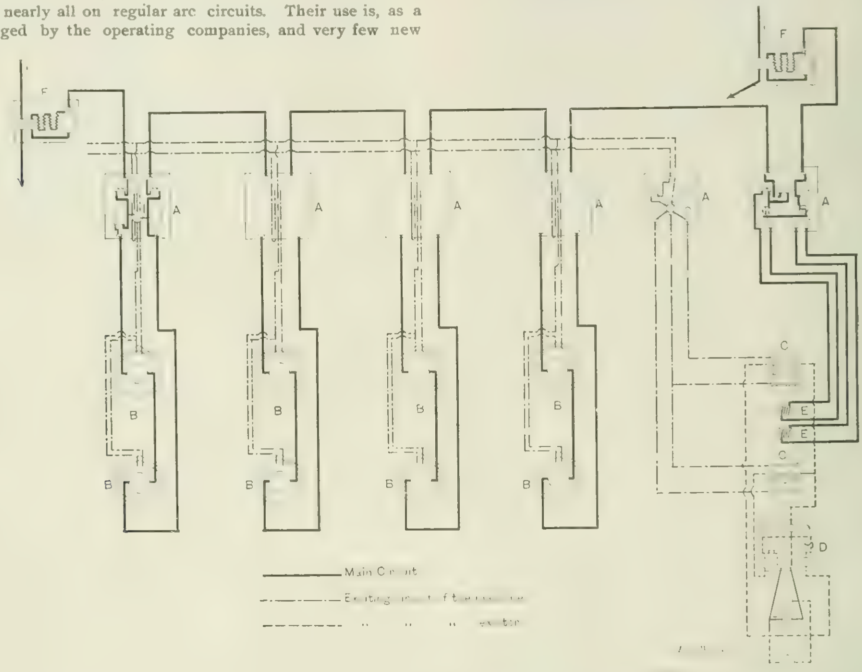


FIG. 23.—PLAN OF VOLTA STATION.

The third station, Pacinotti, contains eight machines of the same capacity as those in the preceding. They are governed as in the Galvani station by controlling their speed. This, however, is done by an electrical motor-governor controlled by a relay on the main line and working in one direction or the other as the occasion may require. In all the stations are carried out the same elaborate precautions regarding insulation, and each machine has around it an insulated wall supported on porcelain. The line voltage from each of the two stations last mentioned is from six to eight thousand and two circuits are carried into Genoa, the extreme distance of transmission being about eighteen miles. The conductors are for the most part bare, except when passing through villages, and are supported on oil insulators carried by wooden poles, save in some few cases where iron poles have been used. The two circuits running into Genoa transmit power for motors only. As might well be imagined, incandescent lighting would involve some very troublesome transformations.

At full load, nearly 1,000 hp is transmitted over the lines, the motors being of all sizes between 3 and 60 horse power. They are of the ordinary series wound type, and their speed is automatically controlled by centrifugal governors, which act by varying the field strength. They are provided with carbon brushes, and are reported to operate very successfully. It is to be noted, however, that the motors are usually placed in special rooms with insulated floors and walls owing to the enormous voltage which has to be taken into the buildings. They are fitted with heavy fly-wheels to assist the governors, and with automatic switches to short-circuit around the motor in case of excessive voltage. The motors are under the special care of skilled assistants connected with the staff of the generating station who inspect the lines and go over the motors at intervals of a few days. These extraordinary precautions both in the matter of insulation and skilled attendance account in great measure for the success of what, under American conditions, would have almost infallibly resulted in disastrous failure. The efficiency of the plant from turbine shaft to motor pulley is said to be a little over 70 per cent. As may be judged from this description, the whole installation is of an enormously complicated character, and the most remarkable thing about it is not so much that it works passably well, as that it works at all. The plan of the Volta station for the most part explains itself. The switchboards for each machine with their plugs for connecting the pair of dynamos connected to it are shown at *A*, dynamos at *B*, the exciters at *C*, exciter switchboard and rheostat at *D* and the solenoids, which control the exciter turbines, at *E*. Lightning arresters are shown at *F*. These consist of a spark gap, impedance coils in series with the line and condenser shunted around them. Every motor is provided with a similar lightning arrester. Taken all together, this Genoa plant is an excellent example of the constant current system followed to its legitimate conclusion. A description of the system is a sufficiently condemnatory criticism judged from our present point of view; at the same time, it should be remembered that several years ago, while this station was being built, the method adopted was practically the only one available in the existing state of the art, and the operation of such a system for several years with even tolerable results speaks volumes for the thoroughness with which the installation was made, and the intelligent supervision that it has had.

(To be Continued.)

Practical Notes on Dynamo Calculation.—XXIII.

BY ALFRED E. WIENER.

Chapter 41.—Forms of Field Magnets—(Continued).

The combination of two horseshoes with common pole pieces furnishes two further forms of field magnet frames. Fig. 81 shows the *horizontal double horseshoe type*, and Fig. 82 the *vertical double horseshoe type*.

Machines of the former type (Fig. 81) are built by the United States Electrical Co. (Weston), New York; the Brush Electrical Co., Cleveland, O.; the Ford-Washburn Storelectric Co., Cleveland, O.; the Western Electric Co., Chicago, Ill.; the Fontaine Crossing and Electric Co. ("Fuller"), Detroit, Mich.; by Crompton & Co., London, Eng.; by Lawrence, Paris & Scott, Eng.; and by Schuckert & Co., Nuremberg, Germany.

The latter form (Fig. 82) is employed in dynamos of Fort Wayne Electric Corporation ("Wood"), Fort Wayne, Ind.; La Roche Electric Works. Philadelphia; Granite State Electric Co., Concord, N. H.; Electric Construction Corporation (Elwell-Parker); and Crompton Co., London, England.

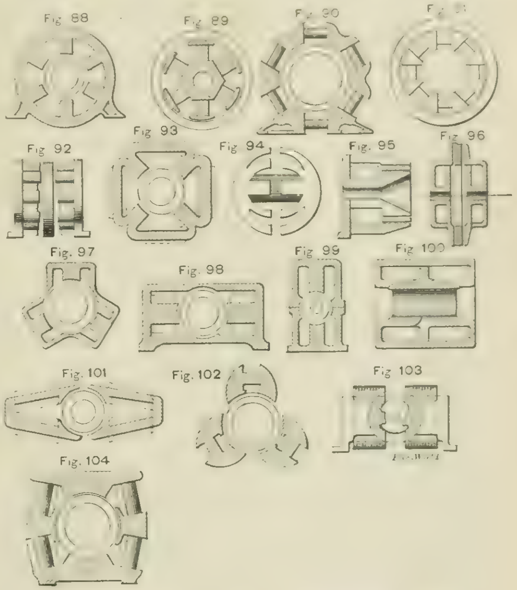
If one or both the pole pieces of a consequent pole double magnet type are prolonged in the axial direction, that is, toward the armature, and the winding is transferred from the cores to these elongated pole pieces, then a type is obtained in which the magnet frame forms a closed iron wrappage with inwardly protruding poles. Forms of this feature are known as *iron clad types*, and according to the number of magnets and to their position are single magnet and double magnet, horizontal and vertical iron clad types.

Fig. 83 shows the *horizontal iron clad type*, having two horizontal magnets. It is used by the General Electric Co. ("Thomson-Houston Arc Light type"), Detroit Electric Works, Detroit, Mich.; Eickemeyer Co., Yonkers, N. Y.; Fein & Co., Stuttgart; and Aachen Electrical Works (Lahmeyer), Aachen, Germany.

A modification of this type consists in letting the poles project parallel to the shaft, one above and one below, or one on each side of the armature; the only magnetizing coil required in this case will completely surround the armature. This special horizontal iron clad form, which is illustrated in Fig. 84, is realized in the Lundell machine, built by the Interior Conduit and Insulation Co., New York.

In Figs. 85 and 86 the two possible cases of the *vertical single magnet iron clad type* are depicted, the magnet being placed *above* the armature in the former and *below* the armature in the latter case. The *single magnet iron clad overtype*, Fig. 85, is adopted in the machines of the Muncie Electrical Works, Muncie, Ind., and in the battery fan motor of the Edison Manufacturing Co., New York. Machines of the *single magnet iron clad undertype*, Fig. 86, are built by the Brush Electrical Engineering Co., ("Mordey"), London; and by Stafford & Eaves, England.

The *vertical double magnet iron clad type*, Fig. 87, having two vertically projecting magnets, one above and one below the armature, is employed in machines of the Wenstrom Elec. Co., Baltimore; the Triumph Elec. Co., Cincinnati, O.; the Shawhan-Thresher Elect. Co., Dayton, O.; the Card Motor Co., Cincinnati, O.; the Johnson Electric Service Co., Milwaukee, Wis.; the Erie Machinery Supply Co., Erie, Pa.; and the Zurich Telephone Co., Zurich, Switzerland.



FIGS. 88 TO 104.—TYPES OF MULTIPOLAR FIELDS.

There are various other bipolar types, which, however, mostly are out of date, and therefore of very little practical importance. These can easily be regarded as special cases of the types enumerated above.

b.—Multipolar Types.

Multipolar—Field magnet frames can have one or two magnets for every pole, or each magnet can independenly supply two poles, or one single magnet, or two magnets may be provided with pole pieces of such shape as to form the desired number of poles of opposite polarity.

If the number of magnets is identical with the number of poles, the magnets may either be placed in a *radial*, a *tangential*, or an *axial* position with reference to the armature, and in the two first named cases they may be put either *outside* or *inside* of the armature.

The *Radial Outerpole Type* is shown in Fig. 88; this form has been adopted as the standard type for large dynamos of the General Electric Company, Schenectady, N. Y.; of the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.; the Crocker-Wheeler Electric Company, Ampere, N. J.; the Riker Electric Motor Company, Brooklyn; the Stanley Electric Manufacturing Company, Pittsfield, Mass.; the Fort Wayne Electric Company, Fort Wayne, Ind.; the Eddy Electric Manufacturing Company, Windsor, Conn.; the Belknap Motor Company, Portland, Me.; the Shawhan & Thresher Electric Company, Dayton, O.; the Great Western Electric Company (Bain), Chicago; the Walker Manufacturing Company, Cleveland, O.; the Mather Electric Company, Manchester, Conn.; the Claus Electric Company, New York; the Commercial Electrical Company, Indianapolis; the Allgemeine Electric Company (Dobrowolsky), Berlin, Germany; the Oerlikon Machine Works, Zurich, Switzerland; Alioth & Co., Basel, Switzerland; the Berlin Electric Construction Company (Schwartzkopf), Berlin, Germany, and numerous others.

In Fig. 89 is represented the *Radial Innerpole Type*, which is used by the Siemens & Halske Electric Company, Chicago, Ill., and Berlin, Germany; by the Alsacian Electric Construction Company, Belfort, Alsace; by Naglo Bros., Berlin, Germany; by Fein & Co., Stuttgart, Germany, and by Ganz & Co., Budapest, Austria.

The *Tangential Outerpole Type*, Fig. 90, is employed by the Riker Electric Motor Co., Brooklyn; by the Baxter Motor Company, Baltimore, Md.; the Mather Electric Company, Manchester, Conn.; the Dahl Electric Motor Company, New York; the Electrochemical and Specialty Company, New York ("Atlantic" Fan Motor), and by Cuenod, Sauter & Co. (Thury), Geneva, Switzerland; generators of this type are further used in the power station of the General Electric Company, Schenectady, N. Y., and in the Hustal, Belgium, Arsenal.

Machines of the *Tangential Innerpole Type*, Fig. 91, are built by the Helios Electric Company, Cologne, Germany.

In the *Axial Multipolar Type*, Fig. 92, there are usually two magnets for each pole, one on each side of the armature, in order to produce a symmetrical magnetic field. This form is used by the Short Electric Railway Company, Cleveland, O.; Schuckert & Co., Nuremberg, Germany; Fritsche & Pischon, Berlin, Germany; Brush Electric Engineering Co., London, England ("Victoria" Dynamo), and by M. E. Desroziers, Paris, France.

Fig. 93 shows the *Raditangent Multipolar Type*, which is a combination of the Radial and Tangential Outerpole Types, Figs. 88 and 90, respectively, and which is employed by the Standard Electric Company, Chicago, Ill.

If only one magnet is used in multipolar fields, the pole pieces may be so shaped as to face [the armature in an *axial* or in a *radial* direction. In the former case the *Axial Pole Single Magnet Multipolar Type*, Fig. 94, is obtained, which is used by the Brush Electrical Engineering Company (Mordey), London, England, and by the Fort Wayne Electric Company (Wood), Fort Wayne, Ind.

In the latter case the Outer-Inner Pole Single Magnet Type, Fig. 95, results, in which the pole pieces may either *all* be opposite the *outer* or the *inner* armature surface, or *alternately outside* and *inside* of the armature; the latter arrangement, which is the most usual, is illustrated in Fig. 95 and is employed by the Waddell-Entz Company, Bridgeport, Conn., and by the Esslinger Works, Wurtemberg, Germany

(To be continued.)

Accidents to Fly Wheels in Power Houses.

To the Editor of The Electrical World:

Sir:—Referring to the discussion of fly wheels in the columns of The Electrical World, I think that in most of the accidents the cause is centrifugal force together with bad design and poor workmanship.

It does not appear that these disasters are confined to electrical generating stations, or, considering the great liability of engines racing in dynamo driving, that they are remarkably frequent.

With the exception of very poor material or design, it does not appear possible that the spokes should be fractured. In an ordinary wheel the spokes are of great strength in comparison to the strain upon them at full load. The only shock they can receive is through the inertia of the parts between the rim when the latter is suddenly checked. Considering that the large wheels generally drive a number of independent units, and taking into account the flexibility and slipping of belts, it is apparent that the shock on the spokes will be slight. When the "instantaneous effort to increase the speed" occurs, or why it should produce any extra strain on the spokes when the load is thrown off by the circuit breaker, is beyond my comprehension.

I fear that the adoption of Mr. Stuart-Smith's theory, that centrifugal force can produce no direct tension in the rim, would lead to disastrous results. I will simply suggest that fitting the spokes loosely in the rim (as mentioned by Prof. Sharp) would produce a rim that could only be fractured by shearing, and that the theory would also apply to the shell of a boiler, where the pressure also acts radially outward. While the direct tension, which is undoubtedly produced in the rim, is generally small compared to the tensile strength of the iron, it may approach the strength of the joints in a sectional wheel.

The bending moment in the rim may be an important factor, but owing to the continuity of the rim over the spokes and to the spokes being rigidly attached to the rim the case is far from the common theory of beams. I should be pleased to hear of a better method of determining it.

It is to be regretted that we have not the complete data of any of the wrecked wheels, but I think a wheel carefully designed and of such proportions as to avoid as far as possible initial strains in the iron is, if well constructed, as safe as any piece of engineering work.

A. M. Phillip.

Copper Fuses.

To the Editor of The Electrical World:

Sir:—Mr. Preece in a paper read before the Royal Society of London, April 19, 1888, states that the relation between the diameter D of a copper wire and the current C required to fuse it may be expressed by the law $C=ad$ 3-2 where a equals 10,244 when d is expressed in inches and C in amperes. With this constant he calculated a table of diameters of copper wires which will be fused by different currents between 1 and 300 amperes. Mr. Preece does not claim to have proved the law for currents as large as 300 amperes. In fact, in a previous paper of December 22, 1887, the largest current used, according to the data given, was less than 60 amperes.

I do not know whether any one has accurately determined the relation between fusing current and diameter for currents as large as 300 amperes. If any of your readers have any authentic data on the subject, I should like to know of it. It is my opinion that the law will not hold for as high values as those given in the computed table which you published in your issue of December 15. I believe that as the current increases the value of a will decrease. It will be noticed that in the table of results obtained from samples of copper wire 6 inches long, given by Mr. Preece in the paper of December 22, 1887, that a diminishes as the current increases between one and 53 amperes.

I recently observed the current required to fuse a large copper wire freely suspended in the air. It was a No. 6 B. & S. wire, and fused at 390 amperes. It did not fuse immediately, but carried the current for nearly a minute before it began to melt. This wire has more than twice as large a sectional area as that given in Mr. Oxley's table for a 390 ampere fuse. I have further data which tends to prove that the value of a is smaller for large currents.

For a given diameter and short lengths of wire the fusing current, of course, depends on the length. It seems highly important, therefore, that the electrical engineer should experimentally determine the fusing current for large copper fuses rather than depend upon a table computed from data obtained from very small wires.

B. S. Lamphear.

Ithaca, N. Y.

Death from Electric Shock.

To the Editor of The Electrical World:

Sir:—A death occurred here the other day from shock, under rather peculiar circumstances, and I should be glad to learn if any of your readers know of a similar case occurring elsewhere.

An ordinary 16-cp 52-volt lamp was suspended in the stable of a house, and upon a black man going to turn it on he received a shock, from which he did not recover. He was in his bare feet at the time and the ground was damp. The house circuit was a 52-volt alternating, secondary with 1,040 primary. All the lamps continued to burn as usual after the accident, and no fuses were blown. On testing the transformer the next day I found a slight leakage between the primary and secondary, the insulation having no doubt broken down completely when the current was on. The insulation of the feeders and mains was the same as usual the afternoon of the accident and also the next morning, there being no extra ground on. On testing the house circuit the next day I found a slight ground on the stable circuit, but this should have been in favor of reducing the shock that the man got off the same circuit.

Arthur H. Shaw.

Georgetown, Demerara, Dec. 29, 1894.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 927 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Dynamo.—A new and somewhat odd form designed by Messrs. Fritsche & Pischon is described and illustrated in the "Elek. Anz.," Dec. 16. The armatured iron is laminate lengthwise, not perpendicularly, to the shaft as usual; these iron bars can be used at the same time as conductors or the copper conductors may be threaded into holes through them; the armature is in the form of a ring resembling a Gramme ring in appearance, but not in construction, and the field magnet poles of opposite polarity are on the outside and inside of the ring; in a three-pole machine, for instance, all the south poles are on the outside and all the north poles are on the inside; it is claimed that by this system the construction of the armature is greatly simplified; the winding appears to be similar to that in the well-known machines of these inventors.

Constructing Small Dynamos.—The Lond. "Elec. Rev.," Dec. 21, begins a series of articles in which it will give the details of a small machine of simple construction which was designed specially for that journal by a practical engineer; it will be equally applicable as a continuous current dynamo of 100 volts and 8 amperes, as a motor of the same input giving about ¾ hp, as an alternator of 70 volts and 8 amperes and a frequency of 30, as a two-phase alternator, a converter of continuous and alternating currents, or the reverse, and as a converter of multiphase into continuous currents; the article does not admit of being abstracted; the present installment is introductory.

Transformer Pits.—Some further discussions and conclusions regarding this subject are contained in the Lond. "Elec. Rev." and "Elec.," Dec. 28; the former contains also an editorial discussion.

Production of Rotary Magnetic Fields by a Single Alternating Current.—The recent Institute paper, by Mr. Gutmann, is reprinted in full in the "Elec. Rev.," Dec. 26 and Jan. 2, "West. El.," Dec. 29, and in abstract in a number of other electrical journals. He describes a method devised by himself some years ago, in which neither condensers nor choking coils are used. The single phase alternating current passes around what corresponds to the field magnets of the motor; the armature (in which currents are induced) contains closed circuit windings, but these circuits do not coincide in number with the poles of the field magnet; he shows that the tendency of such a closed circuit coil is to place itself midway between the two poles of the field, both poles being on the outside of the armature; such an armature will run either at the full, synchronous speed, or at certain other fixed speeds which have a certain commensurable relation to the periods of the exciting current, which speeds he calls harmonic speeds; this action is explained in detail with the aid of a large number of illustrations; polyphase currents are generated in the armature; the greater the number of closed circuits the greater is the number of harmonic or synchronous speeds at which the armature can run; the system embodies all the weak points of the synchronous and all the strong points of the polyphase motor; the motor will not start from a state of rest in the form shown; it has a small starting torque when rotated, and when in rotation it cannot be reversed by changing the connection; the strong points are that the motor develops polyphase currents, in its own winding, and that it is very difficult to pull it out of step, as it has the capacity to stand what he terms magnetic slippage; the motor "becomes self starting as a series, a shunt or an induction motor in a field of single phase or polyphase alternating currents," he illustrates this with a diagram in which the armature has a commutator to rectify the polyphase current to energize the field of one pair of a double system of magnets. "There is in this principle involved the germ of the ideal distribution of power."

Alternating Current Motor.—An illustration of a new form of motor made by Ganz & Co. (Budapest) is illustrated in the "Elec. Rev.," Jan. 29.

Electrical Machinist Practice.—In the serial, by Mr. Hobart, in the "Elec. Eng.," Jan. 2, he explains a practical method of testing an armature for a running balance; it consists in mounting it with flexible shaft couplings made of spiral springs, revolving it at the required speed while supported by temporary guides which can be loosened; the armature should be balanced, say, by adding solder to the binding wire, until it does not wobble when the guides or bearings are entirely removed. (Might it not facilitate matters if the armature shaft thus mounted were placed in a vertical instead of a horizontal position?)

Dynamo Design.—In the serial in the "Elec. Age," Jan. 5, by Mr. Harrison, he discusses the magnet frames of dynamos, giving Kapp's formula and tables.

LIGHTS AND LIGHTING.

Luminous Power of Lighthouse Apparatus.—A paper by Mr. Bourdelles, read before the Maritime Congress in London, in 1893, is published, apparently in full, in "Lond. Engineering," Dec. 28. He discusses a theory of his own; only a short reference is made to electric lighting, and in this he says that as the intrinsic brightness of the arc is said to remain constant, no matter what the nature of the carbons, their distance apart, or the currents, it follows (according to his theory), that the illumination obtained by the apparatus ought itself to be invariable, and the luminous power of an apparatus of a given order would be independent of the electric burner that illuminates it; that is, the luminous range would be independent of the electric energy; but reliable photometric investigations contradict these conclusions, and prove with certainty that the illumination varies as if the intrinsic brightness was itself variable; notwithstanding this, however, he states that until this anomaly is explained, he considers that it is proved, at least in practice, that lighthouse apparatus using electricity makes no exception to the general rule.

Projectors for Coast Defence.—An article on this subject, reprinted from an English journal, is published in the "Journal of the Military Service Institution," for January. It contains little of interest to electricians. The author discusses the use of projectors from the standpoint of a military engineer; he discusses the way in which projectors should be used, their best location, and similar features. He concludes that the most advantageous position for an observer with respect to a target illuminated by the projector is such that the line drawn from his position to the target makes an angle of from 30 to 60 degrees with the beam of the projector; he believes that a really efficient employment of projector can be obtained only by having them controllable at a distance.

Continuous Current from the Alternating Arc.—Mr. Feather, in the "Elec. Eng.," Jan. 2, describes the following experiment: by placing the end of an ordinary bar magnet near an alternating arc, he found that it repelled the arc in such a way as to make a flame on both sides of the carbon, and by placing an electrode in each of these two arcs, and connecting them through a tangent galvanometer, he obtained a unidirectional current, thus forming a novel sort of commutator for converting alternating into direct currents. Another method of obtaining the same result was described in the Digest Dec. 1 and 15, under the heading "Researches with the Electric Arc."

The Making of an Incandescent Lamp.—The "Elec. Eng.," Jan. 2, contains an article, including a large number of illustrations, describing the lamp factory of the General Electric Company, at Harrison, N. J. (Practically the same ground was covered, and in greater detail, in the article by Lieut. Eyre, in THE ELECTRICAL WORLD, Jan. 5.) Each lamp passes through 41 different hands; the bulbs are blown in molds, which insures absolute uniformity; the bamboo filament is now replaced by one made up of a very pure quality of cellulose, which is forced, when in liquid form, through a die of the required diameter, and is hardened by passing through alcohol; the filaments are treated by flashing; the heavy filaments are cemented to the platinum under naphtha, while an alternating current is passed through them; the filaments and stem are joined with a drop of liquid carbon cement; the Sprengel pump is used, and each lamp is individually connected to the pump; the quality of the vacuum is tested by touching one terminal with a spark coil having a half-inch gap, a glow indicating a poor vacuum; the lamps are sorted by running them to the required candle power, and marking the voltage required. The present capacity is 28,000 lamps per day, requiring 500 hp and 900 employes.

POWER AND HEAT.

Utilization of Wind Power.—The article of Mr. Kennedy (see Digest last week) is concluded in the Lond. "Elec. Rev.," Dec. 28. He describes the Lewis system (see Digest Jan. 5), and adds that whatever device is adopted to adjust for varying speeds, there is a loss in using it, and a much larger mill must be installed to do the work in a system like this one, in which all winds corresponding to speeds of less than 750 or over 1,500 are lost while at only one speed, 1,200, is the dynamo doing its full duty; by using compressed air storage these regulations for varying speeds become unnecessary, and if the air cylinders are large enough for a three or four days' supply, no electrical accumulators would be necessary.

Elastic Couplings for Gas Engines.—The questions of the action of an electric coupling between a gas engine and a dynamo is discussed theoretically by Mr. Blondel and Mr. Guillaume, in "L'Ind. Elec.," Dec. 25. The former calls attention to the fact that in a preceding article by the latter he supposed the engine to have an infinite inertia; he makes a correction for the same, and concludes that an electric coupling should either have a very rapid period of oscillation or a very slow one, in proportion to the inequality of the coupling; the second is the easier method, except for alternators; he concludes that an elastic coupling is not only not bad, but, on the contrary, theory agrees with practice in showing that it is excellent under the condition that all proportions are properly chosen. Mr. Guillaume, in replying, states, among other things, that a system having rapid oscillations amounts to one which is practically rigid, while if a coupling is to be effective, the system should take care of a considerable retardation or advance.

Refuse Destruction.—A description, accompanied by large drawings, of a destructor made in Montreal, is published in "Ind. and Iron," Dec. 28.

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Irrigation by Electricity.—An article from the "Irrigation Age" is abstracted in the "Elec. Age," Jan. 2, and the "Elec. Rev.," Jan. 9. An estimate is given in which it is stated that 1.000 hp will run 56 motors of 15 hp, furnishing abundance of water for 15,680 acres, at a cost, not including ditches and reservoirs, of about $160,000, or a little over $10 per acre; assuming 3 pounds of coal per hp per hour, and one man for 10 motors, the total operating expenses would be $100 per day, or less than $1 per acre.

Peculiar Case of Engine Governing.—The "Elec. Eng.," Jan. 2, describes a case in which it appears that the dynamo in a direct driven plant magnetized the governor wheel on the end of the engine shaft, producing a very unsatisfactory regulation of the governor.

Thermal Storage.—In an article, accompanied by a number of illustrations, Mr. Perry, in the "West. El.," Jan. 5, describes the Halpin system, in which heated water and steam are stored in large reservoirs. (See Digest Feb. 11 and 18, 1893, under "Power Generators.")

Turbine Plant.—That of the Buchanen Power and Electric Company is illustrated and described in the "West. El.," Jan. 12.

TRACTION.

Traction.—The discussion of the recent Institution papers is concluded in the Lond. "Elec. Rev.," Dec. 28, abstracts of which are published in the "Elec." Mr. Ferranti believed that the hideousness of the overhead system had been greatly exaggerated, and that if the wires were in the way of fire escapes, he suggests that electricians should invent and give for nothing fire escapes which could be worked without interfering with the overhead lines. Mr. Sharp called attention to the flywheel as a means of storage of energy for electric traction; he suggests a safe limit of speed for the rims had not yet been reached; at 300 ft. per second, a flywheel of 10 tons, with a five per cent. variation of velocity, would give 190 hp minutes; with the present construction of flywheels, the safe limit seemed to be about 100 ft. per second; Americans run much closer to the limit, "and they unfortunately seemed to get a good many cases of flywheel accidents;" the solid disc flywheel was very much better than one made with 6 or 8 arms; he describes a flywheel invented by himself (illustrated in the "Elec."), in which the spokes are made of mild steel, arranged tangentially like the spokes of a bicycle wheel, the ends being fastened only to the rim. Mr. Dallas spoke in favor of the gearing now adopted in this country at the Thomson-Houston works; they had come to the conclusion that the losses were smaller with cast-iron gears than with any other form, the cast iron being close grained with a considerable quantity of wrought-iron scrap mixed with it; gearless motors were rarely of any use for street traction. Mr. Wilkinson, in reply, spoke very favorably of the conduit road in Washington. Dr. Preller replied at some length, chiefly in regard to steep grade roads; at Marseilles the generators were direct-driven by a high-speed, vertical, double-acting engine, but these were afterwards replaced by Corliss engines with rope driving.

Accumulator Traction.—The Lond. "Elec. Rev.," Dec. 28, discusses the recent criticism of Mr. Epstein. It is claimed that 2½ sets of batteries per car is too close a margin of safety; at least three sets should be used; "it is this very practice of inventors claiming too much for their cells which has been chiefly the cause of failure in battery traction."

Light Railways.—The conclusion of a paper, by Mr. White, on this subject is published in the Lond. "Engineering," Dec. 28; he gives detailed items of the cost of some existing railways.

Trolley Balloon.—The "Elek. Anz.," Dec. 16, gives an illustrated description of the model of the balloon which was intended to be operated (but failed to do so) at the Antwerp exhibition last year.

Analysis of Electrolyzed Pipes.—A paper, by Mr. Rigge (Omaha), is reprinted in "L'Elec.," Dec. 28. He gives the results of some measurements of the voltage and current in the earth return; the article contains, word for word, the description of the analysis attributed in another journal (see below) to Mr. Furay. As a remedy against electrolysis he suggests reversing the current frequently, "if it were safe and possible;" it is impracticable to insulate the pipes, and the only practical way which occurs to him is to weld the rails or to bind them with one-inch copper wire. He suggests that frequent voltage measurements should be made all over the line, and that changes in the return conductor should be made as the measurements may indicate.

Air Brake.—An illustrated description of the Genette brake (Chicago) for street railways is published in the Lond. "Engineering," Dec. 28.

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Fuel Consumption.—The "Eng. News," Jan. 10, abstracts from a report of Mr. Parsons, Chief Engineer of the Rapid Transit Commission of New York, some statements regarding the comparative fuel consumption on electric and steam railways. One of the chief advantages in favor of the electric railway is due to the greater efficiency of the fuel; with the ordinary locomotive five pounds of coal are usually consumed per hp per hour, while a large stationary plant could be run with 1¾ to 2½ pounds, and at the same time the stationary boilers can be adapted to the burning of cheap fine coal of an inferior quality. He gives the following table, in which the weight of the train includes that of the passengers; the first three are electric roads, and the others steam:

Railway.	Weight of train, tons.	Coal per train mile, lbs.	Coal per ton mile, lbs.
Liverpool Overhead	42.0	17.5	.416
Intramural	74.0	36.6	.495
City and South London	44.0	28.0	.604
Manhattan (1)	80.8	49.2	.609
Brooklyn Elevated Railway (2)	63.0	42.0	.661
Manhattan (3)	97.1	51.3	.528
Brooklyn Elevated Railway (4)	91.5	48.1	.526

Note.—(1) Ninth avenue train with an average of 3.77 cars. (2) Short train averaging 2.74 cars. (3) All trains averaging 4.50 cars. (4) All trains averaging 4.54 cars.

The better showing of the Liverpool road over the Chicago Intramural is due mainly to the difference between a permanent and a temporary plant; the poorer showing of the City and South London line is due to the use of non-condensing engines, which is estimated to increase the coal consumption 20 to 25 per cent.

Traction.—A part of the discussion of the recent Institution (London) papers is contained in the "St. Ry. Gaz.," Jan. 5. (The whole of this discussion was abstracted in the Digest, Dec. 29, Jan. 12 and 19).

Steep Grade Traction.—Mr. Preller's recent Institution paper (see Digest, Dec. 15), is reprinted in full in the "Elec. Age.," Jan. 5.

Accumulator Traction.—The second and last part of the paper by Mr. Gibbings is published in the "St. Ry. Gaz.," Jan. 5. The whole paper is also reprinted in the "Elec. Rev.," Jan. 2.

Bicycle Railway.—According to the "Eng. News," Jan. 3, a bicycle railway, operated by storage batteries, is being built at Waterport, New York, of which a short section has been put in operation for exhibition; the car carries 25 passengers, and runs on a single rail.

Horse Power for Car Propulsion.—Some simple rules for calculating the hp for propelling cars are given in the "Eng. News," Jan. 10.

Electric Braking of Motor Cars.—Mr. Smith's article (see Digest, Jan. 5) is concluded in the "St. Ry. Gaz.," Dec. 29. He discusses the action of the electric brake, consisting of the motors used as dynamos, and mentions the Sperry brake; he believes that future progress in motor car brakes will be in this line; regarding the strain on the gears, he believes that if they are able to transmit the power to start the car in the short time in which most motor men force them to do it, they certainly will not be damaged by the stress due to electric braking. He explains the curious fact that when an electric brake, such as he describes, is applied, one pair of wheels will sometimes revolve in the same direction continuously, while the other pair revolves alternately forward and backward until the car comes to rest. He believes that a systematic investigation of the subject of electric braking will repay careful study.

Double vs. Single Trucks.—In an article by Mr. Brill, in the "St. Ry. Jour." for January, he discusses the objections to the usual double truck cars and states the advantages of the maximum traction truck for long cars; each of the two trucks contains a large pair of driving wheels, and a small pair of trailing or guide wheels; it overcomes all oscillation and pounding; 87 per cent. of the weight is on the driving wheels; the braking action is said to be very good. In his opinion 18 ft. cars are the longest that should be used on 4 rigid wheels.

Uses of Trolley Cars.—In a short editorial on the progress of electric traction, in the "Eng. News," Jan. 10, it is stated that over 62 electric street railways in the United States now carry mail, sometimes in specially equipped postal cars; the freight and express service is rapidly extending, and is now being furnished on nearly 50 separate roads; in Toronto the city garbage is hauled away on electric cars.

Trolley Car Accidents.—According to the "Eng. News," Jan. 3, 98 persons have been killed in Brooklyn since the introduction of electric traction in 1892, and several hundred were injured; for the year ending July 1, 1894, there were in that city 122 accidents, of which 40 were fatal.

Street Car Fenders.—A number of the latest fenders are described and illustrated in the "Eng. News," Jan. 3.

Electrolyzed Water Pipes.—An abstract of a paper, by Mr. Furay, read at the Montreal meeting of the Fire Chiefs, is contained in the "Elec. Age," Jan. 5. He gives the result of an analysis of the material found on underground iron pipes, that had been acted on by the current; he found that the specific gravity was very small, 1.88; the material it contained about 56 per cent. of iron, 29 of graphite, 1 of manganese, 13 of silicon, besides sulphur phosphorous, etc.

Motor Repairs.— A third paper by Mr. Hobart, with illustrations, in the "St. Ry. Jour.," for Jan., gives practical instructions for the banding and repairing of armatures of car motors.

Conduit Road.—A good illustration of the conduit of the Metropolitan road in Washington is contained in the "St. Ry. Jour.," for Jan.

Three Wire Trolley System at St. Louis.—According to Mr. Gotshall, in the "Elec. Eng.," Jan. 2, the three wire trolley system has been used by him for sometime in that city, and the difficulties that were first encountered have all been overcome; the rest of the system is to be changed to the three wire system.

Alpine Road.—The "Elec. Rev.," Jan. 9, gives some data about the proposed Jungfrau electric railroad, but it appears to include very little that has not already been given in these columns.

Philadelphia.—An illustrated description of the Hestonville, Mantua and Fairmount Electric road is published in the "Elec. Eng.," Jan. 9. A long and profusely illustrated description of the line of the People's Traction Company, in the same city, is published in the "St. Ry. Jour.," for Jan.

Power Station in St. Louis.—A description, accompanied by a number of illustrations of the station of the Lindell Company, is published in the "West. El.," Jan. 5.

Yosemite Valley.—According to the "West. El.," Jan 12, the construction of an electric railway to the Yosemite is to be begun.

Newark.—A well illustrated description of the new power station of the Consolidated Traction Company, of New Jersey, is contained in the "St. Ry. Jour.," for Jan.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Continuous vs. Alternating System.—A correspondent to the Lond. "Elec. Rev.," Dec. 28, in referring to the stations in London, says that there in no doubt that those who are connected with the direct current stations obtain a much more regular and reliable supply than those who use the alternating current; in the latter the difference in voltage between light load and full load of the transformers is another objection to the latter system as also the rentals charged for the primary apparatus; the existing meters used by the majority of alternating current companies will not register correctly the power absorbed by motors, arc lamps, choking coils and other apparatus of a like nature.

Mr. Swinton gives some figures regarding the cost of the mains and feeders for the Scarborough station. With the high tension transformer system the all day efficiency is low, and consequently the working expenses are high, while with the low tension system the loss is great only during the short period, but when it comes to capital cost this consideration works the other way; owing to the high efficiency of transformers at full load, and the comparatively small losses in the high tension main the maximum power need exceed very little that delivered to the lamps.

Rules and Regulations.—A translation of those proposed for Germany, mentioned in the Digest last week, is given in the Lond. "Elec. Eng.," Dec. 28.

Central Stations in Paris.—The Lond. "Elec. Rev.," Dec. 28, contains a very full abstract of the table in "Lond. Elec.," Oct. 25, mentioned in the Digest Nov. 17.

Fecamp.—A small central station in this French town, in which accumulators and turbines are used, is described in part in "L'Elec.," Dec. 22.

High Voltage Systems.—A report by Messrs. Kennelly, Bell & Cabot, on the high pressure wires in Concord, N. H., is reprinted in the "West. El.," Jan. 12, the following extracts from which may be of general interest. In a partial list of towns and cities in this country and abroad, in which alternating currents of about 2,200 volts are used within city limits, they name 47 towns; the second list in which alternating currents of greater voltage than 2,500 are used contains four names: Hartford, Conn., 4,000 volts, Pomona, Cal., 10,000, San Bernardino, Cal., 10,000, and Guadalajara, Mex., 5,000 volts. The rest of the report is chiefly of local interest. In their opinion the system of arc lighting circuits used in Concord, which is similar in pressure to those universally used in this country, is not a menace to lives and property if installed, operated and maintained in accordance with requirements of good practice; they consider all pressures over 500 as being capable of producing danger to persons and property, and that, therefore, the danger would be no less if the pressure were reduced from 2,200 to 1,100.

Successful Municipal Plant.—Under this heading some data of the operating costs for the plant in South Norwalk, Conn., is given in "Elec. Ind." for Jan.

Light and Power Station at Cornell University.—The "Sibley Jour.," for Dec., contains a descriptive illustrated article by Messrs. Ryan & Macomber, of the University light and power station, in which turbines for several hundred hp are used.

Frankfort, Germany.—An illustrated description of this alternating current station, one of the latest erected in Germany, is given by Dr. Haas in the "Elec. Eng.," Jan. 9.

Hints on the Building of Electric Plants.—In a second article by Mr. Armstrong, in "Elec. Ind.," for Jan., he discusses the subject of specifications.

Non-Arcing Lightning Arrestors.—A well illustrated paper, by Mr. Wurtz, is published in the "Tech. Quart.," for July. It is substantially the same as his subsequent Institute paper.

Ferranti Rectifiers.—The illustrated description mentioned in the Digest, Jan. 5, is reprinted in the "Elec. Rev.," Jan. 2.

WIRES, WIRING AND CONDUITS.

Fastenings in Walls.—The Boeddinghaus system is described and illustrated in the "Elek. Zeit.," Jan. 27. A comparatively small hole is drilled in the plaster of the wall, and an open spiral of wire is then inserted and cemented with plaster of Paris, the space on the inside of the spiral being left free; screws for insulators or fastenings can be then screwed directly into this spiral. It appears from the illustrations that the spiral is left handed, and that its pitch need therefore not correspond with that of the screw to be introduced.

Conduit Wiring.—Mr. Noll, in the "Elec. Eng.," Jan. 2, points out the advantages of the use of iron conduits for house wiring; he recommends the use of twin conductors in these tubes in place of two single wires; these conductors have two systems of insulation, one inside the conduit and the other on the wire.

Legal Status of Electric Wires in the Street.—An article on the subject by Mr. Fisher, is published in "El'ty.," Jan. 9.

ELECTRO-PHYSICS AND MAGNETISM.

Electrical Polarized Rays and Electrical Resonance.—A paper by Mr. Zehnder from the "Weid. Ann.," vol. 53, page 505, is abstracted briefly in the "Elek. Zeit.," Dec. 27. He discusses how the rays may be polarized by replacing the reflecting mirrors in the Boltzmann interference researches, by two wire gratings such as those used by Hertz, by means of which interference or other phenomena can be produced.

New Method of Obtaining Line Spectra.—A new method described very briefly in the Lond. "Elec. Rev.," Dec. 28, is to pass a condensed spark between two platinum wires or carbon rods the tips of which are covered with the substance whose line spectrum is to be ascertained; if the condenser is not used the material inflames.

Electromotive Phenomena of Physiology.—The Lond. "Elec. Rev.," Dec. 28, abstracts at some length a paper by Mr. Reid, from "Science Progress," which it recommends very highly; he reviews the existing knowledge of the electromotive phenomena of glands and criticizes the theories which have been offered.

Temperature of the Arc.—The paper mentioned in the Digest last week is abstracted briefly in the Lond. "Elec.," Dec. 28.

Symmetry of the Magnetic and Electric Fields.—A long paper by Mr. P. Curie is contained in "L'Eclairage Elec.," Dec. 25.

Magnetization of Iron and Nickel by Rapid Electrical Oscillation.—A paper by Mr. Klemencic, from the "Weid. Ann.," vol. 53, page 707, is abstracted in the "Elek. Zeit.," Dec. 27. Electrical oscillations are dampened much more in iron wires than in non-magnetic metals, due to the fact that the surface conduction is less; as the generation of heat is proportional to the resistance, the resistance to the passage of electric waves may be determined from the heat, and the permeability can then be calculated; two parallel wires were used, one of iron, and the other of brass, the heat being measured in each case; the permeability will then be equal to the square of the ratio of the heat in the two wires, multiplied by the specific resistance of the brass, and divided by that of the iron; in this way he obtains as the permeability for iron 118, for soft piano wire steel 106, hard 115, Bessemer steel, soft 77, hard 74, and nickel 27.

Electromotive Force With Magnetization.—An academy paper, by Mr. Hurmuzescu, is reprinted in the "L'Ind. Elec.," Dec. 25. If two electrodes of the same magnetic metal are immersed in a liquid which attacks them, and if there is a difference in their magnetization, an electromotive force is produced; this has been noticed by others, but they did not agree regarding the direction or polarity of the E. M. F., the present experiments were made to determine this. He develops the formula theoretically from the principle of the conservation of energy; with iron the magnetized electrodes is always positive; he gives a table of the values, for instance, for 126.3 lines of force per square cm, the E. M. F. was 44 millivolts, for 306.8 it was 155, and for 704 it was 229. For nickel the polarity is the same; for bismuth the magnetized electrode is negative.

Influence of Magnetism on Germination.—Attention is called in the Lond. "Elec. Rev.," Dec. 28, to an article by Mr. Tolomei, in "Malpighia," 1894, page 470, on the effects of magnetism on the germination of the Phaseolus Vulgaris. He found that a feeble magnetic field had no appreciable effect on the germination of the seeds, while a field of greater intensity caused more or less increased rapidity of growth, in proportion to the proximity of the growing seeds to the point of greatest magnetic intensity; young plants were found to be diamagnetic. The journal suggests that such results should be accompanied with quantitative data, so as to give a more accurate notion of the conditions.

Effects of Magnetization on Volume.—The Royal society paper of Mr. Bidwell, mentioned in the Digest Aug. 25, is published in the Lond. "Elec. Eng.," Dec. 28.

Large Electromagnet.—An article from the New York "Sun," describing some experiments with Col. King's large magnet at Willett's Point, N. Y., is reprinted in the "West. El.," Jan. 5. According to this description, the magnet core consisted of an old Rodman 15-inch gun, weighing 50,000 pounds; it was turned into a club-footed magnet by the addition of many tons of heavy iron plates; the coil consisted of old torpedo cables 14 miles long, carrying 20 to 25 amperes; the armature consisted of 6 platform plates bolted together; a calculated force of 44,800 pounds was insufficient to tear off the armature, the chain used being broken by the strain; 5 cannon balls, of 325 pounds each, were suspended like a chain from the muzzle of the gun; an iron spike placed against the breast of a man standing three or four feet off, with his back to the gun, stood out straight; it required the efforts of two men with a sudden jerk to pull away a 25-pound bar from the gun; with its carriage the gun weighs 80,000 pounds; at a distance of 71 feet the magnetism of the gun equaled that of the earth, a compass needle being deflected 45 degrees, at a distance of 300 feet it was deflected 3 degrees.

Curious Magnetic Phenomena.—A description of the phenomena recently noticed by Mr. Lloyd (described in the Digest Dec. 15), is published in the "Elec. Rev.," Jan. 29, by Mr. Stone, who adds a mathematical discussion of it, which he says accounts for it quite satisfactorily, if the reluctance at the fracture is greater than that for the rest of the magnetic circuit. (The compiler calls attention to an abstract in the Digest 29, in which the phenomena was explained.)

Three Phase Currents.—The "Tech. Quart.," for July, mentions, but does not describe the "beautiful apparatus with which Prof. Puffer illustrates the effects of three phase currents."

What is Electricity?—Mr. Walker's paper (see Digest, Dec. 22), is reprinted in the "Elec. Age," Dec. 29.

ELECTRO-CHEMISTRY AND BATTERIES.

Purification of Sugar.—"L'Elec.," Dec. 15, abstracts an article from the "Rev. Ind." It states that it is difficult at present to give an opinion on the future of the electrical method, as the practical résults are not yet sufficiently numerous nor sufficiently positive, but it appears certain from the experiments of Dr. Bersch, in Austria, and of the industrial applications of the Schoolmeyer, Behm & Dammeyer process in Germany, that the electric current exerts a true purifying action on beet juice; the nature of the electrodes is not a matter of indifference; the first cost of the installation is but slight, the process simply completes the purification by carbonate of calcium, it requires less chalk, simplifies the work, and gives a higher efficiency. The process of Javaux, Gallois and Dupont is described in detail; the liquor is purified so that one can obtain all the sugar which it contains in the form of white sugar without requiring treatment with carbonic acid, and without the production of molasses; after adding the chalk it is heated to about 90 degrees C., and should be slightly alkalined, to prevent the partial inversion of the sugar, and to precipitate a large part of the impurities; after filtration it is submitted to the action of an electric current in two series of compartments, separated by porous diaphragms, from a compartment containing water; the annodes in the first liquor are made of plates of oxid of manganese, or of aluminum, for the first series, and of plates of lead for the second series in which the liquor arrives after leaving the first; the cathodes, for the negative compartment filled with water, can be made of carbons, iron or other material insoluble in alkalies. The current decomposes the foreign material, and the acids set free are fixed by the annode while the basic products pass into the compartment containing the water; it is well to submit the liquor first to the action of the annode of the oxid of manganese, as the first acid elements set free by the current forms with the annodes combinations, which are completely insoluble, while the lead which is easily regenerated is better for the final action; if lead was used for the first application, soluble lead salts may be formed with certain liquors; the last traces of soluble lead salts may be eliminated by phosphoric acid.

Purification of Acetic Acid.—The Lond. "Elec. Rev.," Dec. 28, quotes from a Russian journal to the effect that an electric process was started in 1893, by means of which over 500 tons of acid were purified with such success that the old copper apparatus was abandoned: no details are given, but the English journal states "in our opinion, this mysterious box is nothing else than an imitation of the platinum apparatus, invented by Messrs. Johnson and Mather, which works so remarkably well for the concentration of sulphuric acid and other liquids by heat generated by electricity, and which consists of a platinum rectangular pan, fitted internally with insulators, holding the necessary platinum heaters."

Hermite Process.—An apparatus for generating small quantities of the sterilizing liquid, using currents from lighting circuits, is described and illustrated in "L'Ecalirage Elec.," Dec. 15. It appears to be the same as that described in the Digest, Sept. 22.

Cyanide Process of Extracting Gold.—Another article on this subject, by Mr. Andreoli, is published in "L'Eclairage Elec.," Dec. 15, it is devoted to a discussion of the recent litigation in England.

Reduction of Aluminum by Carbon.—An Academy paper, by Mr. Moissan, describing this process in his electric furnace, is reprinted in the "L'Ind. Elec.," Dec. 25.

Thermo-Chemical Actions in Accumulators.—A paper by Mr. Streintz, from the "Weid. Ann.," vol. 53, page 698, is abstracted in the "Elek. Zeit.," Dec. 27. The chemical energy is due to the sulphating of the lead, neglecting secondary actions, such as the absorption of hydrogen, in their negative plate, the generation of free gases, and the formation of hydrated lead oxid. To calculate the chemical energy he divides it into three phases, in the first water it is decomposed, requiring 684 calories, in the second the oxygen oxidizes the negative plate, and the hydrogen reduces the oxid on the positive plate forming water, the former developing 503 calories, and the latter an unknown quantity A.; in the third, sulphating takes place on both plates, developing 234 calories; the quantity A was determined by him experimentally, and was found to be 583; by summing these, he obtains a voltage of 1,885, assuming a constant in Faraday's law of 96,540 coulombs, and the unit of electrical energy as 0.00239. This is under the assumption that all the acid in the solution is used up; with dilute acid he obtained experimentally an E. M. F. of 1.900, and he therefore concludes the close agreement is not an accidental one, but that it proves that the action is really as described. (A series of articles on the theory of accumulators, by the same author, were abstracted in the Digest July 1, Nov. 18, Dec. 9–16, 1893).

Electric-Phoebus Accumulator.—According to a very brief description in the "Elec. Eng.," Dec. 28, the grid holds the active material very firmly, and prevents it from falling; at a discharge of one ampere per kg the capacity was 14 ampere hours per kg of mounted electrodes.

Electrical Sanitation.—A United States consular report from Havre, France, reprinted in the "Elec. Age," Dec. 29, refers to the Hermite process (concerning which many abstracts were published in these columns). According to Mr. Dubosc, microbes may be divided into two classes, those which exist without air, and those requiring air; on the former the action of the chlorine compound is simple, as the freeing of its oxygen causes their instant death; regarding the latter he states that the fatty principles undergo a strong oxidation, which destroys the equilibrium of the chemical medium, thus causing them to perish. It appears that there is a doubt concerning the question of economy in this system. At present about one-half of most water supplies is wasted in flushing drains and sewers, etc., and it is quite conceivable that the use of electrolyzed sea water for these purposes would therefore add immensely to the store of potable water.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Comparing Specific Inductive Capacities.—The "Phil. Mag.," for Jan., contains an illustrated article describing a method, by Mr. Northrup, for comparing the values of the specific inductive capacity of a substance under slowly and rapidly changing fields; he gives the results for paraffine and glass. With but a few exceptions the refractive index has been obtained by others only for very short waves, and he suggests that Maxwell's relation may not hold good in many substances whose specific inductive capacity has been determined in steady or very slowly alternating fields; he therefore devised the method which he describes, in which the fields of force may be made to vary slowly or rapidly. The apparatus is described and illustrated in detail, and the theory given. For paraffine he found that the specific inductive capacity was 3 per cent. less in oscillating than in slowly varying fields, and that of plate glass was 6.2 per cent. less; he concludes that the change is much smaller than several observers have stated; if the apparatus is well made he believes it capable of giving accurate results.

Specific Inductive Capacities of Water, Alcohol, Etc.—In the "Phil. Mag.," for Jan., Dr. J. Hopkinson refers to the recent paper of Prof. Fessenden (see Digest, Dec. 22), in which it was claimed that the values found by many others are not correct; the present writer states that the values said to be incorrect are not those of a single observer but of many whose results are in good accord; he quotes a number of these results, all of which, especially for certain liquids, deviate from Maxwell's law; he thinks much more evidence will be needed than Prof. Fessenden has given before the former results are doubted. In reply to the statement that water insulates as well as India rubber he states that the highest recorded resistance for water is far below this value, "anything appearing in the Philosophical Magazine carries authority, and if inaccurate is calculated to mislead."

Determination of Di-electric Constants.—Mr. Nernst's paper, mentioned in the Digest, Dec. 29, is abstracted in the Lond. "Elec. Eng.," Dec. 28.

Units.—In a paper by Mr. Mewes published in the "Elek. Zeit.," Dec. 27, he discusses the relation between the electrostatic and the electrodynamic system of units in connection with the vibration theory; he describes Weber's fundamental principles of electrodynamics and makes deductions from them in connection with the vibration theory; the article is mathematical in character.

Physical Units.—In Mr. Maclean's serial, in the Lond. "Elec. Eng.," Dec. 28, he discusses the measurement of the units by their electrostatic and their electromagnetic effects, giving tables of the results of measurements of the ohm and the electrostatic units.

Units.—"Science," Jan. 4, contains an article of some length by Prof. Mendenhall in which he gives a brief review of the establishment of electric units, and of the recent electrical Congress He gives the recent Act of Congress, number 105, approved July 12, 1894, which declares them to be the legal units for the United States; there are a few differences between these, and those adopted by the International Congress at Chicago, but he states that they are very slight "and consist entirely of verbal changes that were thought to be desirable and necessary by the Senate committee to which this bill was referred after its passage by the House of Representatives." In conclusion he adds that "one cannot refrain from the opinion that from an absolutely metrological standpoint the regulations of the 'Order in Council' should be condemned rather than approved, etc."

Measuring Large Currents.—The "Tech. Quart." for July mentions but does not describe an apparatus by Prof. Holman and Mr. Laws, "for the measurement of currents up to 300 amperes with an accuracy never before obtained in such measurements."

TELEGRAPHY, TELEPHONY AND SIGNALS.

Peculiar Telephone Troubles.—In an article by Mr. Mix, in the Lond. "Elec.," Dec. 28, he describes some peculiar disturbances which were noticed at Odessa. A theatre had been lighted with alternating currents from a distant station, one having a frequency of 40 and the other of 125, the total power consumed at the theatre being 80 kw; with the low frequency current the disturbance on telephone circuits (the American Bell instrument being used) were insignificant, but when the higher frequency currents were used the disturbance became quite important on lines running in the neighborhood of the theatre. The cause was found to be due to the fact that the wiring of the galleries of the theatre for lighting was run on the loop system, that is, the current entered at one end of the loop circuit and left at the other, for the purpose of having an equal potential on all the lamps of that circuit, the effect of the current being therefore the same as if a single conductor were placed around each gallery and the current was exceptionally large, as the voltage was only 60; the four circuits encircling the theatre in this way produced a very strong magnetic field whose axis was that of the theatre, and it was this field that acted in the telephone wires; it is likely, also, that the iron roof added to the effects in concentrating the lines of force which escaped from the edges of the roof and cut the neighboring wires; the remedy of course is to abandon the loop system; (another remedy, although not as perfect, which suggests itself to the compiler would be to reverse the connections of every alternating loop, in which case the current impulses would be in alternately opposite directions). He also shows the importance of electrostatic induction effects on telephone lines; a single wire forming one line of a new branch from a primary circuit of an alternating current system ran parallel to a group of telephone lines for a distance of about 1,200 feet, the telephone lines being on the opposite side of the street, 60 feet distant; there were no transformers on the branch line, the only current in it being that due to the charging of the line; this caused important disturbances on the telephone circuit, which, however, ceased when the second branch line was also connected; the effect was therefore purely electrostatic; the disturbance was so great as to almost completely prevent communication. He concludes that electrostatic induction is quite as capable, if not more so, of creating telephone disturbances than electromagnetic induction.

Long Distance Telephony.—According to the "Elek. Zeit.," Dec. 27, the Berlin-Memel line has just been completed; it is 1,020 km (about 617 miles) long thus forming the longest line in Europe; it is stated that this line proves that it is possible to construct long distance lines without the expenditure of such large amounts of money as was required for the New York-Chicago line.

Theatrophone.—"Rev. Ind.," Dec. 22, publishes an illustrated description of the system in use in Paris, by means of which any telephone subscriber can be connected with any one of a number of the theatres in Paris.

Information Office.—According to the "Elek. Zeit.," Dec. 27, an office has been established in connection with the large telephone station in Paris, where any question or complaint regarding the service are to be addressed; any subscriber can be connected with this office.

Telephone.—The instrument described in the Digest, Dec. 8, is illustrated and briefly described in the Lond. "Elec.," Dec. 28.

House Telegraphs and Telephones.—The continuation of Mr. Oesterreich's article, describing some new apparatus, is contained in the "Elek. Zeit.," Dec. 27.

Muirhead v. The Commercial Cable Co.—A discussion of this important litigation is contained with illustrations in Lond. "Engineering," Dec. 28. Judgment was given a few weeks ago, reversing the decision of Justice Kennedy, declared in May.

Wheatstone Automatic in the United States.—An article by Mr. Finn, with some tabulated data, is published in the "Elek. Zeit.," Dec. 27.

Gilgit Telegraph Line.—The Lond. "Elec.," Dec. 28, reprints an article from the "Indian Engineer.," giving a description of this line, which is of interest, because it passes over two very high mountain passes.

Fire Alarm Telegraph.—A German system is described and illustrated in the "Elek. Echo," Dec. 29.

Waterproof Electric Bell.—A new form is described and illustrated in the "Elek. Zeit.," Dec. 27, which can be run for months under water. The magnet and the contact braker are enclosed in a hermetically sealed box; the poles of the magnet project to the outside, where they operate on the clapper as usual, but the contact is made and broken by a second armature enclosed in the box; the two armatures, therefore, vibrate synchronously.

Telautograph.—According to "the West. El.," Jan. 12, Gray's telautograph was used successfully, on Dec. 15, on the long distance telephone line between Paris and London, 312.5 miles long, of which 23 are submarine cable; the resistance of the circuit was 706 ohms, and the capacity 11 microfarads; the speed was 18 words in 36 seconds, at one time, and 22 words in 40 seconds at another, each word averaging five letters; the writing was perfectly legible, but somewhat ragged at very high speeds.

Telegraphing Signatures.—An article of a popular nature, by Mr. Perry, is published in "El'ty.," Jan. 9.

MISCELLANEOUS.

Magnetic Separation of Iron and Zinc Ores.—A well illustrated description, by Mr. Ferraes, of an installation in Sardinia, is published in "L'Eclairage Elec.," Dec. 15. A product, which was of no use, although it contained 26 per cent. of zinc ore, is treated in a furnace so as to oxidize the iron ore into a magetic oxid, after which it is treated with a magnetic separator; the material must be finely ground; the three furnaces can each treat 12 tons per day, with an expenditure of 2 tons of coal; the installation was started in 1890, and in the first year 5,000 tons were treated, furnishing 1,530 tons of concentrated ore, having 41.7 per cent. of zinc; at present it is concentrated to 45 per cent.; in addition very pure iron is also produced.

Educational.—The Lond. "Elec.," Dec. 28, reprints and discusses an article by Sir Philip Magnus, on the question of whether examinations are a mere necessary evil.

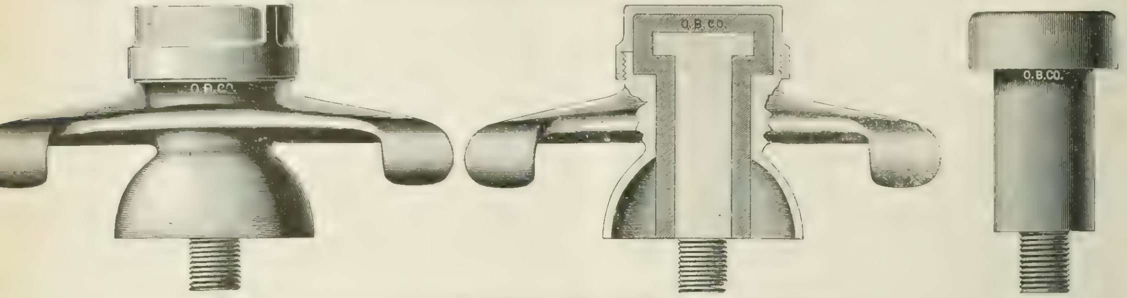
How Does Electricity Kill?—The "Elec. Eng.," Jan. 2, contains a paper on this subject by Mr. La Roche. He relates several cases in which he himself was subjected to high voltage currents, in which he estimates that two and more amperes passed through his body. He describes a test made with a cat, and another with a fox, in both of which the animals were killed, the former with comparatively few shocks of longer duration, while with the latter they were numerous, but of shorter duration. Shocks of prolonged application probably cause disintegration by electrolytic action, but the second method is more certain and quicker; to destroy animal life he concluded that the best method is to shock the body in quick succession, with many shocks, for about 30 seconds, with either a direct or an alternating current of 1,200 to 1,500 volts. He states that it has been demonstrated (when and by whom?) that a current from 1 to 10 amperes (for what length of time?) does not destroy any of the vital organs, but that it takes currents from 10 to 20 amperes (have not a number of linemen been killed with a 9 ampere arc light current?) smaller currents, no matter what the voltage, simply cause suspended animation. He believes that an intermittent direct current not greater than 60 is more deadly than an alternating current of an equal E. M. F., "with an alternating current of high frequency, say, 16,000, a body would act as a condenser, choking back the current, and the higher the frequency of the alternations, the greater the impedance to the current, so that after the first contact was made there would be no sensation of current passing, because the great frequency would prevent the body from returning to zero (sic), its normal state."

Law of Invention.—An abstract of a Franklin Institute lecture, by Mr. Petit, with special reference to electrical cases is reprinted in the "Elec. Age," Dec. 29 and Jan. 5.

A New Type of Trolley Hanger.

A new type of trolley hanger is being placed on the market by the Ohio Brass Company, Mansfield, O., known as "Type K," and of which we illustrate, a straight line hanger in elevation and cross section, an insulated bolt, which is interchangeable with the different forms of hangers, and a single curve hanger. The complete line of "Type K" hangers includes all the various styles necessary to support the trolley wire for the different suspensions in general use.

The hanger is made of three parts, consisting of a body, cap and insulated bolt. The latter is a ⅝-inch drop forged steel bolt molded with a heavy covering of insulating material around it, and is thoroughly protected from moisture and accidental blows by the metal covering surrounding it. The cap, which screws on to the hanger body, bears directly on a leather washer, which is interposed between it and the head of the insulated bolt, and thus holds it securely in position. The design of the cap and threaded lip of the hanger body, which is peculiar to this type of hanger, permits the screwing of the insulated bolt into the trolley wire support, without raising it from its normal position in the hanger body, which is necessary in other forms.



Figs. 1, 2 and 3. Straight Line Hanger and Insulated Bolt.

Waterproof Hydraulic Packings.

The constant demand for a superior packing for the plungers and pistons of pumps, pumping and hydraulic machinery, induced the Garlock Packing Company, Palmyra, New York, to produce a packing which would meet the necessary requirements, which it has finally succeeded in doing after many years of experiments and at a considerable expense. This packing is the outcome of numerous experiments and practical tests in the water ends of pumps, plungers, pump pistons, hydraulic elevators and hydraulic machinery, and with the result that the company now puts forth the claim with confidence that it it has produced a first-class waterproof packing for light or heavy duty, made of the best flax and thoroughly lubricated with a waterproof compound which is strictly free from acid. Heretofore, the best rawhide hydraulic packing answered its purpose well for a time, but soon became water-soaked and soft from the use of oils, losing its strength; and piston plungers were sure to leak badly, requiring constant repacking. This packing is intended to resist excessive pressures and retain its solidity. One of their principal claims for this packing is that it is absolutely waterproof and oil proof. Engineers who daily experience the difficulties of leaky pump plungers will no doubt greatly appreciate the advent of this packing.

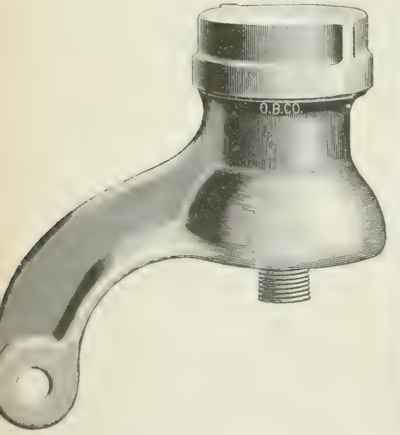


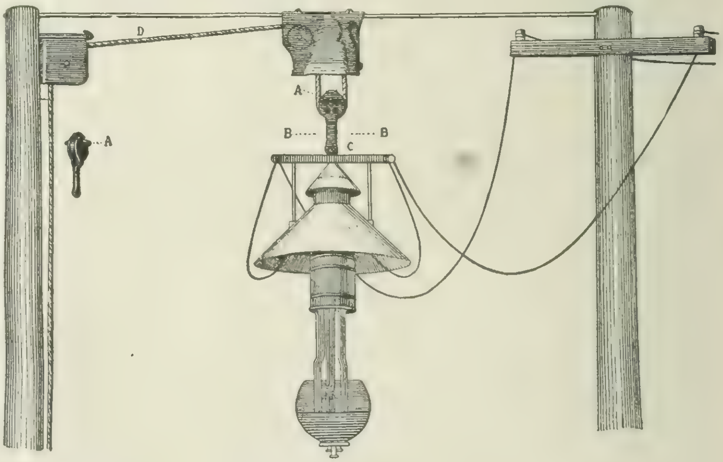
Fig. 4.—Single Curve Hanger.

Arc Lighting in the New York Herald Building.

The arc lighting of the new building of the New York *Herald* is one of the finest examples of this system of illumination in New York. The entire press room is illuminated with eight of the Clark Electric Company's ornamental arc lamps, and the same lamp is also used in the engine room, delivery department, and stereotype foundry. The manager of the *Herald*, and his electricians, Mr. Knight and Mr. Cecil began the investigation of arc lighting from incandescent current for their building ten months ago, and after nine months of trial of various makes of arc lamps, they selected that of the Clark Electric Company, 192 Broadway, New York, as best for their purpose. The lamps in the press room are of a special design, having a combinaton electric arc light and gas fixture. The New York *Herald* is the only newspaper in America that exhibits its entire printing presses where the public can stand upon the sidewalk and see the paper enter the press, come out printed and folded, ready for delivery. Thousands of people visit this establishment and watch the interesting process of producing the modern newspaper.

Safety Hook Pulley.

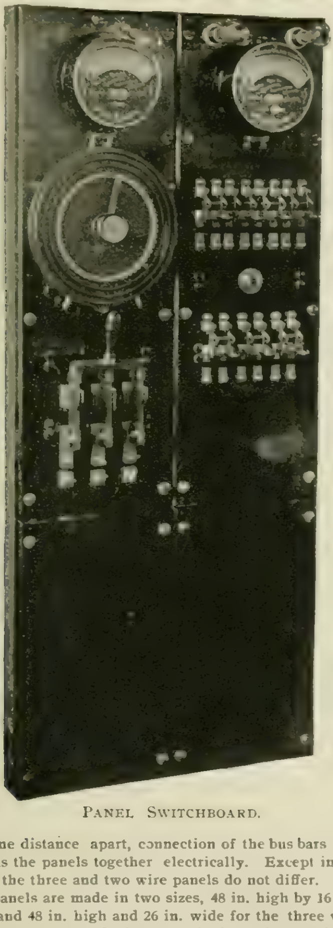
The pulley we illustrate, made by the Barber-Koenig Manufacturing Company, 117 North Vine street, Hazleton, Pa., is designed to obviate danger from falling lamps by relieving the rope by which the lamp is suspended of all strain. When the lamp is in position there is no strain whatever on the suspending rope, nor is there any of the twisting motion which is apt to cause the leading wires to break at the hook-cross arm. The casing of the pulley is made of cast iron, fitted with a rope pulley, and a slotted attachment for catching the lugs of the safety hook. In order to secure good alignment, the supporting guy wire passes through the casing, and is fastened to it. The safety hook "A" at the left of the cut is made of malleable iron, with projecting lugs for engaging with slots in the pulley casing. It is also fitted with a pulley, thus securing a double purchase on the rope, so that the lamp may be raised with ease. The cut shows a lamp lowered slightly, in order to illustrate the method of connecting the safety hook and double purchase on the rope.



Arc Lamp Suspension.

Isolated Plant Switchboards.

Advances made in the electrical art are nowadays all in the direction of economy, and the patient attention to details results now in the elimination of that expense now in the reduction of this. As an example, in isolated plant engineering the design and construction of the switchboard has generally occupied a large amount of time, with consequent expense, usually out of proportion to the size of the contract. To reduce this expense, the General Electric Company has standardized a form of switchboard, of panel type, similar in this respect to those successfully known in its railway work. The panels are of two kinds, one for the generator and one for the feeders. They are of black enamel slate in two finishes, mounted on a steel frame. Flanges on the frames permit of the panels being connected side by side to form one uniform whole. The generator panels are built in eleven capacities, running from 3 to 100 kw. at 125 volts, or from 24 to 800 amperes maximum, and all are 48 in. high, and 16 in. wide. Each generator panel carries one triple pole single throw switch with fuses, one Carpenter enamel field rheostat, one round dial ammeter, and a pilot lamp, all being electrically connected behind the panel. The common bus bars on all the panels being the same distance apart, connection of the bus bars by a copper tie bar connects the panels together electrically. Except in the method of connection, the three and two wire panels do not differ.



Panel Switchboard.

The feeder panels are made in two sizes, 48 in. high by 16 in. wide for the two wire, and 48 in. high and 26 in. wide for the three wire system. The two wire panel carries double pole feeder switches with fuses, one round dial voltmeter reading to 125 volts, one two wire push, button ground detector. The three wire panel carries triple pole single throw switches, with safety catches, two voltmeters, and one ground detector. All the connections are complete, and immediate installation is effected by soldering in the feeder ends and generator leads and connecting the two bars together with tie bars.

These switchboards are made for support either by brackets upon a hollow pedestal, or the framework may be continued down to the floor and the open space filled by blank panels, as shown in the illustration. This method is generally recommended.

The simplicity of construction and ease of installation of these panels, together with the advantage of increasing the capacity without impairing the uniform appearance of the switchboard, have already commanded a wide appreciation among electricians.

The Cummings & Engelman Conduit.

The conduit system of the Cummings & Engelman Conduit Company, Detroit, Michigan, has attracted wide attention, and we illustrate herewith an end and longitudinal section of the low tension system.

It is a draw-in system, carrying any potential on bare conductors up to 6,000 volts. In the manufacture of the conduit lap-welded iron pipe in 20-foot lengths is used, which is first dipped in an insulating varnish, a product of the compound used in filling in the space between the wooden ducts and the pipe. The ducts are made from kiln-dried wood in 20-foot lengths, which are then boiled in oils, thus thoroughly saturating the wood and killing all the fiber. They are then spirally wound with a rope prepared in the same oils. Any number of these ducts may be grouped together, yet separated by the windings, and collectively held together by an outside spiral binding. thus not only holding the ducts together, but, also, forming a space between them, individually, and, after they have been placed therein, between them and the inside surface of the pipe.

After a group of the wooden ducts has been placed in the iron pipe or tube, an insulating plug, two inches thick, is driven in flush at one end of the pipe, the ducts only entering this plug ½ inch, thus leaving an unoccupied space of 1½ inches in the exposed end of the plug. Consequently the ducts project the same distance (1½ inches) beyond the other end of the tube. Each plug has a number of openings corresponding to the number of ducts inserted in the tube, each duct entering its separate and designated hole. The iron tube is now raised to an angle of 45 degrees, and an insulating compound is forced in from the top until it fills completely all space between the ducts and between them and the inside surface of the pipe. After the compound has set, a 1-inch plug is then driven over the projecting ducts until it is flush with the end of the pipe. Thus the male and female joints are formed. Then the tube is lowered and ready for shipment.

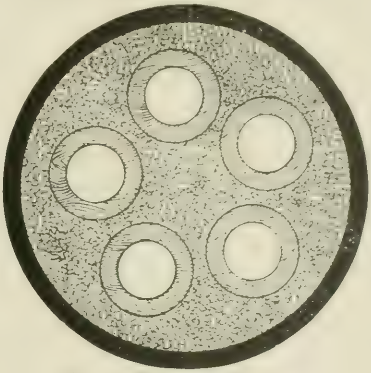


Fig. 1.—Section of Conduit.

In laying the conduit a trench is excavated to a depth of two feet below the grade of the street and of a width sufficient to accommodate the size of the conduit. Any number of conduits may be laid in a single trench. The conduit, Fig. 1, is laid in sections, each joint being completed after the projecting ends of the ducts have been slipped into the plug of the next tube, by means of a turtle-shaped cast-iron box, which, after it has been adjusted about the joint, is securely bolted thereto and an insulating compound poured in. Thus water and moisture are prevented from entering the tube at the joints.

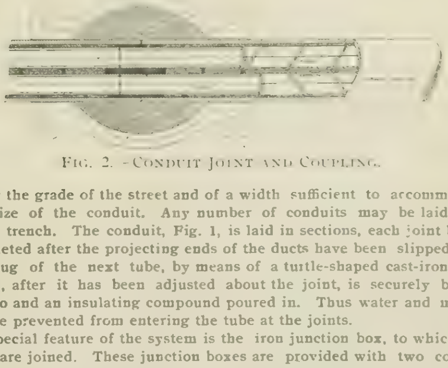


Fig. 2.—Conduit Joint and Coupling.

A special feature of the system is the iron junction box, to which the tubes are joined. These junction boxes are provided with two covers, the outer cover being flush with the street, while the inner cover is bolted against a gum gasket, preventing water or moisture from entering the box. The boxes are made in various sizes, and have from two to six stubs. Moreover, the bare conductors are thoroughly protected in these boxes, so that is is possible to open them for any purpose, at any time and in any kind of weather.

As distinguished from other systems, this conduit, when properly laid need not be disturbed during the life of the tube, thus avoiding expense for repairs. Another feature of the system is the saving of money and time in laying the conduits.

NEWS OF THE WEEK

THE ELECTRICAL STOCK MARKET.

NEW YORK, Jan. 12, 1895.

ELECTRICAL STOCK MARKET news, these days, considering the apathy characterizing the entire financial district, has more to do with speculation regarding the future of the trade and its problematical effect on prices than with the course of quotations themselves. Fluctuations such as really occur cannot be relied upon as furnishing any real indication of the conditions governing the operations of the electrical manufacturing and operating companies treated of. One must rather turn to the specific outside news of trade happenings to gain any idea of the companies' progress or otherwise, leaving the course of stock market quotations to merely give a record of the whims and caprices of fraction-scalping stock exchange traders.

GENERAL ELECTRIC'S quotations, for instance, vary so little or so purposelessly as to leave one no genuine idea as to how the General Electric Company is getting along financially and commercially. Not the least attention, in a stock market sense, is paid to such reports as ordinarily could be depended upon to create some activity in the stock, and judgments as to its value must be based on other things than what the ticker tape has to offer. It is beginning to be a generally conceded fact that the policy of purchasing its own debenture bonds is the best policy so far inaugurated by the General Electric Company's management. Already more than $1,000,000 of these securities have been put into the treasury, with the result that the capital impairment is being gradually reduced. In fact, what with the purchase of these bonds and the appreciation in value of other treasury assets, the large deficit has already been lessened one-third, with every indication of another large reduction soon being made. It is very likely, therefore, that beyond buying its own debentures and marking up the value of treasury assets as they appreciate in value, the officers of the General Electric Company will take no further action on the long-mooted question of making good the impairment in capital. Stockholders—and naturally so—have made strenuous objections all along to any proposition so far broached to reduce the capital stock proportionately so as to make up the impairment, and prefer to further postpone the dividend period rather than submit to any cutting down of their holdings. If profits hold out at the rate they are now being piled up and debenture bonds are bought in open market with the proceeds thereof, then the entire deficit can be made up within eighteen months by the mere operations of the company itself. And, when the impairment is fixed up, the stock will be really worth more than ever. For then the treasury assets will consist, to a large extent, of the bonds of the company, and the stockholders will also be the bondholders of the company, with a first lien on its property in any possible event of disaster. For this reason the principal stockholders prefer to wait a little while longer for the resumption of dividends on their holdings, feeling that when they are once again resumed under the present programme they will continue so uninterrupted.

WESTINGHOUSE ELECTRIC preferred and common stocks afford but little comment, to judge from the sluggishness marking their stock market course. Not that the company's own state of affairs warrants any such lack of attention to its securities. The Westinghouse Electric and Manufacturing Company is progressive and its management gives close attention to the company's affairs. Their latest move, according to Pittsburg advices, has been to prepare for the market a new type of alternating current machinery which is said to be "in many respects radically different from that now in use and especially so in the matter of superiority as to results. The main departure is in the construction of the armature, where solid copper bands take the place of the masses of wire heretofore used, saving the time, trouble and cost of winding, and giving a current of greater volume and steadiness, induction being practically done away with." Of course, these improvements are fully protected. Great things are expected of this new departure.

BOSTON ELECTRIC LIGHT 5 per cent. bonds, recently treated of in these columns, are being offered to the public at 102, the price subject to advance. Stockholders of the company subscribed for $100,000 worth of these securities, and $210,000 were sold to a New Haven banker, to be delivered from time to time as the company needs the money. About $50,000 have been further reserved by the company for stockholders who desire to subscribe but are unable to do so at the present moment.

AMERICAN BELL TELEPHONE stock continues weak around 190 to 192. The stock subscription fiasco continues to throw a cloud on the company. The latest information is that the directors have decided to sell the remainder of their stock at auction. About 3,300 shares remain unsubscribed for by stockholders. So far the date and details of the coming auction sale have not been made public, the whole matter being left to the discretion of the executive committee. There is a good deal of litigation ahead for the company, and it is likely that future stock market values will depend a deal on the result of the various cases in hand. For one thing, the appeal from Judge Carpenter's decision of December 18, in the Berliner Patent Case, to the United States Court of Appeals has been perfected, and the case will straightway be put on the calendar. Then suit has been brought against the Harrison International Telephone Company, of Chicago, to restrain the use of certain parts claimed to have been used by the Harrison Company. Upon the outcome of these suits will depend, to some extent, the future value of Bell Telephone.

ERIE TELEGRAPH AND TELEPHONE COMPANY report a net gain of seventy-nine subscribers in December; 284 for the three months ending December 31st and 672 for the fiscal year. The total number connected Juanary 1st are 16,085.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	128	130
Cleveland General Electric	100	80	90
East River Electric Light Co.	100	—	50
Edison Electric Ill., New York	100	98	100
*" " " Brooklyn	100	110	112
" " " Boston	100	122	124
" " " Philadelphia	100	120	125
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	35	40
Electric Construction & Supply Co., com.	15	7⅛	10
" " " " pref.	15	7⅛	10
Fort Wayne Electric	100	1½	2
General Electric	100	34	34⅛
General Electric, pref	100	67	70
Westinghouse Consolidated, com.	50	32½	33½
*" " pref	50	49¾	50

BONDS.

Edison Electric Ill., New York	1,000	108	109
Edison Electric Light of Europe	190	75	85
General Electric Co. deb. 5's	1 000	92½	93

TELEGRAPH AND TELEPHONE.

*American Bell Telephone	100	190	191
American District Telegraph	100	35	40
American Telegraph & Cable	100	92	93
Central & South American Telegraph	100	102	105
Commercial Cables	100	138	145
Erie Telephone	100	53¾	54
Gold & Stock Telegraph	100	103	105
*Mexican Telegraph	100	180	190
Mexican Telephone	100	75	80
New England Telephone	100	67	69
New York & New Jersey Telephone	100	97	98
Postal Telegraph-Cable	100	50	55
Western Union Telegraph	100	87⅛	88

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* Ex div.

ELECTRIC TRACTION stocks traded in the New York market continue inactive. But each day furnishes another instance as to the growing importance of this class of securities and the increasing weight they will have in future comments on stock market news. For instance, the New York, New Haven and Hartford Railroad, one of the richest corporations in America, is about to introduce electricity experimentally as a motive power on one of its branch roads, with a prospect that, if successful, its use will be largely extended. President Clark has chosen the branch line running from Pemberton, near Boston, to Nantasket Beach, the Coney Island of the Hub, for the experiment, and on its success will depend the introduction of electricity as a motive power on the Warren and Bristol and other branches. "It may," he adds, significantly, "eventually be introduced throughout the entire system." Boston reports have it that there is a movement on foot there by a syndicate to form a street railway consolidation similar to the Metropolitan Traction of New York.

ELECTRIC TRACTION STOCKS.

	Bid.	Asked.
Union Ry. Co. (Huckleberry)	115	120
Brooklyn Traction, pref	61	64
" " com	12	14
Long Island Traction	11½	12
Rochester St. Ry	30	40
Columbus St. Ry	45	50
Louisville St. Ry. pref	87	88
" " " com	37	39
Cleveland Electric Ry.	45	47
Cleveland City Ry.	68	70
North Shore Traction	23½	25
New Orleans Traction	63½	65
Worcester Traction pref.	80	82
" " com.	13	14
Metropolitan Traction, Philadelphia	101½	102
Philadelphia Traction	95	98
People's Traction	51	52
Binghamton R. R. common	100	—

BONDS.

	Bid.	Asked
*Union Ry. 1st. mtge 6s.	105	108
*Westchester Electric 1st. mtge. 5s.	98	101
Rochester St. Ry. 1st. 5s.	95	97
*Columbus St. Ry. 1st 5s.	95	97
Columbus Crosstown 1st. 5s.	95	97
*Binghamton Railroad Co. 5s	99	100

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*With accrued interest.

THE BINGHAMTON RAILROAD COMPANY report gross earnings for 1894 of $70,913; increase, $13,258. The net earnings for 1894 were $32,958; increase, $8,131; the operating expenses were decreased 3¼ per cent.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Jan. 14, 1895.

JAMES F. CUMMINGS, president of the Cummings & Engelman Conduit Company, Detroit, Mich., was in New York recently and called at the office of THE ELECTRICAL WORLD. Mr. Cummings reported that the company has recently acquired considerable new capital and expected to do a large business during the ensuing year.

THE KINGS COUNTY ELECTRIC LIGHT COMPANY has filed its articles of incorporation in the office of the County Clerk of Hudson County, and with the Secretary of State at Albany. The new company proposes to furnish Brooklyn with electric light, illuminate its parks, public and private houses, and to supply the town and villages in Kings County. The capital is $1.000 000, and the projectors are E. C. Low, of Brooklyn; P. G. Burr, of Amityville, L. I., and H. G. Adams, of Montclair Heights, N. J.

HERRICK & BURKE, electrical engineers, have recently organized with offices at 203 Broadway, New York, to do general designing, engineering and consulting work in the field of electric construction of apparatus and its installation. Mr. Herrick has been connected with electric lighting since 1879 and has had a wide and varied experience in this particular branch. Mr. Burke has had an active experience of six years in designing and constructing street railway and standard motors and generating apparatus.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, January 12, 1895.

THE PERKINS ELECTRIC SWITCH MFG. CO., of Hartford, Conn., has removed its New England office from 620 Atlantic avenue, Boston, to 182 Summer street, at which location it possesses ample facilities for the conduct of its rapidly growing business through this department. Mr. F. B. Smith, New England manager, "is the right man in the right place," has done an excellent business in the past and is confident of making a better record in the future, a result which he will unqestionably obtain through his untiring energy.

IT IS PROPOSED to operate by electricity the new harbor range lights to be established at South Boston.

THE REPORT THAT THE N. Y., N. H. & H'fd. R.R will equip certain of its Massachusetts lines with electricity is confirmed by Vice-President John M. Hall. Just to what extent the company will use the electrical system is not known, but it is regarded as certain that the Nantasket and Warren and Bristol branches will be thus converted and in operation by next spring, which will probably eventuate into an electric road between Providence, Fall River and New Bedford.

THE CUSHMAN ELECTRIC LIGHT COMPANY, of Concord, N. H., is a new company just organized for the purpose of manufacturing dynamos and motors under the patents of A. L. Cushman. The company succeeds the Granite State Electric and Machine Company, in which Mr. Cushman has been interested for a number of years. The new company will commence business at once, and as the Cushman motors and generators have already received handsome recognition, particularly in Concord and vicinity, it is safe to predict still greater success under the new order of things. Mr. Cushman possesses exceptional abilities in his particular line. The officers of the company are: President, B. A. Kimball, of Concord, N. H.; Treasurer, Ambrose Eastman, of Boston.

THE FOLLOWING OFFICERS of the Massachusetts Electrical Engineers' and Mechanics' Association were elected at a recent meeting: President, John A. Colcutt; Vice-president, Charles Toner; Financial Secretary, Louis Hoffman; Recording Secretary, J. B. Burke; Conductor, John M. Costello; Assistant Conductor, Harry Johnson; Chaplin, M. Daley; Inside Guard, Barney Toner; Trustees, J. E. Cole, J. L. Winnland E. Lunden. The regular annual ball will be held at Odd Fellows Hall, Boston, January 21, and is expected to surpass all previous efforts in this direction.

General News.

NEW INCORPORATIONS.

THE RALEIGH ELECTRIC COMPANY, Fayetteville, N. C., has been incorporated by A. A. Thompson, F. H. Briggs, and others, to establish an electric light plant.

THE GERSON ELECTRICAL MANUFACTURING COMPANY, Philadelphia, Pa., capital stock $50.000, has been incorporated by Charles Heritage and others, for the manufacture of iron or steel, or both, etc.

THE NYACK TRACTION COMPANY, Nyack, N.Y., capital stock $75,000, has been incorporated to build and operate a street surface road. The promoters are F. R. Bain, S. H. Brown, and T. F. Lawlor, Poughkeepsie, N. Y.

THE FOREIGN ELECTRIC TRACTION COMPANY, Alexandria, Va., capital stock $1,000,000, has been formed by Eppa Hunton and others, for the purpose of buying and selling patents covering electric railway systems, lights, etc.

THE ELYRIA, OBERLIN AND WELLINGTON ELECTRIC COMPANY, Elyria, Ala., capital stock $100,000, has been incorporated by W. B. Bedortha, Charles Metcalf, W. P. Steel, A. H. Johnson, and others. The line is to be 18 miles long.

THE FOREIGN ELECTRIC TRACTION COMPANY, Alexandria, Va., capital stock $1,000,000, has been incorporated to manufacture electric apparatus. W. M. Stewart, P. B. Thompson, G. Y. Atlee, and M. Wheeler, Washington, D. C., are interested parties.

THE SOUTHERN OHIO TELEPHONE COMPANY, [illegible] stock $[illegible], has been [illegible] a system of [illegible] by electricity, telephone or telegraph instruments. The promoters are Wm. H. [illegible] Frank F. [illegible]

THE FARNSWORTH PROPELLER COMPANY, Chicago, Ill., capital stock $2,000,000, has been formed to make or sell steam or electric propellers for water navigation; and to own real estate and buildings necessary for the shipbuilding business. [illegible]

THE KINGS COUNTY ELECTRIC LIGHT AND POWER COMPANY, Jersey City, N. J., capital stock $1,000,000, has been formed to manufacture and use electricity for producing light and power. Edwin C. Low, First avenue, corner Eighty-first street, Brooklyn, N. Y.; Henry R. Burr, Amityville, N. Y., and Hugo C. Adam, Montclair Heights, N. J., are interested.

THE CLEAR CREEK GOLD MINING AND WATER POWER COMPANY, Denver, Col., has been organized by New York, Philadelphia and Colorado capitalists. Henry Levis, president, represents Eastern capitalists; Scott J. Anthony, vice-president, the Denver capitalists. The object is to supply power to run street cars, and all sorts of plants in Denver, by generating electricity at a point some miles distant.

TELEGRAPH AND TELEPHONE.

DETROIT, MICH.—The superintendents of the poor have decided to put in a telephone system at the county house, to cost $245.

DAYTON, O.—The police directors are inspecting the Chicago police telephone system, with the idea of adopting the same system in Dayton.

WABASH, IND.—The Phoenix Telephone Company, of Indianapolis, has been granted a franchise in this city, and has made an energetic canvass, securing 125 subscribers.

THE ERIE TELEGRAPH AND TELEPHONE COMPANY reports a net gain of 79 subscribers in December, 284 for the three months ending Dec. 31st, and 672 for the fiscal year. The total number connected Jan. 1st is 16,085.

ELECTRIC LIGHT AND POWER.

SAN PEDRO, CAL.—C. T. Deering, representing a Los Angeles electric light company, offers to furnish the city with ten lights of 2,000 candle power for $150 per month.

HENDERSON, KY.—A committee consisting of A. B. Hurt, John W. Muscaster and A. J. Miller are investigating the best system of electric light plant for the city.

NORTH AMHERST, O.—Bids will be received until January 30th for furnishing the city with electric lights for a period of not more than 10 years. Jacob Baus is clerk.

WORCESTER, MASS.—The Worcester Electric Power Company is said to contemplate selling current for heating and cooking. The company is considering plans for a new station.

LORAIN, O.—The Lorain Electric Light Company will expend $10,000 in improving its electric light station. Work on the improvement will be commenced as soon as the contract can be let.

EAST ORANGE, N. J.—The Township Committee of East Orange will endeavor to have a bill passed in the Legislature, allowing the township to build an electric light plant of its own.

WAUPACA, WIS.—Architect C. B. Pride, of Appleton, has completed plans for an electric light plant in this city. The buildings are to be put up early in the spring, as soon as the weather will allow.

MT. STERLING, KY.—John P. Martin, of Xenia, O., has been granted a contract by the city for the erection of an electric light plant, water works system and plant to operate an electric railway.

NEW LONDON, CONN.—David Banks, Alex. C. Robertson and Chas. W. Comstock filed, in the State secretary's office, a petition to the incoming Legislature for the incorporation of the Banks Gas and Electric Company of New London.

DENVER, COL.—The Clear Creek Gold Mining & Water Company has been organized to generate electric power. Scott J. Anthony, E. W. Rollins, President of the Rollins Investment Company, Dr. E. W. Smith, and others are interested.

PORTSMOUTH, N. H.—The citizens want all night lights, but are not anxious to spend $150.000 for an electric light plant of their own. The Electrc Light Company will have to change over its entire system in order to adopt the all-night system.

RUTLAND, VT.—The subject is being discussed of establishing a municipal electric light plant. A private company proposes to furnish arcs for $112.50 per annum and 7½ cents per night for incandescent lights, to burn all night; a contract to be made for 10 years.

SALT LAKE CITY, UTAH.—The Citizens' Light Company has been incorporated by Charles Boettcher, of Denver, for $500.000. It will commence work at once, and is in the market for engines, boilers, wire, electric machinery, etc. Address, C. Boettcher, Denver, Col.

NORTHFIELD, VT.—G. R. Andrews contemplates putting in an electric light plant in Northfield. The business men in the place are anxious to see the scheme go through, and several have put their names down for lights. The power will be taken from the old Belknap mill.

BLACKSTONE, MASS.—The city government voted to offer the Woonsocket Machine and Power Company 40 cents per light, per night, for 29 arc lights. The rate now paid is 50 cents per light. The company says it will not accept the offer, and if not, the town proposes to erect a plant of its own.

QUINCY, ILL.—A new electric company, composed of John P. Wheeler, H. O. Channon and J. L. Fawcett, has been organized and will soon ask the Council for permission to put up the necessary poles and wires. This company will furnish incandescent and arc lights and will supply power for manufacturing purposes.

The Electric Railway.

NEWARK, N. J.—At the meeting of the Board of Works an ordinance granting permission to the Consolidated Traction Company to construct underground conduits on River, Mulberry and Market streets was introduced and passed to a second reading.

CHICAGO, ILL.—The Inter-suburban Railroad Company is securing the right of way for an electric line running between the village of Highwood and Fort Sheridan. The Village Board and Highway Commissioners have been petitioned for the privilege.

WESTPORT, CONN.—The Westport & Saugatuck Horse Railway Company has petitioned the General Assembly to change its name to the Westport & Saugatuck Street Railway Company, and to amend the charter so as to permit it to operate its lines by electricity.

DETROIT, MICH.—A syndicate represented by James A. Randall, 43 Campau building, Detroit, has obtained the right of way and a franchise to construct and operate an electric railway between North Detroit and Pontiac, Mich., a distance of 25 miles.

FORT WORTH, TEX.—The Fort Worth Street Railway Company will spend $50,000 in improving and extending its line. Its track will be relaid with 56-pound steel rails, and it will also put in a new electric generator in its plant. G. Hendricks is superintendent.

SYRACUSE, N. Y.—The meeting of the Common Council will consider a resolution extending the time within which the Syracuse Consolidated Railway Company is to equip its remaining lines with electricity, under permission granted by the Common Council..

JERSEY CITY, N. J.—The West Side Republican League has decided to co-operate with the West Side Improvement League in trying to have the electric railroad extended down to Marion. Messrs. William Podmore, John Lockwood and Gustave A. Rhein are interested.

INDIANAPOLIS, IND.—The Presbyterian Association and State Synod has located a summer resort on Bass Lake, Stark County. An electric road is to be constructed from North Judson to Bass Lake Station. S. C. Dickey and G. W. Brown, of Indianapolis, are interested.

FORT PLAIN, N. Y.—A meeting was held at the Fort Plain Club rooms, to consider the advisability of building an electric road between this village and Canajoharie. Nothing definite was reached, but it is understood that another meeting will be held in the near future.

FORT EDWARD, N. Y.—The building of a cable road from the village of Caldwell to the top of Prospect mountain will be commenced soon. The road will be ready for business next summer, and will be a great addition to the many interesting features of Lake George.

COLUMBUS, GA.—Mr. John H. Drake, president of the Drake & Stratton Company, spent several days recently in this city in connection with the work on the new electric system, in which his company is largely interested. It was decided to add about two miles additional track.

WINDSOR LOCKS, CONN.—The Windsor Locks & Suffield Tramway Company, which was chartered by the last General Assembly, will petition the incoming Legislature for power to extend its lines from the north boundary of Windsor Locks through Boston Neck to Suffield.

ESSEX, CONN.—A trolley road from Essex to Centerbrook and Ivorytown Village, where the great ivory and bit manufacturing industry is located, is one of the possibilities of the future. There is talk of extending the line to the seashore resort of Westbrook, a distance of five miles.

COLUMBUS, IND.—By a majority of 43 the proposition to aid in the construction of an electric railway from Indianapolis to Franklin, 20 miles from this city, carried. The amount of bid voted was $34,000. The road is now assured, to parallel the Louisville division of the Pennsylvania lines.

HOT SPRINGS, ARK.—The scheme to build an inclined cable railway 2,000 feet long up West Mountain has been revived by forming a $300,000 company. S. W. Fordyce, of the St. Louis, Southwestern Railroad, and B. F. Small Co., St. Louis have become interested. G. W. Baxter is the promoter.

WASHINGTON, D. C.—Calderon Carlisle, H. L. West, W. P. C. Hazen and others are promoting an electric road to run along M street, Virginia avenue, 12th street, and Tennessee avenue. The company is to have $50,000 capital, and is to be called the East Washington Belt Line Railway Company.

ANNAPOLIS, MD.—H. Yewell Bready, engineer of the Annapolis & Bay Ridge Electric line, has stated that the road will be about five miles long, and that work on it is to begin about January 1. J. C. Musgrove, of Philadelphia, is president. The motors will be 25-hp and the rails 80-pound steel.

ALLENTOWN, PA.—A corps of civil engineers, in the employ of the Inter-County Electric Railway Company, has staked out a road from Summit Hill to Mauch Chunk, via Nesquehoning. The road will connect with the Carbon County Electric Railway at the east end of the East Mauch Chunk bridge.

DETROIT, MICH.—The Detroit Citizens' Street Railway Company is having estimates made of the cost of changing about 25 miles of its lines in this city from horse to electric power. The change will probably be made this winter. Address J. D. Hawkes, general manager, 12 Woodward avenue.

BOSTON, MASS.—The Newton & Boston Street Railway Company has secured a location for its tracks on the boulevard to the Boston line, but the road will not be built, so it is understood, until some definite arrangement is made looking to its connection with the reservoir line of the West End Company.

BRIDGEPORT, CONN.—The Bridgeport Traction Company wants to run its road west to Westport, through Fairfield and Southport; also to Parlor Rock, and a branch to Stratford, which will cross the town of Milford and from there proceed to Sanford's hotel in Woodmont, which is now the terminus of the West Shore road.

DETROIT, MICH.—Electrician Harris has completed his estimate on the expense of equipping with electricity the lines of the Detroit Citizens' & Street Railway Company, and the company has ordered its purchasing agent to buy materials for such equipment at once. Material will be bought in Detroit as far as possible.

STOCKTON, CAL.—The Ideal Placer, Mining, Water & Power Company will furnish water free of charge for one year for the purpose of generating power to be used in operating an electric railroad between here and Lodi, or between here and Sacramento, provided a railroad is built between Stockton and either of the points named.

FOND DU LAC, WIS.—The Fond Du Lac Railway Company's plant has been sold by the sheriff to satisfy liens. The roadbed and track of the electric railway has not been operated since last summer, and was bid in by Elihu Colman, for $322.53, and the plant, inclusive of all appliances and machinery, for $4,367.29. It originally cost $75,000.

LEWISTON, ME.—Notice has been served on the City of Lewiston that the Lewiston Bleachery and Dye Works will apply to the next Legislature for a charter to construct an electric railway from the Main Central station on Lower Main street to the company's works about a mile distant. The scheme will involve the expenditure of about $25,000.

WASHINGTON, D. C.—Senator Teller has introduced a bill to incorporate a company to build an elevated electric railroad between Washington and New York capable of developing a speed of 100 to 150 miles an hour. The bill provides that the road must run trains at the rate of 100 miles an hour, and must carry passengers for two cents a mile.

BINGHAMTON, N. Y.—The Binghamton & State Line Railroad Company, which has begun the construction of a road to connect this city with Williamsport, Pa., is finding great difficulty in securing its right of way along the proposed route. The projectors of the road are now considering the advisability of using electricity instead of steam as a motive power.

CORNING, N. Y.—At the Common Council meeting a franchise was granted to the Corning and Painted Post Company to build an electric railroad. Mayor Adams signed the franchise, which the company accepted. The capital is $100,000. This is the same company that obtained the franchise at Painted Post. Edward Shedd, of Worcester, Mass., is president of the company.

FREDERICK, MD.—Another effort will be made to build an electric railway between Frederick and Middletown. The route is 8 miles long, and crosses Catoctin Mountain. The Middletown Valley people have less than $4,000 of their share of the necessary fund to raise, and it is believed that this sum will shortly be obtained, in which event work on the road will begin next spring.

HINGHAM, MASS.—The Hingham selectmen voted unanimously to grant the franchise petitioned for by the Hingham Street Railway Company. The company is capitalized at $45,000 and will go to work on the construction of the railway as soon as the spring opens. The opening of this railway will form an important link between Nantasket Beach and Boston and interior towns.

BANGOR, ME.—The Bangor and Oldtown electric railway scheme is again being stirred up. The Lewiston Journal says that a representative of a New York syndicate has been in Oldtown and Orono, calling upon the stockholders in the company that have a charter for the building of a street railway from this city through Orono to Bangor. If the deal is made, work will begin 10 days later.

SOMERSET, MASS.—The Selectmen of Somerset gave a hearing in the new hall, on the petitions of the Taunton Street Railway Company and the Fall River & Taunton Company, for a location. John W. Cummings, of Fall River, and Attorney General Knowlton appeared for the Fall River & Taunton road, S. M. Thomas, of Taunton, and A. H. Hood, of Fall River, appearing for the Taunton road.

STOCKTON, CAL.—The directors of the electric street railway company are considering the advisability of establishing an electric plant of their own, to furnish power for propelling the street cars, instead of renting the power from the Gas, Light and Heat Company. If it is decided to establish the plant, it will be located on the lot adjacent to the company's car house, near the corner of California and Oak streets.

NORWICH, CONN.—A trolley road between Norwich and New London is one of the possibilities of the near future. The Norwich Street Railway Company own a charter for a trolley road between these points. The charter expires in July, 1895, unless something is done toward the building of the road. The company has already taken steps to protect its charter. For the past week or two surveyors have been at work between New London and Norwich.

ATLANTIC CITY, N. J.—At the regular meeting of the City Council application will be made for a right of way along South Carolina and Arctic avenues for the building and operation of a double track electric railroad. A largely signed petition favoring the project will also be presented. The promoters of the enterprise are Congressman John J. Gardner, ex-Postmaster Levi Albertson, and Law Judge Adams. There is no doubt but that they will receive the franchise.

LORAINE, O.—The right of way has been secured for a new railway. It will be run from the terminus of the Johnson electric road to Oak Point, a pleasure resort four miles from Loraine; from there to North Amherst, three miles; then to Loraine by way of the quarries, about five miles, to the place of beginning, making almost a circle. H. J. Reddington, president of the Amherst Bank, is at the head of the enterprise. The originators promise to have the road finished inside of a year.

TRENTON, N. J.—The New York and Philadelphia Traction Co., of which ex-Mayor Frank A. Magowan is the president, has in preparation an application for a franchise for the right to use certain streets in this city in connection with its proposed through line between this city and Elizabeth, Newark, Paterson and New York on the one side and Burlington and Camden and Bristol and Philadelphia on the other. The company has bought a large tract of land at Plainfield for the location of one of its principal power houses, which will be built at a cost of some $500,000.

BALTIMORE, MD.—Plans for an annex to the Traction Company's power house on South Charles street have been made by Henry Brauns, architect. The new building will measure 82x84 feet, and will be on Conway street, west of Charles. It will also have an addition 40 feet square, making the entire structure L-shaped. In the main annex will be an office, a wagon shed, storage room for machinery, stable and feed room. The addition will be used for an engine room and boiler house. The material chosen for the building is brick, with granite base and trimmings. A cement floor will be laid in the wagon shed. The roof will be of plastic slate.

NEW HAVEN, CONN.—The New York, New Haven & Hartford Company is contemplating placing electric cars on its Nantasket Beach and Warren & Bristol branches, and perhaps, to still further extend the system if the experiment comes up to expectations. A finely equipped power house is to be built just west of the termination of the steamboat wharf at Nantasket Beach, on the land now occupied by the company for the storage of cars. The current for these lines will be supplied by power houses, one located at Warren, which will run the cars from Providence to Fall River, including Bristol branch, and another at Westport Factory, on the New Bedford line. It will be [illegible]5 miles in length. C. H. Platt is general superintendent, New Haven, Conn.

PERSONAL NOTES.

MR. HENRY W. FRYE of the staff of THE ELECTRICAL WORLD has been compelled by ill health to abandon, for a time, his editorial work and will seek recuperation in the milder climate of New Mexico. The readers of the paper whom he has so faithfully served during the past three years will, we feel sure, join us in heartily wishing him a speedy recovery to health and a prompt return to the field of technical journalism, in which he has made such a marked success.

MR. FREDERICK E. DEGENHART, whose death occurred at Chicago on December 7, 1894, is the subject of a sympathetic memorial notice by the Standard Underground Cable Company, of which the deceased was the Western manager. A copy of the sheet will be sent to any of the numerous friends of its highly appreciated late employee upon application to the Pittsburg office.

MR. MAX OSTERBERG will deliver four lectures in the course of free lectures for the people, instituted by the Board of Education, New York. The subjects will be as follows: Lecture 1.—Fundamental Principles of Electricity and Magnetism. Lecture II.—Current Electricity and Electro-chemistry. Lecture III.—The Dynamo and Motor. Lecture IV.—Applications of the Motor and Dynamo.

Mr. FRANK P. LITTLE, whose death recently occurred at Buffalo, N. Y., was one of the most widely and favorably known electrical engineers of the East, and his loss will be deeply felt in an unusually extended circle of friends and acquaintances. Mr. Little was one of the first electrical engineers to enter into business extensively independent of the large electrical companies, and led the way to a practice which has now become so extensive. Among other important work done by Mr. Little was that connected with the lighting of the State Capitol at Albany, where he installed one of the earliest storage battery plants.

MISCELLANEOUS NOTES

THE MONTREAL ELECTRIC CLUB held its third annual meeting on January 7th. The election of officers took place with the following results: President, W. B. Shaw; Vice-president, H. O. Edwards; Secretary-treasurer, Cecil Dantor; Committee of management, T. F. Pickett, J. A. Duglass and W. Graham.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS will hold its ninety-third meeting at 12 West Thirty-first street, New York City, on Wednesday, January 16, at 8 P. M. A paper will be presented by Professor Alexander Macfarlane, of Ithaca, N. Y., "On the Units of Light and Radiation." A paper will also be presented by Mr. Alton D. Adams, of Boston, entitled, "The Best Metal for Field Magnet Frames." A meeting of Western members will be held the same evening, Wednesday, January 16, 8 P. M., at Armour Institute, Thirty-third street and Armour avenue, Chicago, where, in addition to the above papers, Professor Stine will present an illustrated historical sketch of the first three-wire Edison plant at Sunbury, Pa. If time permits this matter will also be taken up at the New York meeting. To comply with the rules governing the election of officers, the January issue of the Transactions will be held until the first week in February, in order that it may include a complete list of members revised up to that date. Changes of address, if sent in at once, will be in time to appear correctly in this list.

THE BUFFALO ELECTRICAL SOCIETY has secured the services of Prof. Albert L. Arey for a course of ten lectures on "Practical Electrical Engineering," to be given at the rooms of the society, in the Library Building, commencing January 19, 1895, and continuing every alternate Saturday evening, until the course is completed. Prof. Arey is a member of the New York University Extension Course, Professor of Physics in the Rochester Free Academy, and is eminently qualified to place before an audience complicated problems in the most elementary manner. The course of lectures will be of a practical nature, particularly suited to those who have a knowledge of the rudimentary principles of electricity, and is as follows: 1. "How to Produce Electrical Pressure;" 2. "The Electric Circuit and the Effects of the Current;" 3. "The Electro Magnet and its Applications;" 4. "Theory of the Dynamo;" 5. "Elements of Dynamo Design;" 6. "Faults and Ailments of Dynamos, and How to Detect and Remedy Them;" 7. "Alternators and Apparatus for Alternating Circuits;" 8. "Motors and the Transmission of Power;" 9. "Installation Equipments and Methods of Distribution;" 10. "Storage Batteries and Chemical Work." Prof. Arey will illustrate his lectures with a very complete outfit of experimental apparatus. Mr. Frank C. Perkins is president of the society and Mr. A. C. Terry secretary.

THE NATIONAL CONVENTION OF MANUFACTURERS.—The assembly to be held in Cincinnati on January 22, 1895, will be a convention fairly representative of the manufacturing interests of the United States, and will have for its object, in the first instance, to consider and reach conclusions on the main question; *i. e.*, that of forming a National Association of Manufacturers. The main questions to be considered are: First, expediency; second, feasibility, and third, method. After the vote is taken upon the preliminary questions, "Should such an association be formed?" and "Can such an association be formed?" it will be necessary to devote most careful deliberation to the questions "How?" and "To what end?" The preliminary inquiries issued by the Manufacturers Association, and reiterated by the Committee of Arrangements and Invitation in their very handsome and elaborate invitation and circular, are intended, in a purely tentative way to secure in advance of the meeting some general index of prevailing sentiment among manufacturers generally, upon the main question. To this main question, "Do you favor the organization of a National Association of Manufacturers?" replies thus far received are almost unanimously affirmative. Upon the second tentative inquiry, "Will you be present or represented?" the affirmative vote is so largely in the majority as to promise a representative gathering. Answers to the third inquiry, which calls for names of those who will come, display a roster which affords assurance that whatever action is taken by the Convention will be wise and deliberate.

Trade and Industrial Notes.

A CORRECTION.—In the advertisement of the Geo. L. Colgate Co., 136 L[illegible] St., in our last issue the offer of 22 c p lamps at 25 cents should have read [illegible]2 c p lamps.

THE ANSONIA ELECTRIC COMPANY, by permission of the Court to Receiver Cha. S. Merrick, will be sold. Bids will be received sealed, and to be opened the first Monday in February.

THE METROPOLITAN ELECTRIC COMPANY, 186-188 Fifth Ave., Chicago, has recently been making some changes in its store and has put in some new counters and shelving, thus adding to its attractiveness and furnishing better facilities for the display of its increased line of goods.

MR. FRANK STEWART, dealer in electrical supplies, Philadelphia, has moved from 41 to 20 North Seventh street, where he will carry on a general electrical supply business on a more extensive scale; having now a large place and better facilities he is enabled to carry a full line of all supplies.

THE PHOENIX CARBON MFG. CO, 2,134 De Kalb St., St. Louis, reports that it is now fully equippped and its works are running at their full capacity. Its orders are coming in satisfactorily, and the company guarantees satisfaction and prompt attention to all its customers. This company is outside of the carbon trust.

HENRY R. WORTHINGTON has installed an hydraulic plant at the National Carbon Company's Works, in Cleveland, consisting of two compound pressure pumps and two steam accumulators. The pressure carried is 4,850 pounds per square inch and the action of the steam accumulators under this pressure is remarkably smooth and easy and in marked contrast to the varying pressure of a weighted accumulator.

THE GARLOCK PACKING COMPANY, of Palmyra, N. Y., has recently established a New England branch, with offices and salesrooms at 12 Pearl street, Boston, Mass. Mr. John D. Lane, for many years special traveling salesman of the company, has been appointed general manager of the New England branch.

THE ACTON VALVE AND STEAM SPECIALTY COMPANY, No. 79 Washington street, Brooklyn, has just issued a catalogue of its steam and water specialties. Among other specialties illustrated and described is the Acton Regulating Valve, which has been entering so largely into use in connection with electrical plants.

THE ELECTRIC APPLIANCE COMPANY, Chicago, claims to have something entirely original in an advertising novelty which is something that every electric light man in the country has been in need of ever since he went into business, but an article which the market has failed to supply. The "cat will be let out of the bag" at the Convention of the Northwestern Electrical Association, at Milwaukee, on the 16th.

MR. JOHN S. PUGH, Eastern representative of the Barner & Dutton Company, manufacturers of street car trucks, Cleveland, Ohio, reports having done an excellent business during his last trip through the States of New York and Pennsylvania. The company has also booked an order from the Cleveland Street Railway Company for seventy-five trucks, and one for seventy trucks from the Detroit, Mich., Street Railway Company.

THE WASHINGTON CARBON COMPANY, of Pittsburg, Pa., has recently booked some large orders for its new cored carbons. The testimonials received from users of these carbons are exceedingly flattering, and the inquiries which are being continually received are indicative of a big business for 1895. This company has issued a very neat little blotter with celluloid facing upon which appears a scale for measuring carbons, showing the relation of millimetres to inches.

MR. D. M. STEWARD, of the D. M. Steward Mfg. Company, makers of lava insulators, Chattanooga, Tenn., at a recent meeting of the Chattanooga Chamber of Commerce, delivered one of the leading addresses, responding to the toast of "Our Manufacturing Interests." In the course of his address he referred in highly complimentary words to the influence of the press. Newspapers, he said, are in a sense also manufacturers, as expert mechanical knowledge is indispensable to a paper's successful production of a paper of correct proportions, clear legible printing and a pleasing makeup.

THE FOSTER ENGINEERING COMPANY, of Newark, N. J., reports a rapidly increasing demand for its new "Class W" steam pressure regulators. Among orders just booked for large valves it mentions one 10-in. for the Lehigh Valley R.R. Co.'s coal mines; three 8-in. and one 5-in. for the Watts-Campbell M'f'g. Co., for use at the Newark Electric Light and Power station; one 6-in. for the U Street Pumping Station, Washington, D. C.; one 5-in. for Dixon's Paper Mills, and two 6-in and two 4-in. for the new American Liner "St. Louis." These latter are in addition to twenty regulators from 8-in. to 4-in. furnished for that ship in December.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., is building the new car barn for the Lehigh Traction Company at Hazelton, Pa. The same company has a contract for the new Power House for the Keene Gas Co., at Keene, N. H. The new power station for the United Electric light & Power Co., on West 28th Street, New York, is now being put in place by the same company. This will be a model station and one of the most complete and perfect in the Eastern States. The engine and dynamo room is 100 feet square, and the boiler room 60x100 ft. The roof covering on the dynamo room is to be of anti-condensation corrugated iron. The coal pockets in the boiler room will have a storage capacity of 3,000 tons of coal.

Business Notices

WOVEN WIRE BRUSHES.—The Belknap Motor Company, of Portland, Me., are the patentees and manufacturers of the best woven wire commutator brush on the market.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

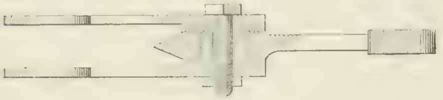
UNITED STATES PATENTS ISSUED JANUARY 8, 1895

In charge of Wm. A. Rosenbaum, 177 Times Building, New York.

532,031. SELF ADJUSTING TROLLEY; J. [illegible], Harrisburg, Pa. Application filed August 29, 1894. This comprises two shells having recesses to receive the standard, a standard with stops thereon, and a pin on one of the shells between the stops.

532,095. ELECTRIC ARC LAMP; A. W. Richardson, Patricroft, England. Application filed March 2, 1894. The combination with a hollow tube, through which the carbon passes, of a tube provided with a shoulder, runners, prongs or fingers and a clutch box.

532,101. INSULATOR FOR ELECTRIC WIRES; D. M. Rothenberger, Lancaster, Pa. Application filed April 4, 1894. In an insulator, a cap covering the connection between the insulator and the wire.



No. 532,168.—Trolley Wire Clamp.

532,103. ELECTRIC LAMP SUPPORT; F. Schefold and J. Northney, New Albany, Ind. Application filed March 1, 1894. This comprises a support and pivoted counter weight, of a tapered guide, and a lug upon the hook adapted to actuate the guide.

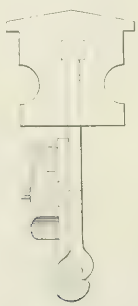
532,104. CONDUCTOR SUPPORTER; J. C. Love, Chicago, Ill. Application filed May 9, 1894. This comprises two clamping plates, one apertured and the other having a loop projecting through the apertured plate, and a wedge key driven through the loop, and engaging the outer face of the apertured plate to force the plates towards each other.

532,113. CONVERTER SYSTEM FOR ELECTRIC RAILWAYS; G. W. Swartz, Florence, Ala. Application filed October 12, 1893. This comprises a switch having an electro-magnet traversed by the secondary circuit when closed and the armature of which constitutes the movable switch member, whereby the secondary coil and coil of the switch magnet are in series.

532,126. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS; A. G. Wheeler, Chicago, Ill. Application filed January 21, 1893. This comprises two sectional supply conductors, one for each track of a two track railway, the ends of the sections of one conductor being connected with the ends of the adjacent sections of the other conductor to maintain an equilibrium of the supply current to the motors connected with the two sectional conductors.

532,133. TROLLEY WIRE CLIP; J. M. Anderson, Boston, Mass. Application filed July 9, 1894. This comprises an "ear," and clip secured thereto, an arm secured to the ear, and means to engage the arm with the trolley wire.

532,142. AUTOMATIC SAFETY ATTACHMENT FOR GAS BURNERS; H. H. Cummings, Malden, Mass. Application filed January 19, 1894. This comprises a gas burner and its cock, a retarded electric circuit closer made operative by the opening of the cock, and a heat actuated device, whereby the operation of the circuit closer is nullified when the gas is burning.



No. 532,160.—Insulator.

532,157. UNDERGROUND TROLLEY ARM; P. C. Just, Chicago, Ill. Application filed January 4, 1894. This comprises a conductor and a flat supporting bar, having recesses at its side edges, and blocks inserted in the recesses, and adapted for contact with the sides of the conduit-slot.

532,160. INSULATOR; M. D. Law, Washington, D. C. Application filed August 29, 1893. This comprises a central link provided at one end with a chamber, side links, a coupling bolt, and insulating material within the chamber of the central link, and provided centrally with an aperture of greater diameter than the coupling bolt. (See illustration.)

532,161. CONDUCTOR; M. D. Law, Washington, D. C. Application filed September 22, 1894. This comprises a conduit, a conductor, supports for same, and blocks of insulating material secured to the conductor between the supports to prevent contact of the same with the wall of the conduit.

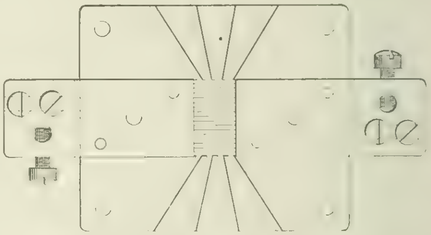
532,165. CONDUIT FOR ELECTRIC RAILWAYS; J. C. Love, Chicago, Ill. Application filed May 9, 1894. This comprises yokes, and a supplementary conduit pipe, comprising integral tubular sections on the yokes, and longitudinally divided pipe sections engaging the sleeves.

532,166. TENSION DEVICE FOR ELECTRIC CONDUCTORS; J. C. Love, Chicago, Ill. Application filed May 9, 1894. A telescoping connection between the sections of an electric conductor, comprising an insulating plate, sleeves attached thereto to receive the ends of the conductor sections, and a revoluble disc mounted on the insulating plate with its periphery engaging the inner ends of the sleeves, the disc being provided with conducting and non-conducting parts.

532,167. ELECTRIC RAILWAY TROLLEY; J. C. Love, Chicago, Ill. Application filed May 9, 1894. An arm comprising a short and a long section, the long section carrying the contact device, and pivoted to the short section, an arm rigidly secured to the short section, and a spring attached to the latter arm for lifting the contact device.

532,168. TROLLEY WIRE CLAMP; J. C. Love, Chicago, Ill. Application filed July 11, 1892. This consists of two flat plates having flanges to engage grooves in the wire, and a screw threaded stud arranged to secure the plates together. (See illustration.)

532,185. CONDUCTOR BOND FOR MEETING ENDS OF RAILS OF ELECTRIC RAILWAYS; R. Reith, Chicago, Ill. Application filed June 14, 1894. A given length of conducting material, a plurality of perforated contact studs projecting therefrom, thimbles within the studs, perforations in the meeting ends of the rails, and means for upsetting the metal of the studs within the perforations of the rail.



No. 532,353.—Lightning Arrester.

532,195. TROLLEY SUPPORT; L. T. Gibbs, Milwaukee, Wis. Application filed July 28, 1893. This comprises a stand on the car provided at its front and rear only with transverse bearing surfaces, a base adapted to receive the pole, and formed at its ends to be sustained by the bearing surfaces, and to rock thereon back and forth and laterally, and means tending to hold the base yieldingly in an upright position.

532,200. TROLLEYS OR ELECTRIC RAILWAYS; J. C. Henry, Westfield, N. J. Application filed September 27, 1889. This comprises a flat ribbon overhead conductor, a contact trolley pendent therefrom, wear plates running on top of the conductors, and lubricators carried by the wear plates.

532,261. CONDUIT ELECTRIC RAILWAY; A. M. Burgher, Clay City, Kentucky. Application filed April 17, 1894. This comprises a trolley arm, a vertically movable spring cushioned hub thereon, and a trolley wheel journaled on the hub.

532,302. CLOSED CONDUIT FOR ELECTRIC RAILWAYS; F. Windle, Philadelphia, Pa. Application filed March 8, 1894. This comprises spring plates extending beneath the slot of the conduit, and a trolley for depressing the plates.

532,328. INSULATED PIPE JOINT; M. J. Locke, Philadelphia, Pa. Application filed June 6, 1894. This comprises blocks adapted to receive the pipes, insulating material between the blocks and straps for confining the blocks together and to the insulating material.

532,353. LIGHTNING ARRESTER; A. Wurts, Philadelphia, Pa. Application filed February 28, 1894. This comprises a pair of insulating plates, a pair of sparkling terminals and an interposed discharge wedge, one or both of the blocks having a plurality of grooves extending outward laterally from the wedge. (See illustration.)

532,354. LIGHTNING ARRESTER; A. J. Wurts, Philadelphia, Pa. Application filed August 3, 1894. This comprises a pair of sparkling terminals, and an interposed discharge wedge formed in a body of fibrous material, the fibers of which extend in a direction transverse to the static discharge.

532,391. ELECTRIC LAMP SUPPORT; J. Northey, New Albany, Ind. and F. Schefold, Parkersburg West Va. Application filed October 18, 1892. The combination with a lamp, of hooks pivotally secured thereto and locking mechanism for temporarily holding the hook in a fixed position.

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THE FRANKFORT-ON-THE-MAIN MUNICIPAL PLANT.

We print elsewhere an article on the new Frankfort municipal plant, from the pen of the constructing engineer, Herr Melms, which admirably presents the various engineering features of this fine installation. The most noteworthy points refer to the system of distribution, and the method of installing the conductors. As will be seen, the distributing cables are merely laid on a bed of sand in trenches under the sidewalks, and the transformer stations are placed in pits below the level of the streets. An interesting feature in connection with the pits is the provision made for ventilation, which is maintained through the heat generated by the transformers. The installation in all of its parts is alike creditable to the engineers who are responsible for its design, and to those who put it in execution, and presents many points well worthy of careful study by Americans, particularly on account of the entirely different practice involved from that followed in this country.

THE NORTHWESTERN ELECTRICAL ASSOCIATION.

The convention of the Northwestern Electrical Association, held at Milwaukee last week, was another success scored for this vigorous organization. While the papers read did not, as a whole, equal the merit of those presented at the previous meeting, this was largely compensated for by the value of, and the interest taken in, the discussions. The commercial feature was again a notable one; by far the greatest value of the meeting of bodies of this character lies, perhaps, aside from the opportunity furnished to the members of comparing notes, in the occasion thus offered of becoming better acquainted with the latest advances in electrical manufactures. The advocacy of gas over the electric light in such a meeting was a decided novelty, but a good end will be served if the result of the discussion tends to cause the members to bring more forcibly before the public the incontestable superiority of the electric light over gas as an illuminant, basing their arguments more largely upon its merit in this respect, and leads them to pay more attention to the inadvisability of allowing lamps to be used beyond an age when their lighting efficiency has begun to materially decrease. The paper of Mr. Cole again brings out the absurdity of charging for the electric light by "flat" instead of meter rates; the former method has been so uniformly found to be disadvantageous, that it is surprising that some stations still adhere to it, particularly as experience has shown that the fear of loss of business through a change to meter rates is largely a chimerical one.

STORAGE BATTERIES IN POWER AND CENTRAL STATION WORK.

The paper read by Mr. G. Herbert Condict before the Northwestern Electrical Association, and printed elsewhere in this issue, brings out strikingly the services that may be rendered by storage batteries in connection with railway and lighting work. In the present instance an eminently unsatisfactory lighting and railway service was, by the aid of a storage battery, so improved as to render it not only entirely acceptable thenceforth to the public, but also, apparently, a source of greatly increased income to the operating company. It is true that the conditions were here exceptionally favorable to the employment of the storage battery, and that it is not probable there are many plants in existence so utterly bad in design that its aid will accomplish similarly great results. Nevertheless, the main principles that rendered its employment profitable in this instance exist to a greater or less extent in plants of good design; as, for example, the possibility, through its use of securing good regulation, and, above all, enabling the generating machinery to be operated at its greatest efficiency. At the present day, when the machinery of a generating station reaches the limit of its capacity at the time of heavy load, the owners should not even consider the advisability of purchasing additional machinery until they have thoroughly investigated the question if the required capacity might not be much better procured through the addition of a storage battery. In laying out a new station it would now also be advisable to always take into consideration, among other designs, one including a storage battery, and then make a comparison between the different designs based upon both first cost and operation.

CHANGES IN THE HYSTERETIC QUALITIES OF IRON.

The columns of our English contemporary, *The Electrician*, have recently contained a number of articles on the question of the changes of the hysteretic quality of iron in transformers, attention being first directed to the subject by Mr. Partridge. Prof. Fleming, in a communication in a succeeding issue, advised caution in regard to accepting any hypothesis that transformer losses invariably increase with time. In the same number Mr. O. T. Blathy states that the fact of an increase of iron losses in transformers with time has been well recognized by manufacturers of transformers for years. Mr. Mordey throws the first full light on the subject, and states positively that the effect referred to is not fatigue of the iron caused by repeated magnetic reversals, but is due to a physical change resulting from long continued heating at a very moderate temperature, and is similar to that resulting through hammering, rolling or by heating to redness and cooling quickly. While the increase thus produced may be as high as 40 per cent., Mr. Mordey calls attention to the fact that this may amount to less than .4 per cent. decrease in the total efficiency of a transformer. In the current issue of the same journal Prof. Ewing gives the result of experiments showing that no change in the hysteretic quality of iron is produced by molecular fatigue through the material being subjected to long continued reversals, if the temperature of the iron experimented with is not permitted to appreciably increase. The conclusion to be drawn from this interesting discussion is that a very notable change in the hysteretic qualities of the iron of transformers does occur in practical use, but that this change is to be ascribed entirely to the effect on the iron of an increased temperature, and not to a molecular fatigue of the metal through the continued reversals of its magnetism.

NEW UNDERWRITERS' RULES.

The amendments made at the recent meeting of the Underwriters' National Electric Association to its code of insurance rules, which are referred to in detail elsewhere, are of considerable interest. One of the most important changes made is in regard to the allowable carrying capacity of conductors, which is increased for concealed work, and a new table added for open-work conductors. As the object to be attained in prescribing the limit of current for conductors of various sizes is to fix the limit of increase of temperature, it was manifestly absurd to class together confined conductors and those so exposed as to be under much more favorable conditions as regards the influence of cooling. As will be seen, the increase in the table for concealed work is considerable, that for No. 4 wire for instance, being increased from 50 to 63 amperes, and 92 amperes being allowed in open work with the same wire. It would be interesting to know upon what authority or experiments these changes are based. While we can see no doubt as to their advisability, yet we think it due to the electrical profession and in the interest of harmony, that any notable changes made in the rules affecting the electrical industry, whether favorable or unfavorable, should be accompanied by the underlying reasons for the same. Several of the other rules have been made more liberal and all of the amendments give evidence of the competency of the gentlemen comprising the National Electric Association to deal with the questions coming within their province. An exception might be made in regard to the advisability of the prohibition in wiring of hard rubber for bushings, though even here, with modern methods of work, little or no hardship will result. While it is well for the association to take up the question of high potentials, they also did well to defer any action in the matter until the occasion arises. In Europe much harm has been done to the electrical industry through the formulation of rules based upon *a priori* considerations, and while the reverse method pursued in this country may at times have had unfavorable results, yet the wisdom of following and not preceding practice has been overwhelmingly established.

THE ELIHU THOMSON PRIZES.

The American electrical public has every reason to be gratified with the history of the Elihu Thomson prizes, recently awarded in Paris. The graceful act of Prof. Thomson in setting aside the 5,000 francs awarded to him in the international wattmeter competition, as a prize for a paper on theoretical electrical research, was a recognition of pure science that is only too rare on the part of those whose principal work has been in the practical branches, though in this case the donor is by no means a stranger in the former field. The generous addition of a second prize of 5,000 francs to be awarded to another paper commended by the committee of scientists having the matter in charge, was a further gage of the sincerity of Prof. Thomson's interest in the higher realms of electrical thought. The public confession thus made by Prof. Thomson of his devotion to the advancement of pure electrical science merely reveals to a wider circle what was previously known of the man and his work by those who had followed his career. In this connection we may state that a very eminent European savant, in reply to a question as to whom among Americans he ranked with the distinguished savants of Europe, named Elihu Thomson as one, the other three being Newcomb, Michelson and Rowland; he further remarked that while the work of Thomson had been principally confined to the practical field, yet when he did take up questions of pure science he showed a grasp of principles, a breadth of mind, and an originality of thought that easily ranked him with the class referred to. Another subject of congratulation in this connection is the fact that the prize in this international competition was carried off by an American, Dr. Webster of Clark University, and it is rather suggestive that the second prize was also awarded to an English speaking scientist, Prof. Oliver J. Lodge.

The Brooklyn Trolley Strike.

As we go to press the Brooklyn trolley strike does not seem any nearer a conclusion than at the beginning. The leading roads positively refuse to entertain any propositions from the strikers, and the latter persist in their opposition to the running of cars, and have finally induced the linemen to strike, thus still further complicating the situation. The companies affected have, through the aid of the police and the presence of the militia, the latter numbering over 7,000, been able to run some of their cars, but much difficulty seems to have been met in obtaining competent men, notwithstanding the protection offered. Considerable damage has been done by the strikers to the cars and lines, many wires having been cut during the nights. Much comment has been caused by the inability of the companies to run their cars with the protection afforded by the police and militia, and those favoring the strikers have advocated the city authorities taking charge of the roads in consequence. President Norton, of the Atlantic Avenue road, states that the situation is at present becoming more favorable, and he expects within a few days to have all of his cars running. One of the New York dailies editorially maintains, however, that the companies have been able to procure only 500 men to take the places of 5,000 strikers.

The National Electric Light Association.

The Trunk Line Association has granted a rate of a fare and a third for the round trip, on the certificate plan, for members and delegates attending the Convention of the National Electric Light Association, to be held in Cleveland, O., February 19, 20 and 21. Negotiations are now pending for a special train from New York to Cleveland, notice of which will be given as soon as the route is selected and schedule arranged.

Municipal Electric Lighting in Massachusetts.

The report for 1894 of the Gas and Electric Light Commissioners of the State of Massachusetts states that there are now municipal electric lighting plants in Braintree, Danvers, Hingham, Hull, Marblehead, Middleboro, Needham, North Attleboro, Peabody, Reading, Wakefield and Wellesley. Of these Middleboro and Wakefield have only plants for supplying both gas and electricity. The others supply only electricity. Danvers, Needham and Wellesley do no commercial business, and the two last named purchase from private companies.

The Meeting of the American Institute of Electrical Engineers.

The 93d meeting of the Institute was held on Wednesday evening. January 16, with President Houston in the chair.

Prof. Alexander Macfarlane read a paper on "The Units of Light and Radiation," in which, after discussing the various propositions put forth in this connection, several suggestions are made in regard to nomenclature. Prof. Macfarlane states that the difficulty that exists in expressing the unit of candle or other spherical source arises from the want of a name for the unit of solid angle, and for this he proposes a new word, *steradian*. In the paper nine different ideas are distinguished in connection with the general subject of radiation; six of these are the same as those recently advanced by Prof. Blondel, the additions being the introduction of an idea for the strength of the source of light, the intensity of a cylindrical source, and the intensity of a plane source.

Prof. Macfarlane criticises the use of the heavy Gothic symbols proposed by M. Hospitalier for a system of light units; in the system of symbols and abbreviations recommended by the Chicago Congress, he says all quantities are denoted by oblique or script letters, and the units and abbreviations for units by perpendicular letters. The proposed symbols, from their perpendicular character, will not harmonize with the other symbols of quantity, and they are besides already used to denote vector quantities. The discussion which followed was participated in by Messrs. Kennelly, Walcott and Burnett, and it was finally voted to refer the paper to the Committee on Units and Standards for consideration.

A paper was then read by Alton D Adams, on the "Best Material for Field Magnet Frames," which is reprinted elsewhere. Part in the discussion which followed was taken by Messrs. Crocker, Sheldon, Burke, Waldo, Rich, Fleming, W. L. Bliss and Gano S. Dunn. The consensus of opinion was that wrought iron did not have the advantages over cast steel for use in magnet frames that was claimed by the author.

Electrical Patent Record of the Past Year.

BY C. W. SWOOPE.

The volume of business transacted at the Patent Office seems to vary directly with the financial condition of the country, and may, therefore, be considered as a fair indication of its prosperity. The number of patents issued by the Patent Office up to January, 1895, was 531,618, of which nearly 20,000 were issued in 1894, as compared with 22,000 for the preceding year, or 162,000 for the five preceding years.

During the past year 1,600 patents, or 8 per cent. of the whole number issued, were for electrical inventions, which is 1,000 less than the preceding year, although the percentage in the former is as great, notwithstanding the corresponding decrease; thus really indicating an increase over 1893. To illustrate the distribution of patents over the electrical field as well as to indicate the amount of attention being bestowed upon any particular subject, the following statistics have been carefully compiled from the "Illustrated Record of Electrical Patents," as published each week by THE ELECTRICAL WORLD:

Electric Traction.		
Electric railway systems and conduits	102	
Trolley and car appliances	113	
Electric locomotives	18	
	——	233
Dynamos and parts thereof		110
Motors and parts thereof		76
Regulators and current controlling apparatus		139
Transformers		23
Cut-outs and circuit breakers		33
Arc lamps		82
Incandescent lamps		33
Systems of electrical distribution		45
Switchboards		21
Switches		65
Wires, cables and conduits		44
Insulators and insulation		52
Electric measuring instruments, meters, indicators, etc		66
Telephones		97
Telegraph		43
Signal systems		110
Bells, annunciators, gas lighting, clocks, etc		103
Batteries—		
Primary	39	
Secondary	34	
	——	73
Electric heating and appliances		25
Electric welding		7
Electric mining		12
Medical apparatus		11
Cranes, hoists, etc		23
Miscellaneous		89
Total		1,615

Electric traction claims the greatest share of attention from inventors; of these patents only 3 per cent. were issued to foreign residents as compared with 9 per cent. the previous year.*

Current regulating and controlling devices, as well as signal systems, appear to be engaging particular attention. Of the whole number of patents granted during the year only 6 per cent. were issued to foreign residents.

The Elihu Thomson Prize in France.

It will be remembered by our readers that the Thomson wattmeter was awarded a first prize of 5,000 francs in the international competition of wattmeters held in Paris, France, several years ago, and that Prof. Elihu Thomson very generously set this amount aside to be offered as a prize to the best paper submitted dealing with a theoretical question connected with electrical science.

Four papers were submitted in the competition thus opened, one written in German, another in French, and two in English. A committee of distinguished French scientists and electricians, which included Mascart and Hospitalier, were named to award the prize. They reported that one of the papers, that in German, did not conform with the terms of the programme, and that a second, written in French, on dielectric hysteresis, while containing some very interesting matter, did not throw any new light on the subject. The third and fourth papers are on electrical oscillations, and the one to which the prize was awarded is entitled, "An Experimental Determination of the Period of Electric Oscillations," written by Dr. A. Webster, of Clark University, Worcester, Mass. The committee reported that the subject of oscillations in this paper is presented after a method new in its details, which permitted the author to measure periods of some hundred thousandths to the second; and that the influence of the principal cause of errors seems very slight, although there remain some doubts as to the inherent capacity of the self-inductance coil used

The final conclusions of the committee are as follows: "The committee consider that paper No. 4 (by Dr. Webster) is worthy to receive the prize established by Professor Thomson, and hope that this award will encourage the author to continue his excellent researches. The committee regret, however, not having at their disposal a second prize of equal value which they could grant to the author of paper No. 3." The paper thus referred to is by Dr. Oliver J. Lodge, and is devoted to a verification of the formula giving the period of oscillatory discharges of a condenser; this is pronounced by the committee an extensive study, in which the author has sought by means of elaborate calculations to evaluate all the inherent corrections necessary in the employment of the method.

Professor Elihu Thomson very generously met the wishes of the committee in this respect, and placed at their disposal a second sum of 5,000 francs, which was then awarded to Dr. Lodge.

New Underwriters' Rules.

At the recent meeting of the Underwriters' National Electric Association a number of changes were made in the rules of that association. The rule relating to lightning arresters has an addition to the effect that the wires for the two separate earths required must be run as nearly as possible in a straight line from the arresters to the earth connection. The rule relating to motors has been changed so that single pole switches may be used on motors of ¼ hp or less on low tension circuits. The rules relating to interior wiring are altered so as to no longer permit the use of hard rubber tubing for bushings, and to prohibit the use of snap switches on high potential circuits. A new section is added to the rules covering the use of arc lamps, requiring that where hanger boards are not used lamps must be hung on insulated supports other than their conductors. A new section is also added to the general rules for inside wiring requiring that conductors must be so spliced or joined as to be both mechanically and electrically secure without solder; after which they may be soldered to insure preservation and covered with an insulation equal to that on the conductors.

A special rule for inside wiring has been added, specifying that when from the nature of the case it is impossible to place insulated wire in non-combustible supports of glass or porcelain, the wires may be fished on the loop system if enclosed throughout in approved continuous flexible tubing or conduit. The section relating to double pole safety cut-outs is amended so as to require only the maximum safe carrying capacity to be stamped on them, and not also the carrying capacity at which they are to be used. A new rule has been added prohibiting the use of series incandescent lamps for decorative purposes inside of buildings.

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* See THE ELECTRICAL WORLD, February 3, 1894.

A resolution was passed requiring each inspector to make tests within his territory in regard to the subject of electrolysis of underground pipes from trolley currents. Another resolution was passed calling the attention of the various underwriters' organizations and of companies maintaining overhead wires to the necessity for the enforcement of the rule in regard to the testing of wiring of buildings as to their freedom from grounds and compliance with Rule 44 in regard to the insulation resistance of installations.

The question of transformers was considered with respect to limiting the potential of the primary wires, and the advisability of requiring step-down transformers for this purpose; the matter was referred to a sub-committee for report.

The grounded neutral of the three-wire system is the subject of another resolution in which it is declared that the practice of grounding the Edison tube system is a constant menace to the properties lighted thereby, and the practice followed by some Edison stations of blowing out or burning out grounds occurring either on the positive or negative sides of the underground system is pronounced extremely dangerous, and evincing a wanton disregard for the safety of property interests.

In the report of the meeting attention is called to the rule adopted at Chicago in regard to high and low potential systems. This specifies that any circuit attached to a source of over 300 volts difference of potential between any two wires shall be considered as a high potential circuit, and coming under that class, unless an improved transformer device is used which cuts the potential difference down to less than 300 volts. This requires that the systems coming under the above description should be installed under the rules for series arc systems, and it applies to three or five-wire systems with a greater difference of potential than 300 volts.

The rule in regard to the carrying capacity of wires is amended, and the following two tables substituted for the single table heretofore given:

	TABLE A Concealed Work.	TABLE B. Open Work.
B. & S. G.	Amperes.	Amperes.
0000	218	312
000	181	262
00	150	220
0	125	185
1	105	156
2	88	131
3	75	110
4	63	92
5	53	77
6	45	65
8	33	46
10	25	32
12	17	23
14	12	16
16	6	8
18	3	5

By open work is meant a construction which permits of all parts of the surface of insulating covering of wire being surrounded by free air. The carrying capacity of 16 and 18 wires is given, but no smaller wire than 14 is to be used except in interior conduits and in fixture work.

The Best Metal for Field Magnet Frames.*

BY ALTON D. ADAMS.

Cast iron, cast steel and wrought iron being the materials at our command for field magnet construction, it is an important question to the engineer and manufacturer which will produce a dynamo of given capacity, speed, efficiency and working qualities at the least cost.

I am not aware that any of the works on dynamo construction attempt a definite answer to this question, and the practice of builders is by no means uniform. Economical points of saturation requiring about the same magnetizing force per unit of length in each metal, are for cast iron a little under 40,000, cast-steel 70,000 to 80,000, and wrought iron about 90,000 lines per square inch.

The cost of cast steel is fully equal to that of forgings in simple shapes, and as it lies between cast and wrought iron in magnetic qualities, the cost of machines made with it will be between those of cast and wrought iron. A comparison will, therefore, be made between the cost of the latter two.

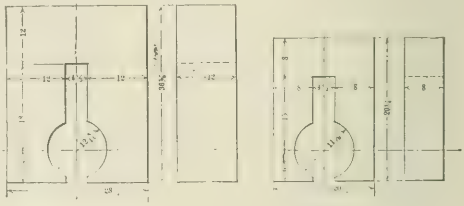
To be fairly compared, machines of different materials must be equal as to magnetic flux in field and armature cores, ampere-turns on armatures, field ampere-turns required in air gaps and as nearly as possible in magnet frames, watts used in windings, and be of the same capacities and speeds.

Taking wrought iron at a saturation of 90,000 and cast at 40,000 lines per square inch, the section of an equivalent cast will be two and one-quarter times that of wrought frame, and as the length of the cast-iron frame must be a little greater to give enough winding length, its weight will be about two and one-half times the wrought. A saving is thus at once made in favor of the wrought magnet, as forgings can be had per pound for much less than two and one-half times the cost of cast iron.

The same number of ampere turns and watts being required for the coils of the cast as the wrought iron magnet, and the weight of wire varying as the square of its length, the coils for the cast-iron frame will be much heavier. The armature core may have the same diameter in each frame, but must be longer in the cast frame so as to come under the pole pieces, thus materially increasing its weight.

As for the same resistance, the weight of armature winding increases as the square of its length, considerable more wire is required for the armature core of the cast-iron machine. In addition, the purely mechanical parts, shaft and base must be larger and more costly in the cast-iron machine because of the greater weights they have to carry.

To illustrate the difference in cost of construction, the following data of two machines is presented, each having capacity of 25 kw of 1,275 revolutions per minute, the same winding losses, the same ampere turns on armatures and field ampere turns in air gaps equal to about twice the armature ampere turns active at the pole corners.



FIELD MAGNET FRAMES.

The air gaps and armature cores of each machine are crossed by 4,320,000 webers, and allowing a leakage of 5 per cent. the field core must furnish 5,760,000 webers.

A wrought-iron field to carry 5,760,000 webers, at 90,000 per inch saturation, requires a section of 64 square inches, which is provided by a core of 8 inches square and a cast-iron field at 40,000 lines per square inch requires a section of 144 square inches provided by a core 12 inches square.

Allowing sufficient length for magnet windings the same air gap resistance and an armature core of 11 inches diameter for each of these frames, their dimensions will correspond to the following drawings:

The weights of these frames are

Wrought-iron frame	1,020 lbs.
Cast-iron frame	2,730 "

For work as shunt motors the wrought-iron machine requires 11,000 ampere turns in the air gaps and 2,000 in iron, the cast machine 11,000 ampere turns in air gaps and 3,800 in iron.

With 440 watts expended in field coils of each machine, an average length per turn of 38 inches in the coils for wrought iron and 54 inches in the coils for cast iron, the weights of these coils are

Wrought-iron machine	133 lbs. copper.
Cast-iron machine	340 " "

The drum armature for the wrought frame is 11 inches diameter and 8 inches long, that for the cast frame 11 inches diameter and 12 inches long, without allowance for shaft hole.

The weights for armatures are

Wrought-iron machine	211 lbs. discs.
Cast-iron machine	316 " "

With a loss at full load of 490 watts in the armature winding for wrought-iron machine, and 464 watts in the armature winding for cast-iron machine, these windings require in

Wrought-iron machine	49 lbs. copper.
Cast-iron machine	71 " "

The above indicates plainly the great saving of wrought over cast iron in dynamo construction.

From the users' standpoint the wrought-iron machine seems preferable on account of its lesser weight and bulk, this difference being especially marked in machines for direct connection to engines, and other purposes where slow speed is necessary.

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* A paper read before the American Institute of Electrical Engineers, January 10, 1895.

The Frankfort-on-the-Main Municipal Light and Power Plant.

BY G. J. MELMS.

FRANKFORT-ON-THE-MAIN is a very old city. It was a Roman military station, an important city during the middle ages, and has become in modern times one of the rich commercial cities of continental Europe, and at present is one of the money centres of Germany. Thanks to the excellent municipal government, Frankfort has also become in the course of time one of the handsomest cities in Germany. Its wide and well paved streets, its water and sewerage systems, its modern public buildings, parks, the famous Palmen-garten, the monumental Grand Opera House, the Central Railway station, all tend to give this city a metropolitan air. But with all its modern improvements Frankfort was up to recent date without a public central lighting station.

In 1889 the city appointed Prof. Galileo Ferraris, Dr. Kittler, Director Uppenborn, Dr. H. F. Weber and Councillor W. H. Lindley (engineer of the city) to constitute a commission to give an expert opinion on the relative advantages and disadvantages of direct and alternating current systems, the commercial value thereof, the dangers of high tension currents, etc., etc., and, in general, the practical application of electricity to the arts, all with special reference to the introduction of electric light and power on a large scale for the city of Frankfort.

This commission did not, however, arrive at results to warrant the city acting, and it was not until after the Frankfort Electrical Exposition in 1891 that a second commission was appointed, consisting of Councillor W. H. Lindley and Oscar von Miller, to work out plans for the erection of a central station of sufficient size and capacity to satisfy the wants of the city for years to come.

In two voluminous reports, this commission advised the city to adopt the high tension alternating current system; after long preliminaries, and after the usual struggle between the rival manufacturing companies, the city gave the contract for the construction of the entire plant to the well-known firm of Brown, Boveri & Company, of Baden, Switzerland, whose senior member and general constructing engineer is Mr. C. E. L. Brown, the designer of the generators used for the Frankfort-Lauffen experiment. Under the contract this firm, besides constructing the plant, must also operate the same for a number of years, the profits to be divided by the city and firm, share and share alike. This arrangement is due to the fact that the city considers a purely business administration less expensive.

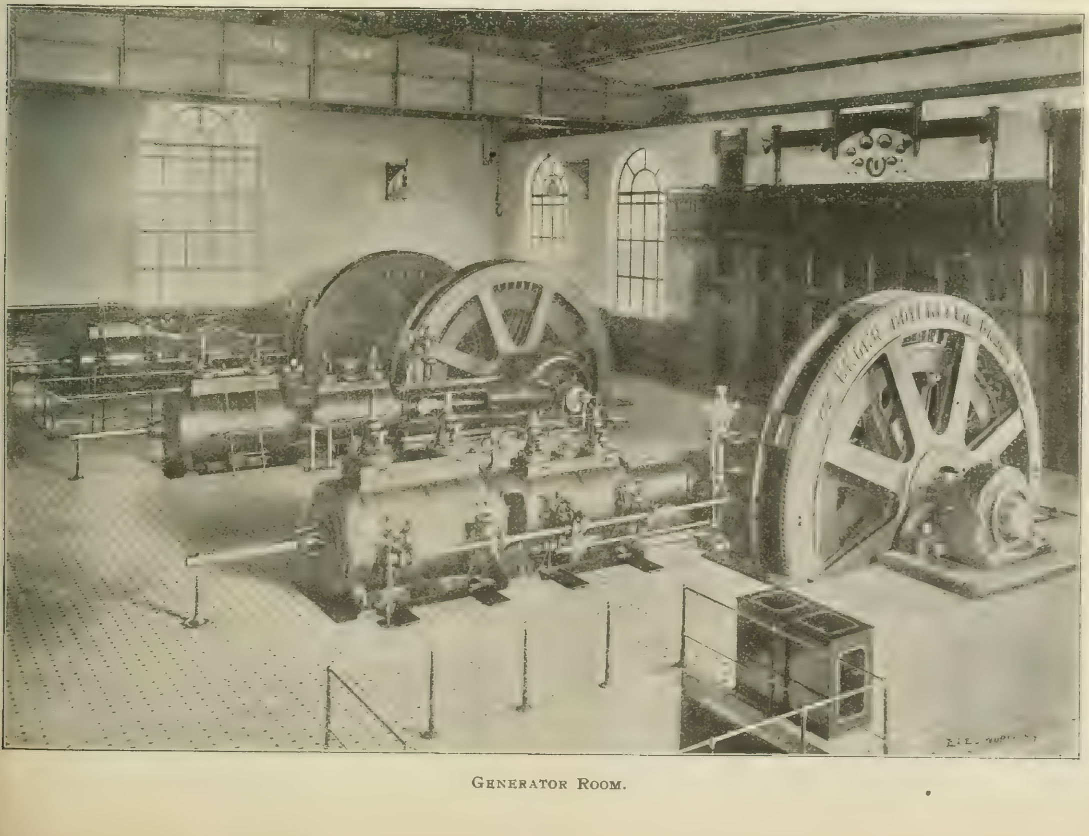
That the city decided to build a central station of the magnitude and in so thorough a manner is pre-eminently due to the unwearied efforts and efficient work of W. H. Lindley, an engineer of repute and prominence.

The station when completed will have a capacity of 10,000 hp, one-fourth of which is at present in operation. The station, the underground cable system, the transformer stations, in fact the complete installation at present in operation, will cost $535,000 including real estate.

Work was begun on the 27th of March, 1894, and on the 16th of October of the same year current was sent through the cable system, and with the exception of a few hours, regular service has been given ever since.

The Generating Station.—The power house is situated at the west end of the city, 500 feet from the river Main, from which water for condensing purposes is drawn; this position also offers an advantage, as the fuel can thereby be supplied either by water or railway. The station covers a space of 23,475 square feet; the grounds, however, are large enough to allow the present works to be quadrupled.

The building is an imposing fireproof brick structure, trimmed



Generator Room.

with red sandstone, with a frontage of 210 feet and a depth of 210 feet. The main entrance, or front projection of the building, contains offices, testing rooms, and cable switchboard and distributing room. The main building or machinery hall is a large, well-lighted hall with iron truss roof; it is 75x125 feet, and serves as dynamo and engine room. The boiler and coal storage rooms are directly adjacent to the main building, and project in the form of two wings on either side. The condensers and all the supply and exhaust pipes are in the basement conveniently located for inspection.

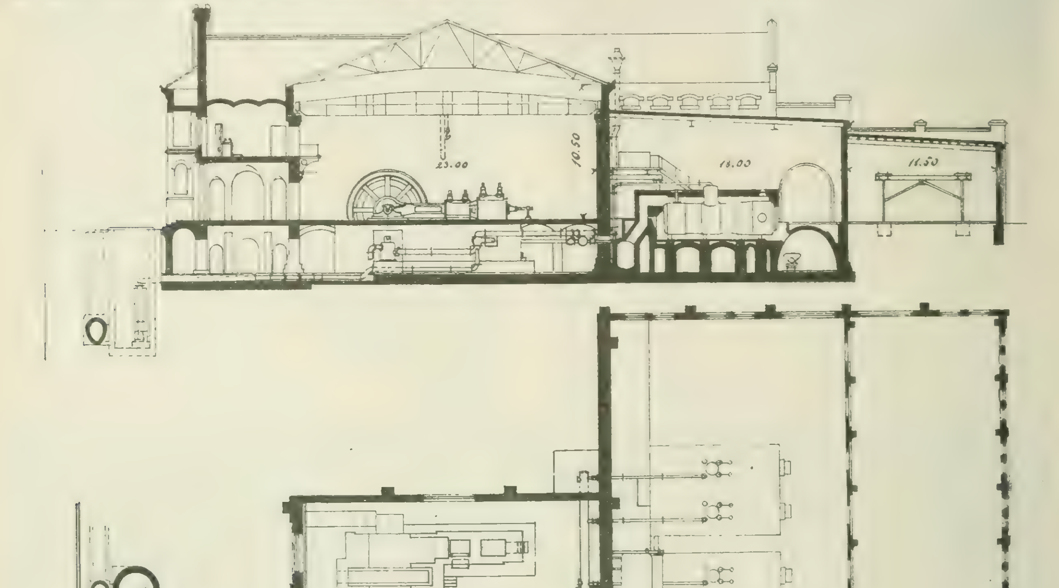
The Steam Generating Plant.—The boiler room, which is 217 feet by 59 feet, is at present equipped with eight Cornwall-Fox boilers with corrugated fire flues and cross Galloway tubes, of the following dimensions:

Heating surface	925 sq. ft.	Steam drum, length	.... 4 feet
Length	28.8 feet	Diameter	3.28 feet
Diameter, outside	8.2 feet	Total weight	........53,560 lbs.

The boilers work under 120 pounds pressure, and are walled in, in groups of two, and accessible from all sides. The furnaces are stoked by hand, and have inclined grate bars. The corrugated furnace empties into a combination chamber. The heated gases then pass underneath the boiler, turn up at the forward end, then pass along the upper outer shell into the smoke flue, directly at the rear of the boilers. The combination chamber is an excellent preventer of smoke, as it becomes hot, and the gases emptying into it ignite and thus in a great measure prevent smoke.

According to contract each boiler is to evaporate 3,300 lbs. of water per hour, under a steam pressure of 120 lbs., the feedwater temperature being 30° Celsius; under forced fires the boilers will generate up to 5.6 lbs. of dry steam per square foot of heating surface, and under all conditions not more than 1 per cent. of water may be contained in the steam.

The main smoke flue, which is subdivided into sections by means of iron doors, runs along underneath and in the rear of the boilers and empties directly into the chimney at the east end of the build-



PLAN OF STATION.

Elec. World.

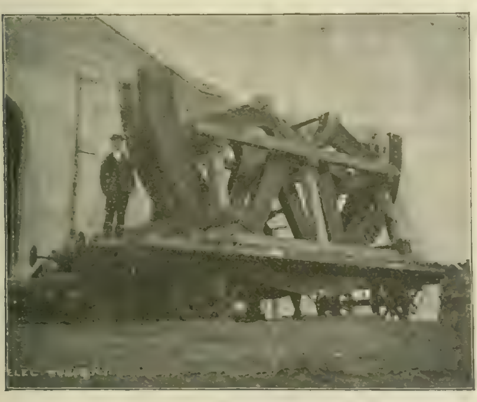
ing. This chimney has a height of 165 feet and a diameter of 10 feet.

As soon as found necessary a second chimney of the same dimensions will be built at the west end of the building. In front and below the boilers the ash pit is located, which receives the waste ashes and cinders in iron wagons.

The coal storage room has a capacity of 1,500 tons; it is traversed its entire length by an elevated track used to transport and evenly distribute the coal. An electric elevator at the west end serves as a coal hoist. Two double acting feed pumps of modern construction, each with a capacity of 5,285 gallons per hour, are located in a separate room, situated in the centre of the boiler room. A Kennedy water meter is connected to the feed pipes in such a manner that they can be cut in or out of service. Two warm water feed tanks of a capacity of 5,285 gallons are placed adjacent to the pump room, above and at the end of the boilers. The water in these tanks is heated by the exhaust steam from the pump. All feed water pipes are so arranged that any section can be cut in or out of service without interfering with the rest of the system.

Feeder Switchboard.

Two steam receivers of 24.75 inches diameter are situated in the basement of the machinery hall between the engines and boilers and are joined in the middle by a copper expansion pipe. The pipes from the boilers to the receivers, and from the receivers to the engines, are patent welded tubes; all curves or elbows leading directly to the engines are made of copper.



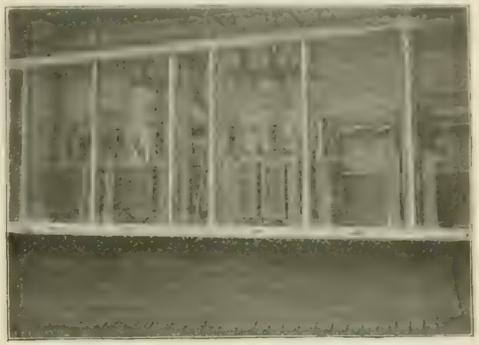
Upper Half of Armature Frame.

The steam receivers as well as the various leads can be cut out of service by properly located valves. The tubes for the injection water lead directly from the suction wells, situated in the front of the building. These wells are two metres in diameter and are three metres deeper than the lowest known level of the river Main; they are connected with the river by a two-metre tunnel. The exhaust and condensation water is led from each engine directly and independently into a receiver shaft, from which it flows into the river.

Without going into further details it will suffice to say that the piping system of this station is as perfect as modern engineering can make it, no pains, experience or money having been spared to arrive at the best results.

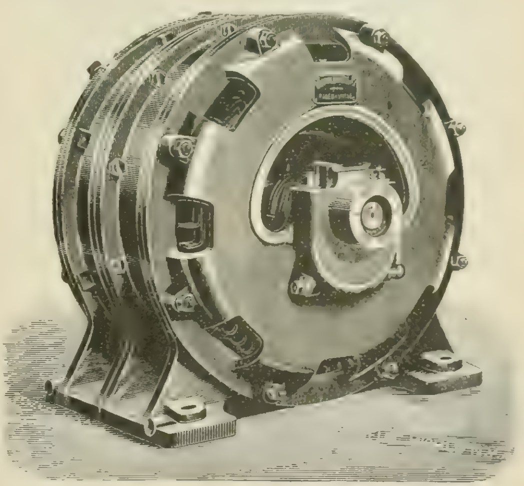
The Engines.—Three Kuhn tandem coupled engines, each of 750 hp capacity, are at present in operation. These engines are mounted on massive foundations, and have the following general dimensions: Diameter of low pressure cylinder, 37.8 in.; diameter of high pressure cylinder, 24.4 in.; stroke, 4 feet; weight of fly wheel, 53,000 lbs.; number of revolutions per minute, 85.

The bed plate is cast in one piece, with the low and high pressure cylinders coupled in tandem. The valve gear is of the well-known Kuchenbecker type; all valve mechanism is on one side of the engine, which is also fitted out with automatic lubricating, speed indicators, etc. The steam passes from the high pressure cylinders into the receiver, placed horizontally between the two cylinders and at a lower level.



Rear View of Switchboard.

From the low pressure cylinders the steam is exhausted into the condensers connected with a vertical air pump driven off the main shaft, and the condensed steam and water of condensation are discharged by the air pump into the subway described above. The engines can be operated condensing or non-condensing, and under the contract are not to use more than 15 lbs. of dry steam per horsepower-hour, excluding the condensed water in the steam pipes, under a maximum load of 750 effective hp.



Alternating Current Motor.

The Generators.—The alternators, which were furnished by the firm of Brown, Boveri & Company, are built directly on and about the fly-wheel of the steam engine. The field magnets rotate, while the armature is the fixed part of the machine. There are 64 poles, and, consequently, at the normal speed of 85 revolutions 2,720 complete alternations per minute.

The magnets are round, but with rectangular forged pole pieces, and provided with cylindrical, high-edged spools, on which are mounted the exciting coils. The electromagnets are built according to one pattern, and are, consequently, interchangeable; by loosening a single screw it is possible to remove and change any magnet with its coils. The exciting current is led to the field magnets by two collecting rings, which are each provided with two sets of brushes.

The armature, which encircles the field magnets, is carried by two cast-iron wheel-shaped frames, which rest on cast, cylindrical bearings in pillow-blocks concentric with the shaft. The armature is made in 16 similar segments, which are interchangeable, and are built up of laminated iron sheets; every part of it is easily accessible for inspection. Each segment contains four coils, so that there are 64 in all, and these have a simple winding of copper strips, of only a few turns, which are completely imbedded in paper insulation.

MAP OF DISTRIBUTING SYSTEM.

These alternators work almost noiselessly, and with hardly any rise in temperature; they are easily and safely coupled in parallel, with no fluctuation of the voltage in the conducting system, this operation being performed without any auxiliary resistance.

The exciting machines are six-pole dynamos mounted directly on the main shaft, their armature having a series drum winding, and are so constructed that single wires can be easily changed.

Mr. Brown guaranteed the following commercial efficiencies for the alternators at different loads, including the excitation of the magnets:

Steam Engine Load	[illegible] of Alternators	[illegible] at the Switchboard
a [illegible]	[illegible] per cent	[illegible] kilowatts
b [illegible]	[illegible]	[illegible]
c [illegible]	[illegible]	[illegible]
d [illegible]	[illegible]	[illegible]

The whole plant is arranged for a maximum working potential of 3,000 volts in the primary wires.

The switchboard is mounted over the entrance of the dynamo room; in front of it runs a gallery from which the whole interior of the house can be overlooked. The wooden framework, built in most approved style, is divided into three panels, which are covered with white marble plates and have room for the connections of 12 machines.

For the present installation only the middle panel is used, and there the ammeters, voltmeters, indicators, etc., for four machines are set up. In the centre of this panel there is also a static voltmeter, with which the potential in the secondary network near the feeding points can be measured; the plugs for making connections with these pressure wires are arranged in the form of a horseshoe about the instrument. Furthermore, this middle panel also contains the large station ammeter, of a capacity of 1,500 amperes, and the station voltmeter, which gives the average potential of the system.

Each machine has its special ammeter and phase indicator, while for every two machines there is one voltmeter with a switch. No measuring instruments are provided for the exciting dynamos; the regulating resistances for these machines are placed behind the switchboard, and can be easily reached. Each dynamo can be regulated separately, or, by coupling the resistances, all at once. All the connections are conveniently accessible from the large space behind the switchboard.

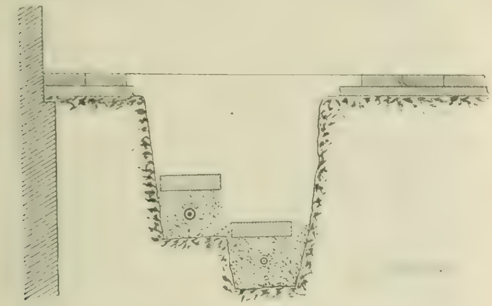
The cables run from the machines on insulators through the cellar and then rise, behind a wooden casing, directly to the switchboard. Main conductors, as well as reserve conductors, run from the dynamo switchboard to a second one—the feeder switchboard—which is situated in the large space behind the main switchboard, and from which current is distributed to the city. On this switchboard are mounted the ammeters and switches for the main feeders leading to the city. The board is arranged for the complete installation proposed, consisting of 12 feeders, but at present there are in place only the ammeters for the six main feeder cables which have so far been laid, though the binding posts and levers for the safety fuses and switches of the complete cable system are already set up.

The distribution in the city is effected by means of transformers connected in parallel, and a secondary conducting network. Carefully made calculations showed that this system would entail by far the least initial cost, even though the engines and dynamos must have a greater capacity than those in a central station with accumulators; similarly, calculations gave an earning capacity of 11¾ to 12 per cent. for the whole plant, the highest return on the capital invested compared with other systems.

The primary potential of 3,000 volts was chosen in the belief that in the present state of engineering it is entirely possible to keep underground cables with this potential in steady operation, and, moreover, with the safety which is essential for such a system, and that with this tension the losses in the main conductors could be extraordinarily diminished without employing too great sections of copper. At full load, the losses in the feeders amount to 4 per cent., in the primary distributing network 1 per cent., and in the secondary network 1.5 per cent.

A secondary distributing network was decided on, because the size of the transformers could thus be better suited to the consumption of current, as in this case a transformer must supply a considerable number of consumers. As, furthermore, the transformers can be decidedly larger, another advantage of this arrangement is a surer and more economical operation than with small individual transformers for every user, which latter plan would also have the disadvantage of carrying the high-tension currents directly into private dwellings. Moreover, with large transformers feeding a secondary network, individual consumers are more independent of disturbances in the transformers, as in such cases all points of consumption are easily kept in operation.

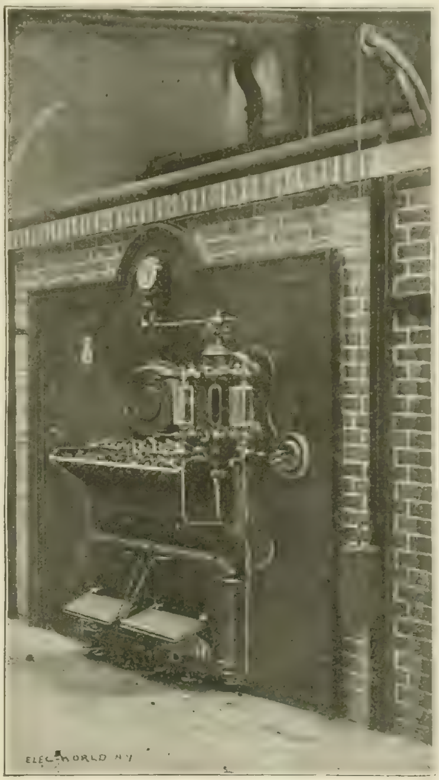
It has, indeed, been asserted that when a transformer becomes overloaded and has its safety fuse blown, the neighboring transformers will likewise become overloaded and blow their fuses, so that by this means a large part of the network will cut itself out. But this overloading can go on only until the limiting capacity of the safety fuse of the secondary cable running to the lamps belonging to the troublesome transformer has been reached; then the cable fuse will blow, the comparatively small overloaded region will be cut out, and the remaining part of the network remains intact. As a matter of fact, a case which confirms this latter view has occurred, in which the overloading of the transformer was brought about by the fact that light was furnished free of cost, and shortly before Christmas the owners of shops not only burned all their lamps simultaneously, but even had a large number installed temporarily.



CONDUCTORS INSTALLED IN TRENCH.

From the central station there run six main feeders (as already mentioned) to as many feeding points in the city, which, as far as possible, are fixed at centres of consumption. These points, in the cable diagram, are designated by double rings, and numbered from I. to VI. At No. II it was necessary, on account of the great number of connecting cables, to duplicate the feeding point, as can be seen on the diagram, in such a manner that a primary conductor of 590,000 cir. mils (210 mm²) section had to be drawn to the opposite side of the street. From these main feeding points the high tension network branches to the transformer stations, which are designated by simple points. This network is so arranged that every two feeding points are joined together by high tension conductors, to which the transformers are connected in parallel. The individual parts of the high tension conductors have no further connection among themselves, an arrangement which makes it possible to quickly find any fault occurring in the network. Another advantage of the conductors running from feeding point to feeding point is that every transformer can obtain primary current from two sides, and if disturbances should occur at any place in the high tension network, the transformers will still be kept in full operation and only the defective piece need be cut out. A great source of safety against the occurrence of faults lies also in the fact that connection boxes in the primary network are almost entirely avoided. The different transformers are furthermore connected together by the secondary network, from which the current at 120 volts is led into the houses.

LAYING CABLES.



FRONT OF ONE BOILER

The cables are laid throughout under the sidewalks in order to keep the roadway open for traffic while excavating. At street crossings the cables are drawn through iron pipes. They are besides imbedded in clean sand, and in order to preserve them from injury while the ground is being dug up, they are covered, the main feeders with wrought iron plates specially treated to preserve them from rust, and the cables of the secondary and primary conducting network with bricks. High and low tension cables lie in the same trench, which has two steps, as shown above. The secondary cable lies in the upper step, two feet (60 cm) below the level of the sidewalk surface, the primary cable four inches (10 cm) deeper, and to one side. The distance of the secondary cable from the foundation walls of the houses is also two feet (60 cm); so that the branch cables to the houses are very short, while there is yet sufficient room to set the branch connection boxes comfortably. The cables connecting with the houses terminate in a box, in which at the end of the cable is imbedded in an asphalt insulation, and in whose upper part are the house safety fuses. The box is also a switch, for when it is opened the house wiring is cut off from the street network.

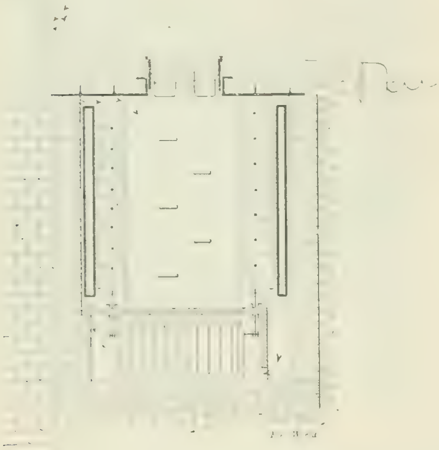
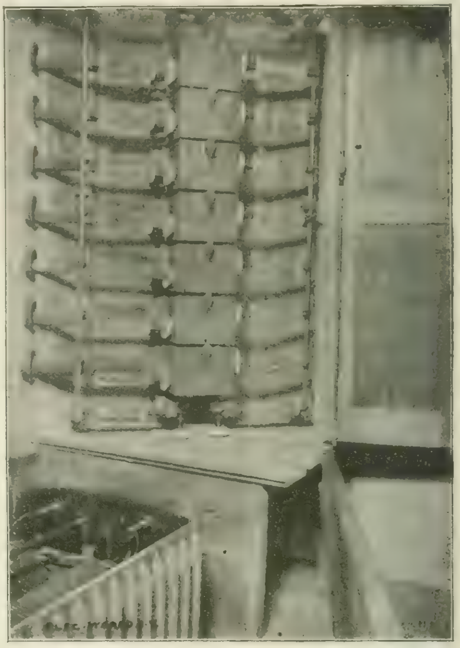
All the cables were furnished by Felten & Guilleaume, of Mulheim, on the Rhine, and were entirely laid within four and a half months. The total length of the conductors amounts to 46½ miles (75 klm) of concentric cable, and four miles (6.5 klm) of many stranded pressure cables. For the high tension of 3,000 volts, concentric lead cables with iron ribbon armor and with sections of from 50,000 to 420,000 cir. mils (25 to 210 mm^2) are used; these reach a total length of 24 miles (37 klm). The thickness of the insulating layer between the inner and outer conductors is 3/16 inch (5 mm); the outer conductor is surrounded with an equally thick layer of insulation and the whole is covered with a double wrapping of lead and double iron ribbon armor, which is provided with a coating of asphalt compound. The low tension cables have the same construction, with the difference that the insulating layers have a thickness of only ⅛ inch (3½ to four mm). The sections of the low tension cables are 140,000 and 200,000 cir. mils (70 to 100 mm^2), but for some individual consumers who are directly connected to transformer stations, the sections run up to 670,000 cir. mils (340 mm^2). The length of the secondary network which is already laid amounts to 23½ miles (38 klm). The insulation resistance of the whole cable network, including all connecting parts, amounted, on the day of its acceptance, to more than 6.2 megohms per mile, at 32° F.

The transformer stations, contrary to the usual practice, are placed in specially arranged pits situated below the level of the streets. These pits are 9 feet (2.85 m) deep, 6 feet (1.8 m) long and 4 feet 8 inches (1.4 m) wide. They are covered with an iron plate, and have a manhole closed water tight. The transformers are placed in the lower part of the pit, and are covered by a wooden floor.

The cables in the pits are arranged systematically, the secondary cable being always led into the bus bar on the house side, the primary cable to that on the street side. Furthermore, the outer and inner conductors in all the shafts are separated by having the safety fuses of the two on opposite sides, so that those of the inner conductor are always on the right, when one stands in the pit with his back to the secondary cables. This is done principally on account of the primary cable, in order to avoid mistakes in connecting it, which would cause a very high tension in the inner conductor, amounting perhaps to many times the normal operating potential.

The equipment of the pits can be seen from the illustrations. The cables run to a terminal box screwed fast to iron bars, from which the two poles are led out to the sides. On both sides are mounted round copper rods of 1 1-5 inches (30 mm) diameter, fastened to the insulators, which serve as bus bars, and to which the cable is attached with safety fuses which also act as cut-outs. The lead strips of the primary safety fuses are placed in porcelain troughs, which are filled with dry sand, etc., so that when the fuses are burned the molten lead will be prevented from flying about. The secondary fuses are mounted on ordinary porcelain plates.

Placing the transformers underground was the subject of considerable study; it was necessary particularly to consider whether the heating in the pits would not be so great as to endanger the insulation of the high tension cable, and whether it would be possible to keep the pits dry during sudden variations of weather. These questions were happily solved by the setting up of a ventilation which was kept going by the heat generated by the transformer. In order to provide a path for the circulation, an iron box was placed at the top of the pit, and divided into two air tight parts, which contain, respectively, the entrance and the exit of the circulating air. The wooden floor over the transformer does not quite touch the wall on one side, and here a tongue-shaped piece sticks down as far as 4 inches from the bottom of the pit. On the opposite side there is an earthen pipe, built into the wall, which has an opening close under the floor, and leads to one division of the cast-iron ventilation box. The cold air now enters through the corresponding division of the ventilation box into the pit and circulates behind the wooden floor under the tongue shaped piece, over the transformers and to the ventilating pipe and out through the other division of the box. It has been determined by measurements that the temperature in a pit, with the transformer at full load, does not rise over 38° F, with an outside temperature of 41° F.



Transformer Pit.

The Frankfort central station begins operations on a much larger scale than is recorded of the stations of other cities. The part finished is announced to be able to take care of 35,000 incandescent lamps, or their equivalent, and there are now about 20,000 incandescent lamps, 50 arc lamps and 13 motors connected. The motors will in a few days be increased to 30, and altogether application for 31, aggregating 180 hp, has been made. They will be distributed among the following various occupations and places: printing establishments, bakery, ice manufactory, furniture factory, accumulator factory, copper smithy, machine shop, drug factory, mill building establishment, tannery and butcher shop.

The time of operation has been too short to render a final decision on the results which are expected, but in the meantime it is certain that the plant in all its parts answers every requirement with small cost of operation, and the choice of the system will, it is believed, be justified by the outcome.

The Way They Do Things in Switzerland.

According to the London *Electrical Engineer* the Swiss Council have agreed to grant the franchise for the electric railway running to the top of the Jungfrau, "on condition that the company contributes $20,000 to the construction of the observatory as well as monthly subscriptions to certain scientific societies."

Convention of the Northwestern Electrical Association.

The third annual convention of the Northwestern Electrical Association was held at Milwaukee on Wednesday and Thursday, January 16 and 17, and the success of the last meeting was repeated both in the attendance and interest manifested in the proceedings. As at previous meetings, the discussions were well sustained and lively in their character. The more purely commercial feature of the convention was rendered prominent by a large contingent of representatives of supply and manufacturing houses, some of whom made considerable displays of wares in the parlors of headquarters.

The meeting was called to order by President C. C. Paige, of Oshkosh, at 11.20 A. M. of Wednesday morning. Mr. Paige, in his presidental address, dwelt upon the magnitude and importance of the electrical industries in the United States, stating that there are now over two hundred millions of dollars invested in electric light and power plants. He referred to the advocates of municipal ownership as engaged in "an unholy, infamous, communistic warfare on these and kindred enterprises," which is not only antagonistic to the true principles of our institutions but to government itself and to fair-minded business equity. He predicted that if such principles should get a foothold in this country they would gain control of legislation and management of public affairs to such an extent as to embarrass if not wholly destroy these great interests, and he called upon investors for a united and vigorously pursued effort to head off the advocacy in this country of what is denominated as communistic European ideas of government. Reference was made to the advocacy of municipal ownership by some manufacturers of electrical apparatus, who having induced private capital to invest next turn their energies to excite and encourage competition, either through municipal or so-called citizens' plants. The president expressed his pleasure at seeing such a large number present at the meeting and felt assured in saying that the association now has a strength that can be useful and be beneficial to all. Mr. F. Copeland, of Lacrosse, complimented the president, saying that in it there is a great deal of food for reflection, the remarks being to the point and should be well considered by the members. The meeting then adjourned until 2 P. M.

The afternoon session was opened by Mr. Pliny Norcross, who read a paper on "Hints upon Daily Work About a Dynamo Plant."

Mr. Norcross said that the creation of electricity by a dynamo was just as great a mystery to him now as it was in 1885 when his plant was first started; he had made some desultory efforts to learn something about electricity by reading books, but they contain so many strange words and symbols that he got tired and sleepy, and had long ago given up trying to learn anything about the subject. Of late when he desires any information he hires some one to tell him, but also relies a great deal on men who travel for electrical companies and supply houses for his information.

Mr. Norcross referred to the desirability of a dry and solid foundation for dynamos and the necessity of care in finishing generators so that the armatures are accurately balanced in order to avoid vibration, and good workmanship throughout is declared to be as essential as the electrical features. He favors slow-speed dynamos with heavy, substantial and broad bases, large accurately turned shafts with heavy boxes babbited with the very best material, and wide pulleys; he believes in the use of wider belts than is really thought necessary and the use of the best lubricant that money can buy. He states that the blower is a great help and that a current of cool air directed upon the heated parts may prevent disaster. Slipping of belts is referred to, which is stated to be sometimes due to the belting being too short, other times too narrow, or to overload; or the pulley of the dynamo may be so small that the belt cannot get sufficient contact with its surface; excess of speed, and greasy belts are also causes of slippage. He advocates the use of wider belts as a means of relief, the belt being kept pliable by the sparing use of some good belt dressing; iron wheels are preferred for large driving pulleys and wood or fibre for small driving pulleys; iron pulleys may be improved by putting leather, canvas or paper on the outside, but this must be carefully done by an expert or it will come off and make serious trouble. Mr. Norcross considers the day of high-speed dynamos past and advocates uniformity in the dynamos and lamps in a plant.

In placing wall controllers he suggests that it is well to do it in such a manner that they cannot tremble; in case of a wooden frame building he advises a post through the floor and sunk well into the ground so as not to be affected by vibration, the wall controller to be secured to a plank crossing the upper end of the post. He likes a plain carbon better than one coated, and with a rounded or blunt or even flat end, that the carbons may be less likely to slip by each other between the time of trimming and lighting. By the use of one-half inch carbons he now obtains 10 or 11 hours of light.

Mr. Norcross advised that fibre or hard rubber instead of lignum vitæ bushings be used as the latter material is checked by heat.

In wiring through trees, he recommends that a couple of pieces of thick narrow board be used 18 inches to two feet long grooved so as to receive the wire and then wired together under the offending limb. Mr. Norcross thinks the electric light is more expensive than gas, and states that the most disastrous course ever pursued by the men who put in an electric light plant in competition with gas, is to announce to the public that the new light is cheaper than gas. The electric light stands firmly enough upon the fact that it is a better light than oil or gas. Mr. C. C. Burton next read a paper on "Interior Conduit and Interior Wiring." It is generally considered, he said, that the majority of interior wiring found in most cities is such as reflects little credit on its author and less on the companies who allow it to menace property running current through it. It is far better, he thinks, to have high grade exposed wire than to use low grade concealed wires, and that the ideal method of wiring as far as concerns security and insulation is exposed, heavily insulated wire supported upon non-combustible insulators. Without using interior conduit he considers that concealed wiring cannot be of such a character as to secure the necessary immunity of life and protection from fire hazard, or enable inspection at all times subsequent to installation.

Mr. Burton describes the interior conduit system of installation at length, including the latest form, the iron conduit. As to the cost of installing interior conduit he states that in actual practice it has been shown that it will require an additional expenditure of only 20 per cent. for plain conduit and 40 per cent. for brass conduit, these figures being based on the cost of installing interior conductors by the old method, while the cost will not average more than 10 per cent. for plain and 20 for brass conduit over the system now required by insurance regulations. The recent concession of the underwriters permitting two conductors to be used in a single tube of iron armored conduit is referred to as likely to open a wide field of use for this form. Practical experience has demonstrated that a building can be provided with iron armored conduit and conductors placed therein at an expense less than with brass armored conduit using the double tube system.

In the discussion which followed, the fact was brought out that while in many instances the insurance rate has been raised on account of wiring, the wiring itself was not so much at fault as was the system of conducting it in the buildings, and that the fuse blocks were the most frequently to blame for accidents. It was suggested that some system of examination be established that would prevent incompetent men from wiring buildings; by thus bringing up the standard of safety the rates of insurance would again be lowered to normal figures. It seemed to be the sense of the convention that insurance men, if no other cause of fire could be assigned, attributed it to electricity. Mr. Sullivan made favorable mention of the good accomplished by the Chicago board of inspection and suggested that their methods be estabished generally where possible. The meeting adjourned until eight in the evening.

At the evening session Mr. William Goetz read a paper on "Incandescent Lamps vs. the Welsbach Burner." In the discussion Mr. Farwell, who operates both the electric and gas plants at Waukesha, having practically no competition, took the side of the Welsbach burner, claiming that it was a better and cheaper light than the incandescent lamp. The Welsbach burners were introduced by Mr. Farwell to protect himself on account of the considerable objection made when the price of incandescent lighting was raised by him from ½ to 1 cent per lamp hour. The discussion which followed the remarks of Mr. Farwell seemed to show that on account of his not having the latest machinery the electric light furnished by him was defective; and, therefore, there was naturally greater satisfaction given by the Welsbach burner. It was stated that many people objected to the Welsbach burner on account of the ghastly hue imparted to surrounding objects. To meet the competition of the new burner it was suggested that lamps be replaced before burning out, thereby keeping up the efficiency of the light. Mr. Thorp did not think much trouble was to be anticipated from the new Welsbach burner, and said that after electricity had been in the field as long as gas, there would no longer be any comparison between the two. The general feeling was that while electricity was not as cheap as gas, it was preferable to any style of gas burner on account of its better and more agreeable light, greater cleanliness and healthfulness.

Mr. John R. Markle then read a paper on "Some Characteristics and Economies of Accumulators as Applied to Central Lighting and Power Stations." Mr. Markle said that storage batteries could perform the important functions of storage of equalization of pressure, and of transformation of E. M. F. and current more perfectly and at the same time with greater economy than any other apparatus. They enable reductions to be made in the cost of feeders to distributing points on account of possessing a better time factor and, on account of the influence on the load factor, also involve less first cost of generating machinery and greater economy of operation. He stated that the space required for the accommodation of storage batteries is less than for steam, air or water storage, until very high pressures are reached; a space of 10 yards square will accommodate a battery having a capacity of 1,000 kw hours. He referred to the perfect manner in which pressures may be equalized or controlled by means of storage batteries and the manner in which short circuits and grounds may be promptly blown by them. As a consequence of their regulating properties higher efficiency lamps may be used; a saving in this respect over the employment of what he denominates "dead or live" equalizers being about 20 per cent. and over alternating transformers of from 25 to 45 per cent. Mr. Markle referred to a recent visit to Portland, Ore., where alternating currents will be transformed into continuous currents for lighting and for stationary and street railway motors, and as the voltage employed is but 6,000 and the distance only 14 miles, he asked why continuous currents instead of alternating were not employed in the first place. The first cost of producing and installing storage batteries, he states, is generally misjudged for the reason that there is a lack of knowledge of the many details of manufacture of properly constructed elements and of the necessary auxiliary apparatus for the working, labor, freight, and supervision, are not taken into consideration, nor the interest on the capital invested in factories and machinery and on the necessary capital, the cost of selling—such as solicitors' and agents' salaries—nor the loss from bad debts, cost of insurance and taxes, cost of administration; besides the above are the expenditures for books, stationery, advertising, etc.

He stated that the railway power house offers the most favorable opportunity for storage batteries on account of the frequent and wide variations of load. In a case quoted where storage batteries were thus applied the results showed a saving of 2.2 pounds of coal per hp hour, involving a saving of $2,500 per year; the cost of storage batteries would be recouped in this case by the saving of coal alone in four years. This saving would be due to the fact that the engines are running continuously at their best efficiency with less repairs, and also owing to the absence of load variation, burning out of generators and motors, etc.

The following comparison of the cost of direct and storage battery systems is given.

By direct system.

Cost of 500 hp steam plant at $70 per hp	$35 000
Cost of 400 kw electric plant at $30 per kw hour	12 000
	$47,000

By storage battery system.

250 hp steam plant at $70 per hp	$17 500	
200 kw electric plant at $30 per kw	6 000	
Accumulator of 750 kw hours capacity at $30	22 000	
		$46,000

On Thursday morning Mr. G. L. Cole read a paper on a comparison between charging for incandescent lighting by meter and by contract systems, in which he gave his experience in changing to the meter plan two years ago in Beloit, Wis. At that time some customers were charged by contract and others meter rates, and the two questions that came up for consideration were in regard to the outlay on the meters, and whether the additional returns would warrant the change.

To compensate for the extra investments in the meters it was decided to charge a meter rental which now pays a good percentage. Mr. Cole found that on the contract plan with 825 incandescent lights wired, the daily average load was 450, while with the meter system, he could now calculate on only one third of the installed being in use at one time. As an instance of the difference between the two systems, one customer formerly paid $3.50 per month, while at meter rates he paid $7.64 per month. By the meter plan a minimum charge of $1 per month is made when a house is not occupied, while if this serivce was furnished on contract there would be much difficulty in collecting on account of the customer desiring a discount because lights were not used. Another advantage of the meter system was that smaller transformers can be used, as a customer would not use at any time all the lamps wired unless on some special occasion, when a large transformer could be temporarily installed. In illustration a case is given of a factory in which 95 lamps were installed and where a 50-light transformer is used and whose bills at the rate of 20 cents per kw average $57.13 per month. In another factory where 180 lights are used only until 6 P. M., a 150-light transformer is installed, and an additional 40 lights connected for lighting a lodge room later in the evening.

Mr Cole has now 3,300 lights wired from two dynamos, one of 750 and the other of 1,000 lights, and the average increase is about 115 lamps installed per month. He finds that people will put in more lights when they use the meter system than under contract system, and this adds to the profit from wiring. The conclusions are that with the meter system the station receives pay for the current furnished, and the customer pay for the current received. The service is more satisfactory, and the meter admits of a larger field to be covered than is possible under the contract system. Economy is stimulated on the part of the customer, and tends to make the owner also pay more attention to this point. The meter system is eminently fair to both parties, and soon after its installation commends itself to the public.

Mr. G. Herbert Condict read a paper describing the use of the storage battery in connection with the lighting and street railway plant at Merrill, Wis., which we reprint in full elsewhere.

Mr. Charles E. Gregory delivered a short address on the subject of electrical business, the keynote of which was the principle of paving the way for a profitable business by obtaining the confidence of customers through fair dealing. He laid stress upon the desirability of looking out for economies in central station practice and particularly with respect to the steam plant. When in the dark in regard to any point, he advises the employment of an expert and as an instance says that in the case of scale in the boiler, it would be advisable to have a chemical analysis made of the water, and a prescription obtained based on this.

The reports of committees were then received, and officers were elected as follows: President, H. C. Thom, Madison; First Vice President, Geo. G. Grim, Jefferson; second Vice President F. Copeland, LaCrosse; Secretary, William Goltz, of Milwaukee; J. Schuete, Manitowac.

Mr. Thom being called upon to make an address, said he felt keenly the generous endorsement which his election to the presidency implied, and hoped that his conduct in the administration of his duties in behalf of the organization would be of such a character as to merit the mark of appreciation bestowed. He said he was greatly interested in the progress and good results that could be brought about by the Northwestern Electrical Association, which was now getting down to businesss, and he believed that its influence would continue to grow until it would be looked upon as a potent factor in shaping the policy of the interests which it represents.

The following board of directors was elected: Chairman, F. Copeland, Lacrosse; O. M. Rau, Milwaukee, and Mr. Highland of Clinton, Ia. It was decided to hold the next meeting in Chicago.

A suggestion was made that the name of the association be changed so as to include the entire Western States. This was opposed on the ground that the association was formed to be a benefit primarily to its members, which would not be the case if they were composed of representatives from different sections of the country where interests and conditions widely varied.

WORTHY OF SPECIAL MENTION.

Washburn & Moen Mfg. Company had a good supply of envelopes, filled with samples of insulated wire, price lists and copies of its "Pocket Handbook of Iron and Copper Wire in Electrical Transmission." Messrs. Whyte and Gage were kept busy supplying these.

The General Electric Company took special pains to illustrate its claims to the patronage of central station managers. It displayed a fine lot of specialties in the club room, and had two arc lamps burning on the hotel circuit to demonstrate the advantages of its constant current arc lamps. When Mr. A. C. Bunce wasn't busy with his work for the convention, and that seemed to have no end, he was hard at work in the interest of his firm. He was ably assisted by Mr. W. J. Ferris.

The New Helios Arc Lamp enjoyed the distinction of being better displayed than was ever an arc lamp in the history of conventions. By the aid of lenses, the crater of the arc in two lamps was perfectly reproduced on a sheet of muslin. This showed the manner of burning as nothing else could do. Mr. Chas. G. Burton, of the Central Electric Company, is to be credited with arranging the display, and with making many friends for the Helios.

Geo. Cutter, accompanied by Mrs Cutter, was one of the most notable characters present. He looks as well as of old, and seems to find business all right.

The Metropolitan Electric Company had, as usual, an exceedingly good representative in Mr. L. W. Burch. He made his exhibit attractive, and was continuously on the move.

The Peoria Automatic Filter was cleverly displayed, both in exhibit and literature. It had a parlor all to itself, and no end of attention. Mr. J. A. White looked after the display.

Kerite Wire carried away the honors of the wire displays. Its destiny was in the hands of S. F. B. Morse, and that gentleman did the thing right. He provided a novel entertainment in the performance of Prof. Patterson, who gave a splendid act of swinging electrically lighted Indian clubs. The "Kerite" parlor was a popular resort.

The Central Electric Company had the best exhibit of any supply house. It was handsomely arranged, and the accompanying literature was exceedingly effective. Mr. H. D. Latimer worked hard all the time to maintain the position of the celebrated house, and he succeeded. This gentleman has earned his right to particular mention, because of his excellent work on the Central supplemental catalogue, of which mention has already been made in these columns.

The Chicago General Fixture Company made a handsome display of its leading specialties that called forth many favorable comments.

"Billy" Low easily made himself the leading spirit of all the fun. His company was much in evidence in line of displays. Mr. Low and his able assistant Wilson, industriously circulated a neat leather case filled with samples of fuse wire. These made a decided hit.

Chas. E. Gregory, one of the most popular fellows in the business, gave the delegates something of a novelty in the way of literature. He distributed a card with portraits of four of his "positive" stockholders. Gregory's paper was also well received.

R. H. Pierce was accompanied by Mrs. Pierce. "Dick" was the chief authority on knotty problems, and he was frequently called on at the meetings.

John R. Markle, who, by the way, THE ELECTRICAL WORLD wishes to congratulate on his recent entry into the great order of the "United," was accompanied by his charming bride. His paper and advocacy of storage battery made him a prominent figure at all times.

M. M. Wood, whose railway specialties are known the world over, and who is now in business for himself, at 1536 Monadnock Block, Chicago, distributed cards bearing his familiar face, and data concerning his devices.

The Western Electric Company, having recently entered the supply field in earnest, sent Messrs. Ellicott and Wilkinson to represent them.

The Dearborn Drug and Chemical Company distributed a particularly interesting leaflet, bearing the significant proverb, "An ounce of prevention is worth a pound of cure." It also gave away a tortoise shell calendar for 1895.

Storage Batteries for telephone work were described in the leaflet of the Pumpelly-Sorley Storage Battery Company.

M. B. Austin, recently appointed Western agent for the Safety Insulated Wire and Cable Company, made a splendid impression on the delegates, and moved the letters K. K. up several stages on the scroll.

Sunbeam Lamps sparkled wherever Mr. F. S. Terry went. In the illuminated clubs of Prof. Patterson two "vapor" lamps, the manufacture of which type was interrupted by patent litigation, blazed in all the glory of a superior illuminant. It is understood these will soon be placed on the market.

J. M. Hill kept people reminded that "Columbia" lamps were strictly in it, and he succeeded, apparently.

Henry S. Hive and Max A. Berg carried the Wallace Electric Company's colors.

Buckeye Lamps had a strong and eloquent advocate in Mr. J. H. Cooke, who seemed to be exceedingly well liked.

James Wolff did the honors for the New York Insulated Wire Company, and he was eminently successful in keeping himself and Grimshaw wire under the most favorable light.

Mr. F. S Terry, one of the original founders of electrical associations, and one of the best known men in the business, distributed cards showing that he has taken up a few leading specialties as manufacturers' agent. The C-S automatic magnetic cut-out is one of these. Mr. Terry's host of friends will be delighted to learn that he is again in the saddle in earnest.

T. R. Mercier, of the Milwaukee Fire Alarm Company, was one of the ruling spirits of the convention.

Globe Carbons were represented by Mr. Chas. L. Rodman.

Mr. J. R. Allen consulting engineer of 1627 Monadnock Block, Chicago, was one of the newcomers who made many friends.

Mr. Jno. C. McMynn, introduced to the electrical world through his connection with the lighting of the famous Ferris wheel, had the honor of being the only man to become both an active and honorary member. "Mac" is one of the best of fellows.

C. B. Fairchild, editor of "The Street Railway Journal," and several publications connected with that enterprise, was an interested listener to all the proceedings.

The C. M. & St. P. R.R. placed a special parlor car at the service of the Chicago contingent. The trip to Milwaukee was exceedingly pleasant.

Some one told a story about Sunbeam lamps. A gentleman and his wife went to visit Mr. F. S. Terry in Chicago, and in the distance they saw a light which the gentleman insisted was a locomotive headlight. It proved to be an ordinary "Sunbeam," and as he represented another lamp, his wife had the laugh on him.

The proceedings were made unusually interesting by the brisk debates. Many of the members are lawyers, and for downright cleverness, take a Wisconsin lawyer, and bet on him to win.

The banquet will never be forgotten. To learn all about it our readers will have to ask some of those who were in attendance. "It was a good thing; push it along," and about expresses it when we look forward to future meetings.

The Electrical Engineers, of St. Paul, gave away a neat and serviceable diary pocket book for 1895 that was highly appreciated.

A Storage Battery Electric Railway and Lighting Plant.*

BY G. HERBERT CONDICT.

The city of Merrill, with a population of about 9,000, is situated on the Wisconsin River in the lumber regions of Northern Central Wisconsin, 255 miles north of Milwaukee. The city is divided by the Prairie River (which here flows into the Wisconsin) into two parts, the east and west side. The Merrill Railway & Lighting Company operates the trolley road running between the two extremes of the city, a distance of 1¾ miles. The road was built for three cars with two turnouts, but only two cars are run ordinarily. The cars are run without a schedule, making the round trip in from 20 to 30 minutes, according to demands of travel.

Power is supplied from a water wheel at the east side plant of the company, situated near the track, about one-half mile from east end. The water wheel is run without a governor, as that was found to be useless, owing to sudden variations of load. As can be readily understood, the running of cars under these conditions was not at all satisfactory.

The electric lighting of the city is divided between two stations, the east side one being run from the water power plant before mentioned, situated at the centre of the east side light distribution, and the west side from a steam plant. The east side equipment consists of two 25-kw Edison dynamos, carrying a maximum of 1,000 lights on the 3-wire system; and a United States 500-volt machine for municipal lighting, carrying 150 lights, 5 lamps in series. The west side equipment comprises a 20-kw Edison machine, carrying a maximum of about 400 lights on the two-wire system, and a Weston 150-light, 500-volt machine, and a 30-light Thomson-Houston arc machine. There are no gas works in the town.

The storage battery plant recently installed is situated midway between east and west sides on the line of the trolley road, about ¾ mile from the east side power house and ¼ mile from centre of the west side light distribution.

The plant consists of 240 chloride accumulators with a capacity of 500 ampere hours at a 50-ampere rate of discharge. The batteries are divided into four series of 60 cells each, connected to a switchboard and so arranged that cells may be connected to the railway, 240 in series, or to lighting circuits in two parallel series of 60 cells each, one on each side of the 3-wire system; they are thus capable of supplying nominally 400 16-cp lamps for ten hours, or at the maximum rate of discharge, 600 lamps. An independent feeder connects the battery with the east side power house ¾ mile distant. A variable resistance is placed in circuit between the battery and the railway so that when the battery is fully charged, requiring a voltage of 600, the voltage on the railway circuit may be cut down if necessary.

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* A paper read before the Northwestern Electrical Association, Jan. 17, 1895.

The operation of the east side lighting and the night running of cars (or rather car) was most unsatisfactory before the battery plant was installed. Owing to lack of power it was necessary to couple together railway and lighting water wheels, so that the slightest variation in the railway demands was apparent in light. Only one car could be run during lighting hours.

That the dwellers in Merrill, east side, should consider electric lighting a failure under these conditions, and that the traveler in the slow, dimly lighted car sighed for the return of the ancient horse car, is not to be wondered at. On Jan. 4, 1895, the battery was connected to the railway circuit. The great improvement in the running of cars was immediately noted by all, but it was at night that the contrast was most apparent. The two water wheels were connected together as usual, but the railway generator charged the battery at a steady rate of 20 amperes instead of running a car with its ever varying demand of from 0 to 120 amperes. Instead of one dimly-lighted, slow-running arc, two brilliantly lighted cars were operating at the highest speed allowable on the streets. Instead of a succession of sharp peaks the voltage "curve" of lighting circuit became practically a straight line; instead of 9 volts variation on each side of three-wire system, as at first, there is practically no variation, demonstrating most clearly the capability of the battery to respond to all demands of railway, no matter how severe. On several occasions the two cars were operated by the battery alone for several hours at a stretch, thus allowing in the daytime the entire shutting down of the power plant and, at night, the use of the two water wheels exclusively for lighting.

The company intends to increase its power at the east side plant by the addition of a wheel to operate the railway generator. By this addition the two wheels now in use may be utilized for east side lighting while the battery carries the west side incandescent lighting. The battery will be charged during the day, as at present, from the railway generator, at the same time keeping voltage even on railway circuit. This plan will enable the company to do away entirely with the west side steam plant, there being surplus water power sufficient to run the arc and 500 volt incandescent machines now at the west side.

Electrical Medical Apparatus.

BY HARRY E. WAITE.

Faradic Apparatus.

MUCH improvement has recently taken place in faradic medical apparatus, for it is only a few years since all that a physician required of a faradic battery was that it should be strong enough to twist the patient all out of shape and sing loudly. It did not make any difference whether the current was smooth or jerky as long as it had the above requirements; in fact, the laity imagined that they were not being properly treated unless the current was strong enough to hurt. Now it is just the other way. What a physician requires most in a faradic battery is that the current be absolutely smooth and not jerky, and that the vibrator make as little noise as possible.

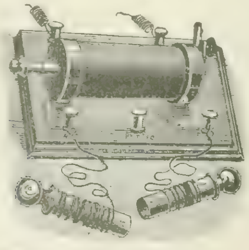


FIG. 1. SMALL MEDICAL COIL.

The general construction of a faradic is about the same as it has always been, except the secondary coil. Fig. 1 shows what is called a "Medical Coil," the construction of which is shown in Fig. 2, *P*, P_1 being the primary and *S*, S_1 the secondary circuits. Experiment has taught that in order to get the best results it is necessary to have three separate secondary coils. Winding the three coils on one spool will not answer, for the following reasons: First, one of the coils will have to be at least an inch away from the primary coil, so that in order to get a strong current from this coil you will have to use an unnecessarily large current in the primary circuit, so large that it will in a very short time burn out the platinum on the vibrator at *A* in cut. Second, by having the coil so large in diameter we only get half the number of turns for the same length of wire, so that the electromotive force is much less. To illustrate, suppose 100 feet of wire is wound on a spool one inch in diameter and the same amount on another two inches in diameter; it is easily seen that there will be twice as many turns on the first as on the second, because 3.14 inches will make one turn on the former and only a half turn on the latter. From Fig 3, which shows the distribution of the magnetic field in a secondary coil, it will be seen that if the strength of the primary current is the same for both coils, the coils named, the

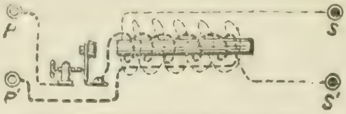


FIG. 2. CIRCUITS OF MEDICAL COIL.

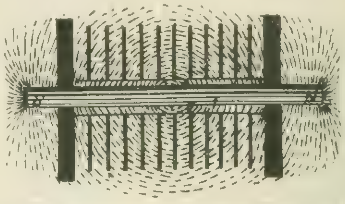


FIG. 3.—DISTRIBUTION OF MAGNETIC FIELD OF COIL.

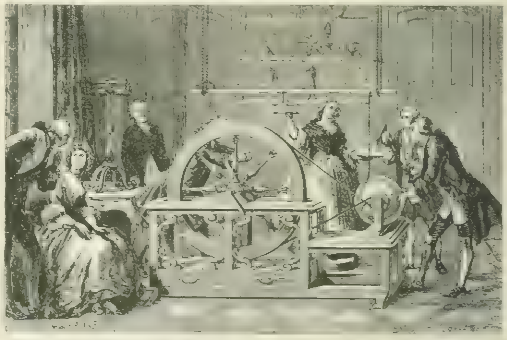


FIG. 4. ONE OF THE FIRST FORMS OF THE STATIC MACHINE.

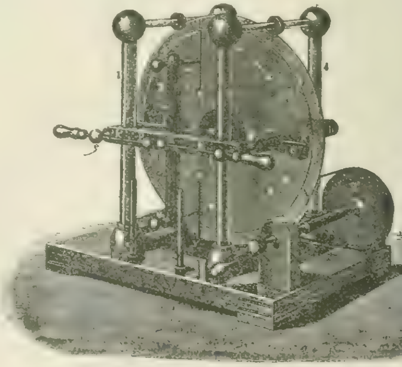


FIG. 5.—HOLTZ INDUCTION MACHINE.

one with a small core will give a greater quantity than the other, as the magnetic field is much stronger in it. The most perfect faradic apparatus made to-day is one which will give from one to one hundred and fifty thousand vibrations per minute and count them. The counting is a most important point, as it is an acknowledged fact that different nervous diseases have different rates of nerve vibration.

Static Apparatus.

There is a great difference in the appearance of the modern static machine, and the machine as it was made over one hundred years ago. Fig. 4 shows one of the first forms of static apparatus. Then came the Holtz induction machine (Fig. 5), and although this model was a great improvement still one could not depend upon it to always work. Dr. A. L. Ranney was the first to enclose all the working parts in a practically airtight case, and by so doing make a practical machine and one that can be relied upon to always work. A first class machine should give a spark of from ten to twelve inches. The number of plates has nothing to do with the length of spark—that depends entirely upon the diameter of the circle. Fig. 6 shows a modern static machine. A machine that will give a twelve-inch spark has an electromotive force of 247,000 volts, but owing to its enormous internal resistance, which is about 247,000,000,000 ohms, it is a perfectly safe current. There is nothing equal to static electricity as a remedy for nervous diseases.

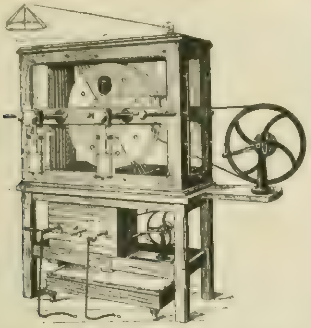


FIG. 6.—A MODERN STATIC MACHINE.

Electrical Power Transmission.—X.

BY LOUIS BELL, PH. D.

The transmission of power to series wound motors at constant potential is a branch of the art which as regards stationary motors has been developed only in special cases. It is, however, the method universally employed for electric railway work. One or two sporadic efforts have been made to operate electric railway systems at constant current, but with such indifferent success that the method has been abandoned.

Counting in electric railways, it is safe to say that at present the majority of all electrical power transmission in the world is done with series motors worked at constant potential or as nearly constant potential as may be practicable. As before mentioned, regulation is generally obtained through the use of rheostats in series with the motors, thereby cutting down the applied voltage, or by throwing the motors either in parallel or in series with each other, or in the third place by a combination of the above methods. Concerning the operation of motors thus arranged, sufficient has been said to explain the situation clearly. The general good properties of the method are most prominently exhibited in the simplicity of the motor windings and the very powerful effort which can be obtained in starting the motors from rest. These properties are of extreme value in railway service.

Aside from the operation of electric railways, series motors at constant potential are frequently employed for hoists and similar work where a powerful starting torque and considerable range of speed at the will of the operator are desirable. In spite of the considerable use of motors for such purposes there are no plants either here or abroad which may be said to be operated exclusively after this method, for it is generally found desirable to combine in the same system series wound motors for severe work and shunt wound motors for purposes where uniform speed is of prime importance. As a rule the power transmission so accomplished is over a comparatively small distance and really involves the problem of distribution more than transmission alone. A considerable number of electric hoists designed by different makers are in use at various points throughout this and other countries, doing service in mines, operating elevators of one kind or another, working derricks and traveling cranes and a large variety of similar purposes. Many of the motors employed are of the railway type.

The voltage employed for this work in America at least is usually either 200 to 250 volts or 500 to 600 volts, the former being most generally used in mines, where difficulties of insulation are considerable, or in operating motors supplied by three-wire systems already installed. The latter voltage is generally selected for work above ground. None of the plants so equipped are, however, sufficiently large or characteristic to be worth a detailed description. The power installations and method of distribution are in general closely similar to those employed for electric railway work. Plants of higher voltage than from five to six hundred are so infrequent as to be hardly worth considering in practical engineering. It is perfectly possible to wind series motors for voltages considerably exceeding this figure, say for 1,000 or 1,200 volts, or, in rare cases, more, provided the units are of tolerable size, but inasmuch as most plants for the distribution of power require both large and small motors, wound both series and shunt, the general voltage is in nearly every case kept at a point at which it will be easy to meet these varied requirements; therefore 500 volts, the American standard for railway practice, has been usually selected.

The only noteworthy exceptions may be found in the use of the Edison three-wire system for distribution of power to railway and other motors. By this method it becomes possible to transmit the power at the virtual voltage of 1,000 and to employ 1,000-volt motors, either series or shunt wound, for the larger units in order to help in preserving the general balance, while at the same time using motors of all sizes wtih any kind of direct current winding, connected between the middle wire and either of the outside wires. The advantages of such an arrangement are very evident, and if the number of motors be considerable, so that it is possible to balance the system with a fair degree of accuracy, we have at our disposal a very convenient method for the distribution of continuous currents. It is interesting to note that this scheme found its first considerable development in electric railway service itself. Of course the use of both 110 and 220 volt motors on Edison three-wire systems is comparatively common, but the extension of the plan of operating electric roads, even under conditions which as regards balance are somewhat trying, is a considerable advance in the art of continuous current transmission.

The method of working electric railway on the three wire system is well shown in Fig. 25. Here the road is a double track one to which the method is generally best adapted. The ground and supplementary wire serve as a neutral wire, both tracks being placed in parallel for this purpose and thoroughly bonded. On a double track road, the cars running on each side of the system will be substantially the same in number, and if the total number of cars be considerable, a very fair balance can be obtained, although never probably as good as is customarily and necessarily used in an Edison three wire system for lighting. In order to still futher improve the balance of the system and prevent its being disturbed as might otherwise occur by a blockade on one track at some point, it is better to make the trolley wire above each track consist of sections of alternate polarity and of convenient length, so that even in case of a blockade, stopping a considerable number of cars, the load would be removed almost equally from both sides of the system. Installed in this way, a railway system is operated at a virtual voltage of 1,000, and the saving of copper over the ordinary distribution at 500 volts is very considerable in spite of the inevitable lack of balance, particularly in small roads, demanding a neutral wire of more than usual capacity. The total amount of copper required for such a system at 1,000 volts between the outside wires, making a liberal allowance for the neutral wire, which in this case means through bonding and supplementary wires for the tracks, is not much, if

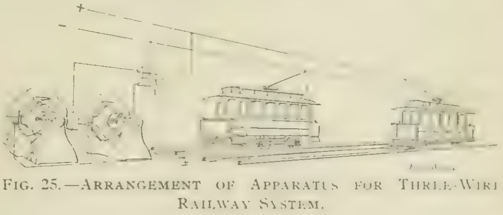


FIG. 25.—ARRANGEMENT OF APPARATUS FOR THREE-WIRE RAILWAY SYSTEM.

any, in excess of 40 per cent. of the copper required in an ordinary railway system at 500 volts. The advantage, especially in the case of long lines, is obviously very great. The three wire method is not necessarily confined to double track roads, as even where only a single track is employed various sections or branches of it may be linked together to form a fairly well balanced three wire system. It is interesting to note that this plan has been in use in several American street railway plants for the past few years, notably at Bangor, Maine, and at Portland, Ore., at both of which places power is transmitted over long feeders from central stations operated by water power. Very recently, the serious trouble which has been caused on many large electric railway systems by the electrolytic action of the current on gas and water pipes has brought the three wire system into prominence, all questions of transmission aside. It is obvious that where the earth and rail are only used as a neutral wire, the stray currents are comparatively small, while in an ordinary grounded system the earth and rail return has to take care of the entire current used, and the almost inevitable result is electrolytic action of more or less severity on cables and pipes running in the vicinity of the tracks. Apart from railway service, the three wire distribution has been but very little used for power transmission purposes either here or abroad, but no particular difficulties are involved, and it occasionally may prove a very serviceable method for the transmission and distribution of power over moderate distances.

(To be continued.)

Electrodynamic Machinery.—XXIII.

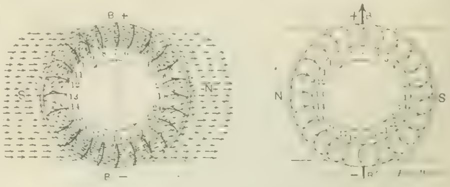
BY EDWIN J. HOUSTON AND A. E. KENNELLY.

111. The armature of the dynamo electric machine which comes next in order of complexity was that devised by Gramme, and now known generally as the Gramme ring armature. This armature, as its name indicates, belongs to the type of ring armatures, and consists essentially of a ring-shaped laminated iron core wound with coils of insulated wire. A simple ring of iron, Fig. 96, wound with 24 separate turns of wire, is placed so as to be able to revolve about its axis in the bipolar field *N*, *S*. Considering the ring to be first at rest, the turns 6, 7, 8, 18, 19 and 20 are represented as being linked with the total flux passing through the cross section of the ring. If the total flux entering the armature at the north pole and leaving at the south pole, that is, passing from *N*, to *S*, be two megawebers, then one megaweber passes through the upper half of the ring, and one megaweber through the lower half. The loops 5, 9, 17 and 21 are diagrammatically represented as having 900 kilowebers passing through them. The loops 4, 10, 16 and 22 carry 700 kilowebers; 3, 11, 15 and 23 carry 500 kilowebers; 2, 12, 14 and 24 300 kilowebers, while 1 and 13 carry no flux.

112. Suppose now, the ring be given a uniform rotation of one revolution per second, in the direction of the large arrows. It is evident that at any instant there is no change in the amount of flux linked with the turns occupying the positions 6, 7, 8, 18, 19 and 20; so that, although these contain a maximum amount of flux they will have no E. M. F. generated in them. Loops 5 and 9, however, are in a position at which the flux they contain is changing; that is to say, the amount of flux that is passing through them at each instant has neither reached a maximum nor a minimum; and the same is true with regard to the loops 17 and 21. In 5, the flux is increasing, and in 9, it is decreasing; consequently, the E. M. F. in 5 is directed oppositely to that in 9, and, according to rule, is indicated by the curved arrows (Sec. 90); for, if coil 5 be regarded by an observer facing it from *S*, the flux, as the ring moves on, will thread the loop in the same direction as the light coming from the face of the loop to the observer considered as a watch dial, and the E. M. F. generated in the loop will be directed counter-clockwise, while the E. M. F. in the loop 9 must have the opposite direction. Moreover, similar reasoning will show that all the coils to the left of the line *BB′*, that have E. M. Fs. generated in them, will have these E. M. Fs. similarly directed; *i. e.*, outwards, as shown, while all on the left hand side of the line will have the E. M. Fs. also similarly directed, but inwards. Loops 1 and 13, which lie parallel to the direction of the flux, will, in the position shown, have no flux threading through them, but during rotation the rate of change of flux linked with them is a maximum, consequently the E. M. F. induced in them is a maximum.

113. Instead of conceiving separate conducting loops to be wound on the surface of the armature, as shown in Fig. 96, let us suppose a continuous coil is wound on the surface of the armature as shown in Fig. 97, the first and last ends of the coils being connected together so as to make the winding continuous, then it is evident that the E. M Fs. so acting in the coil, being similarly directed on each side of the vertical line *BB′*, might be made to produce a continuous E. M. F. in the conducting wire which would be oppositely directed in the coils lying to the right of the line *BB′* from what it is in those lying to the left of the line *BB′*, and that, moreover, if two wires, or collecting brushes, were employed in the positions *BB′*, the E. M. Fs. from the two halves of the ring would unite at the brushes *BB′*.

Such a condition finds its analogue in the E. M. Fs. produced by two series-connected voltaic batteries connected as shown in Fig. 98, with their positive poles united at *B*, and their negative poles at *B′*. The figure shows two batteries of 9 cells each connected in series. Here, as indicated, all the cells have equal E. M. F. This condition of affairs need not, however, exist in the Gramme ring analogue, since the only requirement is that the sum of all the E. M. Fs. generated in the coils on the right hand side be equal to the sum of those on the left hand side. In point of fact, as already observed, the E. M. Fs. are not the same in each of the coils, those at 1 and 13 having a maximum, and those at 7 and 19 having zero E. M. F. Since these oppositely directed E. M. Fs. balance each other, no current will be produced in the armature unless an external circuit be provided, joining the brushes *BB′*.



FIGS. 96 AND 97.—DIAGRAM OF GRAMME RING ARMATURE IN BIPOLAR FIELD. 24 SEPARATE TURNS.

114. Diagram 96 shows no difference between the amount of flux threaded through the coils 6, 7 and 8 or 18, 19 and 20, and, consequently, according to theory the total absence of induced E. M. F. In practice, however, owing to leakage (Sec. 68) and other causes, no coil is entirely free from E. M. F. generated in it.

Moreover, the difference in the E. M. F. generated in coils 13, 12, 11 and 10 is not as great as might be inferred from their angular position on the armature, owing to the fact that (Sec. 86) the flux enters the armature core nearly uniformly all around its surface.

In order to determine the total E. M. F. generated in such an armature as is represented in Fig. 97, it is first necessary to determine the E. M. F. generated in a single turn. Considering a turn starting from the position 7, and, therefore, containing no flux, being carried by the uniform rotation of the armature in the direction of the arrows to the position 19 in a time t seconds, during this time the flux threading through it changes from $\frac{\Phi}{2}$ webers in one direction to $\frac{\Phi}{2}$ webers in the opposite direction and, therefore, the change in flux linkage will be Φ webers, Φ being the total flux passing from *N* into *S*, through the armature. Whatever may be the distribution of flux through the armature and in the air-gap, the average E. M. F. generated in the coil during this time will be $\Phi\ t$ C. G. S. units of E. M. F. If the number of revolutions made by the armature per second be n, then one revolution takes place in the $\frac{1}{n}$th of a second, and a half revolution in the $\frac{1}{2n}$th of a second, so that $t = \frac{1}{2n}$ and the average E. M. F. is

$$\frac{\Phi}{\frac{1}{2n}} = 2n\,\Phi$$

115. If, for example, the armature be revolved at a speed of 600 revolutions per minute or 10 revolutions per second $n = 10$, and since Φ has been assumed to be 2 megawebers, the average E. M. F. generated in any loop in passing from the position 7, to the position 19, will be 20x2,000,000 = 40,000,000 C. G. S. units, or 0.4 volt (Sec. 71). The same E. M. F., oppositely directed, however, will exist on the average in any turn on the right hand side of the line *BB′*. If the ring were wound with only four turns, say 1, 7, 13 and 19, the E. M. F. generated in these turns when placed in series and con-

nected to the brushes *B* and *B′* would evidently fluctuate considerably, since when the coils occupy the position shown, the E. M. Fs. would be a maximum in 1 and 13, and be zero in 7 and 19, while after ⅛ of a revolution, all four coils would be active. If, however,

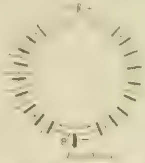


FIG. 98.—VOLTAIC ANALOGUE OF E. M. FS. GENERATED IN GRAMME RING.

numerous turns are wound on the coil, it is evident that the total E. M. F. between the brushes *B* and *B′* will be very nearly uniform, since the only fluctuation which can take place is that coincident with the transfer of a single turn beneath the brush; consequently, in order to determine the total E. M. F. generated by the rotation of a Gramme ring armature, it is only necessary to multiply the average E. M. F. in each turn by half the number of turns on the armature; *i. e.*, by the number of turns active between *B* and *B′* on each side, so that if w be the number of turns on the armature counted once around, $\frac{w}{2}$ will be the number of turns active between brush and brush, and the total E. M. F. on each side of the armature will be

$$2 \Phi n \times \frac{w}{2} = \Phi\, n\, w \text{ C.G.S. units} = \frac{\Phi\, n\, w}{100,000,000} \text{ volts.}$$

If $w = 24$, as in the case represented, then the total E. M. F. will be 2,000,000 × 10 × 24 = 480,000,000 = 4.8 volts.

Laboratory of Houston and Kennelly, Philadelphia.

(To be continued.)

Practical Notes on Dynamo Calculation.—XXIV.

BY ALFRED E. WIENER.

If two magnets furnish the magnetic flux they are placed concentric to the armature and the two sets of polepieces so arranged that adjacent poles on either side of the armature are of unlike polarity, but that poles facing each other on opposite sides of the armature have the same polarity. Such a *Double Magnet Multipolar Type* is shown in Fig. 96; it is that designed by Lundell, and built by the Interior Conduit and Insulation Company, New York.

In giving the yoke of the Radial Multipolar Type (Fig. 88) such a shape as to form a polepiece between each two consecutive magnets an iron clad form is obtained having alternate valient and consequent poles, and requiring but one-half the number of magnets as a Radial Multipolar Machine of same number of poles.

Fig. 97 shows a field-frame of the *Multipolar Iron Clad Type*, having six poles, which is the form employed in the Gearless Street Car Motor of the Short Electric Railway Company, Cleveland, O. In Figs. 98 and 99, two special cases of this type are depicted, both representing, *Fourpolar Iron Clad Types*, and differing only in the position of the magnets. The *Horizontal Fourpolar Iron Clad Type*, Fig. 98, is used in the Edison Iron Clad Motor (General Electric Company), and in the dynamos of the Wenstrom Electric Company, Baltimore, Md. The *Vertical Fourpolar Iron Clad Type*, Fig. 99, is employed by the Elliott-Lincoln Electric Company, Cleveland, O.

Fig. 100 shows a special case of the Horizontal Fourpolar Iron Clad Type, obtained by symmetrically doubling the frame illustrated in Fig. 84, and providing four poles instead of two. The cores are so wound that the centre of the cylindrical iron wrappage has one polarity and the ends the opposite polarity. Two oppositely situated polepieces are joined to the middle, and the two sets of intermediate ones to the ends of the magnet-frame; the lower half of Fig. 100, consequently, is a section taken at right angles to the upper half, the diametrically opposite section being identical. This type has been developed by the Storey Motor and Tool Company, New York.

Multipolar fields may also be formed by a number of independent horseshoes arranged symmetrically around the outer armature periphery. Figs. 101 and 102 show two such *Multiple Horseshoe Types*, double magnet horseshoes being employed in the former and single magnet horseshoes in the latter type. Multiple horseshoe machines of the double-magnet form (Fig. 101) have been designed by Elphinstone & Vincent, and by Ellwell-Parker Electro-Construction Corporation, England; while the single-magnet form (Fig. 102) is employed by the Electron Manufacturing Company, (Perret), Springfield, Mass.

Further forms of multipolar fields can be derived from the bipolar horizontal and vertical double-magnet types, respectively. If, in the Vertical Double Magnet Type, Fig. 76, an additional polepiece is provided at the centre of the frame so as to face the internal surface of the armature at right angles to the outer polepieces, the *Fourpolar Vertical Double Magnet Type* is created, which, when laid on its side, will constitute the *Fourpolar Horizontal Double Magnet Type*, Fig. 103. If, in the Vertical Double Magnet Type, Fig. 78, the two cores are cut in halves and additional polepieces inserted at right angles to the existing ones, the *Vertical Quadruple Magnet Type*, Fig. 104, is obtained; the same operation performed with the Horizontal Double Magnet Type (77) will give the *Horizontal Quadruple Magnet Type*.

Fourpolar Horizontal Double Magnet Dynamos are (Fig. 103) built by the Zurich Telephone Company, Zurich, Switzerland; and Vertical, Quadruple Magnet Machine (Fig. 101) by the Duplex Electric Company, Corry, Pa.

Numerous other multipolar types have been invented and patented, but have not yet come into practical use.

Chapter 42.—Selection of Type.

If the type is not specified, the field magnet frame for a large output machine should be chosen of one of the *multipolar types*, as in these the advantage of a better proportioning and a higher efficiency of the armature-winding, and the possibility of a symmetrical arrangement of the magnetic frame results in a saving of copper as well as of iron; while for smaller machines —below 10 kilowatts capacity—the *bipolar forms* are preferable on account of the great complication caused by the increased number of armature sections, commutator divisions, field coils, etc., necessary in multipolar machines, and on account of the narrowness of the neutral or non-sparking space on a multipolar commutator.

The field, moreover, should have as few separate magnetic circuits as possible; thus in the case of a bipolar type, it should be a single magnetic circuit rather than the consequent pole type which is formed by two or more magnetic circuits, of one or two magnets each, in parallel, because the former is more economical in wire and in current required for excitation. In two-circuit consequent pole machines, for instance, such as the Double Magnet types, Figs. 77, 79 and 80, and the Double Horseshoe types, Figs. 81 and 82, according to Table LIII., Chapter 43, there is 1.41 times the length of wire, and consequently also 1.41 times the energy of magnetization required than in a single circuit, round cores being used in both cases, and the single circuit having exactly twice the area as each of the two parallel circuits in the consequent pole machines. Triple and quadruple magnetic circuits, *i. e.*, 3 or 4 cores, or sets of cores, magnetically in parallel, are still more objectionable, requiring, when the cores are of circular cross-section, 1.73 and 2.00 times as much wire, respectively, as a single magnetic circuit having a round core of equal total sectional area.

If a machine has several magnetic circuits, each of which, however, passes through all the magnets in series, then the frame is to be considered as consisting of but one single circuit, for the subdivision only takes place in the yokes, and it is immaterial as to the length of exciting wire whether the return path of a single circuit is formed by one yoke, or by a number of yokes magnetically in parallel. The above-named objection to divided-circuit types, consequently, does not apply in the case of the Iron-Clad Forms, Figs. 83 to 87.

According to Table LII., Chapter 40, the Horizontal Double Magnet Type, Fig. 75, and the Horizontal Iron-Clad Type, Fig. 83, are the best bipolar forms, magnetically. The iron-clad types, furthermore, possess the mechanical advantage of having the field-windings and the armature protected from external injuries by the frame of the machines, which makes them eminently adaptable to motors for railway, mining and similar work.

The Inverted Horseshoe Type, Fig. 68, which ranks very highly, as far as its magnetic qualities are concerned, has the centre of its armature at a comparatively very great distance from the base, requiring very high pillow-blocks, which have to carry the weight as well as the downward thrust of the armature inherent to the inverted forms having the field-windings below the centre of revolution; see chapter 24. The side pull of the belt with a high centre line of shaft tends to tip the machine, and the changes in the pull due even to the undulations of the belt will cause a tremor in the frame which jars the brushes and, eventually, loosens their holders, and which has a disastrous influence upon the wearing of the commutator. On this account the inverted forms, or "under-types" can only be used for small and medium-sized machines, in which the height of the pillow-blocks remains within practical limits.

In selecting a *multipolar* type, Table LII. shows that the Radial Innerpole Type. Fig. 89, offers the best advantage with regard to the magnetical disposition; with this type, however, are connected some mechanical difficulties, due to the necessity of supporting the frame from one of its ends, laterally, and the armature from the other.

In the outerpole types the armature core can be supported centrally from the inner circumference, and the frame suitably provided with external lugs or flanges resting upon the foundation, a most desirable arrangement for mechanical strength and convenience. The most favorite of the outerpole forms is the Radial Outerpole Type, Fig. 88, on account of its superiority, magnetically, over the Tangential and Axial Multipolar Types.

In all dynamo-designs the consideration is especially to be borne in mind that the whole machine as well as its various parts should be easily accessible for inspection, and so arranged that they can conveniently be removed for repair or exchange. A large number of machines owe their popularity chiefly to their good disposition in this respect.

The shape of the frame in all cases is preferably to be so chosen that the length of the magnetic circuit in the same is as short as possible.

(To be continued.)

Static Electricity and Printing.

To the Editor of The Electrical World:

Sir:—We notice in a recent issue an inquiry for some device to assist the pressman in dispelling the much abused electricity, so commonly present in all pressrooms during the winter months.

As we have had in the past an exasperating experience with electrification in our pressroom, and are now having no trouble whatever, we will endeavor to explain to your readers the means we have in use for ridding ourselves of that annoyance.

It is well recognized among pressmen that the output of the pressroom in the winter is greatly curtailed, and principally on account of the trouble with electricity, as manifested in offset or smutting, imperfect delivery, uneven piles on the delivery board, etc., necessitating, also, slower speed of the press.

The main principle of our device is the liberation of steam, in the form of vapor, immediately under the sheet of paper as it leaves the cylinder after being printed.

To do this we attach a perforated steam pipe to our heating system (we have a heating coil under each press, which makes the matter easy), and suspend it directly under the tapes of the delivery, from six to twelve inches from the same as the circumstances may direct, extending the pipe the full width of the press.

To prevent moisture from dripping on the form or rollers, a section of eave-trough, closed at the ends, is suspended under the perforated pipe, and to secure even distribution of the moisture a smaller trough is fastened in an inverted position over the pipe, thus preventing any blowing of the water or steam. A suitable drip pipe is attached to the lower trough to carry away surplus condensation.

We think the accompanying sketches will sufficiently illustrate the application of the device.

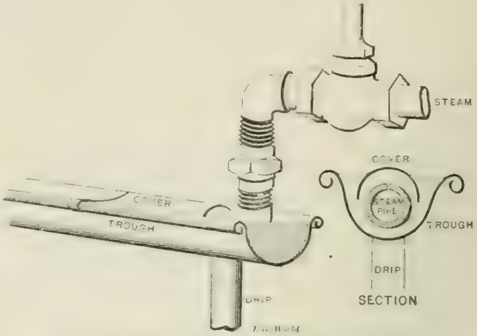
If the main principle is adhered to, of applying the moisture immediately under the sheet as it leaves the cylinder, a modification of this device may be applied to any press by an intelligent pressman, and avoid any further trouble with electricity.

Before applying this device to our presses we were greatly troubled with offset or smutting, failure of the sheet to leave the cylinder, etc., and the paper could not be made to deliver in even piles with the best of mechanical joggers, while the pressman often received severe shocks from the charge on the pile on the delivery load.

This may look like going to a great deal of trouble, and the machine may appear to the electrician as unscientific and crude, but a brief trial of it on one press will satisfy the most skeptical pressman of the perfect working of the scheme, even though there be no wires attached.

The amount of steam to be admitted is small and may be soon learned; enough to form a small cloud of vapor is sufficient.

There is no damage to the surface of the highest finished supercalendered paper, unless the press be stopped with a sheet directly over the steam. We also find no trouble with rusting of the machinery, as would be the case if the atmosphere of the room were dampened to the same extent as it is directly under the sheet.



APPARATUS FOR DISSIPATING STATIC CHARGE.

We have never attempted to solve the scientific theory of the operation of this device. Perhaps the more technical of your readers can.

WM. C. GAGE & SONS.

BATTLE CREEK, Mich.

To the Editor of The Electrical World:

Sir:—The electricity in paper, of which many printers complain, is usually in the paper when it is received from the mill. No doubt the cylinder printing machine adds something to it.

We have tried these remedies: (1.) A continual wetting of the floor, and the production of a moist atmosphere; this is only a partial benefit. (2.) The attachment of copper wires leading from the paper to the floor; apparently of no benefit at all. (3.) Steaming the paper by allowing the steam to escape from a gas pipe pierced with little jets. This has been quite effectual. Mr. Morehouse, of New Haven, says that heated air accomplishes the same purpose. With his method he uses a hollow copper tube pierced with holes about one and one-half inches apart from which come flames about an inch high. This tube is put underneath the feed-board of a cylinder press, which sends a current of warm air upon the paper after it has been printed. He claims that this is entirely effectual.

THEO. L. DE VINNE.

NEW YORK, N. Y.

Shunt vs. Compound-Wound Dynamos.

To the Editor of The Electrical World:

Sir:—In a recent number of THE ELECTRICAL WORLD I noticed an article on dynamos for power plants. The writer made the statement that most men in charge of power and lighting plants preferred shunt to compound-wound dynamos, considering it better to rely entirely upon hand regulation than placing dependence on the compound winding to accomplish the desired regulation. I did not suppose such to be the case at all in this country, although this idea does prevail to a large extent in England.

It would seem that the use of compound winding is analogous to the use of the governor on a steam engine. Of course, compound winding regulates only within certain limits. Attendants are needed to look after it occasionally, but such is the case with the engine governor as with any automatic system of regulator.

I have seen a Corliss engine slow down and almost stop when a large load was suddenly thrown upon it. It would have stopped entirely had not the engineer opened the valves and admitted more steam. Yet they continue to use the same governor.

It must require an immense amount of labor in a large plant equipped with shunt machines to keep good regulation when the load is constantly varying. It there is a nearly constant load a shunt machine is all right. A well designed compound machine will regulate well except in case of a sudden and large change in load.

CLEVELAND, O. F. T. CARLTON.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS BY CARL HERING

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors or publishers are solicited, and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 922 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Constructing Small Dynamos.—The article mentioned in the Digest last week is continued in the Lond. "Elec. Rev.," Jan. 4. Besides the specific dimensions of the machine, some general figures and recommendations are also given.

Small Motor.—An illustrated article intended for armatures, describing the construction of a very small motor, is published in "L'Elec.," Jan. 5.

Unipolar Machine.—Another article by Mr. Ziegenberg is contained in the "Elek. Anz.," Dec. 23. As the direct and the counter E. M. Fs. in many forms of proposed unipolar machines are equal, thereby producing no voltage, he suggests making the latter less than the former, thereby obtaining a useful difference; this he (erroneously) believes can be done by having a different field or speed at the part of the circuit where the counter E. M. F. is generated. He states that in an ordinary Gramme ring machine a current will circulate in the two parts of the winding if the machine is not well constructed, and by increasing these errors in its construction he believes this difference can be made very great (but is not this current an alternating one?); a diagram of such a proposed machine is given (his error lies in the fact that he forgets that precisely as many lines of force leave the armature as there are entering it, and that the speed must be calculated in revolutions per second, which is the same for all parts of the armature); he claims to have made some tests in which currents were produced (these tests, however, are not conclusive, as they do not appear to represent the true conditions). He also suggests reversing the counter E. M. F., thus making both useful; this he thinks may be done by rotating one annular magnet in one direction on one side of two flat-ring armatures, and another oppositely polarized magnet in the other direction on the other side of this armature (if the lines of force ended abruptly in the iron core of the armature, which they do not, this would undoubtedly work very well); he assumes that the lines of force will rotate with the iron and the coil of the magnet which generates them; he admits, however, that the result is somewhat doubtful.

Electricity in Mining.—The serial by Mr. Berthon is continued in "L'Elec.," Dec. 29; he discusses electric pumps.

Constant Speed Motors.—The "Elec. Age," Jan. 19, contains an article by Mr. Fay, in which he discusses shunt motors in which the speed must be absolutely constant, for use, for instance, in silk mills where a variation of 4 to 5 per cent. is quite out of the question; he believes it will be superseded by the compound motor. He gives some diagrams showing the variations in speed of a number of different motors; for a three-hp motor there was a change of speed of 16.67 per cent. between no load cold and no load hot; this must be due to the heat of the field coils; between no load hot and full load hot the speed fell 10 per cent., which was due to the heating of the armature; similar results are given for a number of different motors.

Dynamo Design.—In a continuation of Mr. Harrison's serial in the "Elec. Age," Jan. 19, he discusses magnetic leakage and reprints Mr. Wiener's recently published table giving the factor of leakage for various types and sizes of dynamos.

LIGHTS AND LIGHTING.

The Light of the Future.—The Lond. "Elec. Rev.,' Jan. 4, contains an article by Mr. Gray on this subject. He discusses the recent researches of Ebert, and examines whether they are necessarily inconsistent with what is already known. According to Langley 2.4 per cent. of the radiant energy in the spectrum of an Argand gas flame lies in the visible part, and he assumed that only 25 per cent. of the total energy produced by combustion took the form of radiant energy; Thomsen found that only 15 per cent. appeared as radiant energy, which with 2.4 per cent gives 0.36 per cent. as the ratio of energy producing light, to the total energy of combustion in the Argand gas flame; assuming that the efficiency of the amyl acetate flame is about the same as that of oil or gas, it is theoretically possible for a lamp converting all the energy into luminous radiation to produce 280 times more light than the amyl acetate flame for the same expenditure of energy. Ebert found that his lamp gave 1,500 to 2,000 times more light than the amyl acetate lamp or from 5 to 7 times more than would be theoretically possible provided the same rate of expenditure of energy in the luminous part of the radiation produced the same candle power; experiments by Merritt (Amer. Jour. of Sc. vol. 37, p. 167) with the incandescent lamp show that the ratio of the expenditure of energy of luminous radiation to the candle power is by no means constant; there is nothing, therefore, inconsistent with these results in supposing that a given expenditure of luminous energy in the luminescent lamp produces 5 to 7 times greater intensity of light than the same amount of energy produces in the amyl acetate flame; the extraordinary efficiency of Ebert's lamp is, therefore, theoretically possible; he finds that the Argand flame, the amyl acetate lamp and incandescent electric light all give about the same candle power per watt of luminous energy; the ratio of the luminous energy to the total energy in the electric lamp giving 16 cp is, according to Merritt, .054, while in the amyl acetate lamp it is .0036; it is, therefore, 15 times as great in the former as in the latter, and one can, therefore, only expect about 100 cp in the luminescent lamp for 1 cp in the incandescent lamp.

Silvered Bulbs.—In an article in the "Zeit. f. Beleucht.," Dec. 30, the effects of silvering one-half of the bulbs, on the economy in lighting, is discussed. Two lamps were tested for candle power, first with the reflector and then after removing the silver coating; in the first case they gave 40 and 45 cp, and in the second case 16.9 and 17.3, measured in the direction of the axis of the reflector; this corresponds in one case to 3.488 watts per candle without reflector and 1.473 with reflector; for the second lamp 3.559 without and 1.368 with reflector. A table gives the total cost of power and lamps for 1,000 hours for different candle powers, with and without the reflector, which shows that with the usual incandescent lamp 375 hours cost as much as 1,000 hours with the reflector (this of course refers to the light in the direction of the axis of the reflector and not to the total diffused light).

Construction of Incandescent Lamps.—An article by Mr. Krueger is begun in the "Zeit. f. Beleucht.," Dec. 30; he intends to describe the lamp construction of different systems; in the present portion the "Seel" lamp is described.

POWER AND HEAT.

Diphase Transmission Plant.—A brief abstract of a description of a diphase plant installed at a French factory is given in the Lond. "Elec. Rev." and "Elec.," Jan. 4.

Cooking by Electricity.—Lond. "Lightning," Dec. 27, contains an article by Mr. Dowsing on this subject.

Operating Ships' Turrets.—An article is begun in Lond. "Engineering," Dec. 4, describing the installations on the new French cruiser Latouche Treville, and on the Chilian cruiser Capt. Prat, in which all the operations of working the guns and manœuvring the turrets are performed by electricity.

Transmission of Power.—The "Sch. of Mines Quart." for November contains an interesting paper by Mr. Self on "Electricity for Mining Plants," which, though referring more particularly to mining plants, is also of general interest. He considers only the question of the cost of generating the motive power at the mine (not including coal mines, of course, and that for transmitting it electrically from a distance. He takes the case of a mine the power for which is generated from wood fuel cut from the neighboring forests, and he finds that for a plant using 500 hp the total annual destruction of the forest exceeds 10,100 cords, or at 60 cords per acre this is equal to 167 acres per year; at the end of 10 years this means an area of 1 mile wide and 2.6 miles long; at a cost of $4 per cord at the mine, the total expenditure for power will be $75 per hp per year. He then calculates in a general way how far one may be justified in transmitting the power electrically to the mine. Since the cost of the generating and receiving plants will be substantially the same whether they are one or 50 miles apart, the problem becomes one of a determination of the possible distance over which it will pay to transmit the power. He develops a very simple general equation in which he substitutes the above mentioned cost for the power at the mine and from it obtains the number of dollars which may be spent for conductors and still keep the final total cost per hp per year the same; this he finds to be $312,500, after fixing upon the E. M. F. to be allowed and the per cent. loss on the line it is then a small matter to find the distance; for financial reasons it is unwise to spend such a large amount for copper, but assuming $50,000 and a 20 per cent. drop it will pay to secure and improve by storage reservoirs or otherwise any waterfall within a radius of nearly 14 miles for 2,000 volts, or 21 miles for 3,000 volts. By assuming the amount to be expended for pole line, etc., and substituting in this equation, one can determine the value of the electrical plant in the price of wood per còrd or coal per ton; the difference between the actual cost of fuel and the so-calculated cost may be taken as a convenient measure of the advantages of electricity over steam.

Proposed Transmission Plant.——A plant has been proposed to utilize the power of the Cedar River, Washington, some distance east of Seattle, the calculated power of which is 54,590 hp for 12 hours per day. A brief description is published in the "Eng. News," Jan. 17, but it refers entirely to the civil engineering features; in order to regulate the speed a differential governor is used driven by an independent source of power; the company proposes to sell the power at ¾ of a cent per hp hour, which represents an average saving of about 35 per cent. on the present cost of 13 separate power plants in that city.

Estimates for a proposed plant near Seattle are given in the "Elec. Eng.," Jan. 16. The power is that of the Snoqualmie Falls, Washington, 23 miles east of Seattle; it is 286 feet high and its theoretical capacity is 51,607 hp; it is intended to deliver about 5,000 hp at Seattle at $30 per hp; the Westinghouse Company has made an offer for the whole plant, at $350,000.

Niagara Falls Plant.—A short article in the "Elec. Eng.," Jan 16, gives some illustrations of the present plant, a previously published description of one of the alternators, and the recent letter of Prof. Forbes.

Tree-Felling Machine.—"Cassier's Mag." for Jan. contains an illustrated description of a machine made in Budapest in which a series of parallel holes are drilled by a simple portable device containing an electric motor.

TRACTION.

Accumulator Traction.—In a further communication of Mr. Epstein, in the Lond. "Elec. Rev.," Jan. 4, he states that the cost of renewals of the accumulator made by this company amounts to only 1.5 cents per car mile; that the outlay is much less in an accumulator system than with long distance transmission; that a battery reserve of 25 per cent. is ample, although 50 per cent. might be preferable; regarding the great cost of handling the batteries, which was recently stated to be very great, he states that a small road using only a limited number of cars, and presenting exceptionally unfavorable features, is no proper criterion, and that with light batteries this cost would be much reduced.

Acummulator Traction.—"Helios," Dec. 1, states that part of the tramways of Hagen, Germany, are to be equipped with copper-zinc accumulators; no further information is given except that they are claimed to be lighter and more durable than the lead accumulators.

Series Traction System.—In an article of a general character by Mr. Perry, in the Lond. "Elec.," Dec. 4, he discusses the relative merits of the series and multiple arc systems, pointing out the objections to the former, and its advantages; by the use of a system devised by himself he thinks that series traction has been rendered practical.

Electric Traction in Europe.—An article by Mr. Dawson is contained in the Lond. "Elec. Rev.," Jan. 4. He states that the working expenses of European trolley lines average considerably less than 11 cents per car mile, and the average ratio of operating expenses to receipts is well below 90 per cent.; that for the English horse car lines is 81 per cent., the working expenses being 19 cents. Germany has now 180 miles of track, with 630 cars, and more than 8,000 hp in operation, besides 230 miles additional, for which contracts have already been let. In Halle, Germany, there was one accident to every 88,638 car miles; on the Berlin horse railways there was one in every 41,625 car miles; in Boston it was 52,475.

The same journal contains an article by Mr. Holroyd Smith, on "The Present Position and Prospects of Electric Traction in This Country" (England). The article is general in character, and is chiefly of local interest.

A detailed discussion of the subject of the return circuit, by the same author, with numerous illustrations, is published in the "Bul. Ass. Ing. Elec. Montefiore," Dec. 15.

Electric Traction.—A long series of papers on this subject by Mr. Philip Dawson is begun in Lond. "Engineering," Dec. 4. The chief aim will be to describe briefly the present state of electric traction in the United States and Canada from data collected by himself during a recent visit to this country.

Light Railways in Belgium.—Major Addison's report to the Board of Trade on light railways in Belgium is published in the Lond. "Elec. Eng.," Jan. 4.

Municipal Ownership.—An editorial in the "Eng. News," Jan. 17, argues in favor of municipal ownership of street railways; "the best available remedy within great cities seems to be municipal ownership of the whole street railway system, and its lease to operating corporations on terms just to both parties, but leaving the absolute control in the hands of the city authorities. This is the plan now on trial in Toronto and in Detroit; and it has been long enough on trial in the first named city to prove the wisdom of those who carried the plan through against powerful and interested opposition. There are objections to the plan, we will admit; but these are far outweighed by the objectionable features of the present general abuse of power obtained for nothing by the street railway companies which have grown to such colossal proportions during the past few years."

Supplementary Wire.—In an article by Mr. Wynkopp, in the "Elec. Eng.," Jan. 16, he argues against the use of the supplementary return circuit between the rails; he shows that the rail bonds may be made sufficiently conductive so that this wire will not be required, the chief objection, however, being that it lasts but a short time. If it be suppressed and employed partly in increasing the bond capacity to that of the rail, the resistance will be reduced quite appreciably, although only about half of the copper saved has been added to the bond, showing that there is actually a saving of about 666 pounds per thousand feet, while the resistance of the return circuit has been decreased.

Single Rail System.—A description, with an illustration (showing no details) of the Beecher single rail accumulator system at Waterport, N. Y. (see Digest, Jan. 19), is given in the "Elec. Eng.," Jan. 16. The car has 50 cells of chloride accumulators, and a 5 hp slow speed motor, the car weighing 4 tons without passengers; it will seat 24 persons; on a recent trial trip, with 23 passengers, a speed of 19 miles an hour was obtained with an expenditure of only 3¾ hp. A contract has been made to construct and equip a 4-mile road from Waterport to Lakeside, on which speeds of 40 miles an hour, including stops, are to be made; the structure is normally 12½ feet above the surface; water power is to be used.

Electric Traction.—A portion of the discussion of the recent Institution (Lond.) papers (all of which was abstracted in these columns) is reprinted in the "St. Ry. Gaz.," Jan. 12.

Horse Power for Car Propulsion.—A correction and some additions to the simple rules mentioned in the Digest last week are published in the "Eng. News," Jan. 17.

New York Rapid Transit System.—The "Eng. News," Jan. 17, contains a communication from Mr. Reno, in which he enumerates the advantages of using his system in place of the one proposed by Chief Engineer Parsons; he claims that by using this system the cost will be within the legal limit, and that by no other plan can this be done; the article discusses only the civil engineering features.

Washington and Baltimore Line.—According to a reprint from a Baltimore paper, in the "Elec. Age," Jan. 19, this road, the length of which is 27.5 miles, will cost about $1,000,000; it will be operated by the block signal system; 20 motors of 100 hp will be used covering the distance in about 35 minutes; there will be two stations of 1,000 hp each.

Ohio.—According to the "Am. Eng." for January, the president of the Ohio Road Commission of 1893 proposes to build a great network of about 4,000 miles of electric lines at about $5,000 per mile, all over Ohio at the public expense, the counties pay half and the State the remainder; there is a probability that the scheme will be brought before the next Ohio Legislature.

Jersey City.—An illustrated description of the Jersey City, Hoboken & Rutherford R. R. Co. is published in the "St. Ry. Gaz.," Jan. 12.

New Haven.—A detailed description of the power house of the Fairhaven & Westville R. R. is given in the "Elec. Eng.," Jan. 16.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Possible Improvements in the Supply of Electrical Energy.—The Lond. "Elec. Rev.," Jan. 4, contains an article by Mr. Ferranti on this subject, in which he points out the directions in which progress must be made. Continuous current stations generally show better results in the way of cheapness of supply, but they are always in districts of small areas, and are incapable of extension; they can therefore never bring the distribution of electric energy to the position which it will surely attain; the distribution of electrical energy must be done on a large scale to be commercial, and to obtain this a large area must be supplied, and from a site not in the congested heart of a big city; this points clearly to the use of the high tension alternating current system, which therefore is the only one that can completely meet the conditions which are absolutely necessary. Cables are now being made at moderate prices, capable of conducting such high pressures, so that the question of voltage becomes "almost negligible;" there is little improvement to be looked for in this direction; if the other apparatus will stand 5,000 instead of 2,000 volts this increased pressure could be supplied through cables costing practically the same money for the same sectional area; the one seriously weak point is the question of transformers, and it is principally in this direction that one must look for improvement; the distribution after transformation is also an important point, and incandescent lamps ought therefore to be increased in voltage, and there ought to be a better system of wiring; the apparatus at the generating station is far too complicated to be able to be run cheaply and it is often of inferior quality;

engineers and capitalists have still got to learn 'that the best plant that money can buy is none too good for the purpose.'' Regarding the running economy he believes that it can be increased quite appreciably by superheating the steam to 450 or 500 degrees F.; there is no doubt that the internal combustion engine will be the cheapest and best motive power.

High vs. Low Pressure.—An article on this subject by Mr. Kennedy is contained in the Lond. "Elec. Rev.," Jan. 4. The only high pressure system which has survived, he states, is limited to that one in which sub-stations are supplied, from which low pressure wires are used; he discusses the circumstances under which the advantages of high pressure are great enough to warrant its adoption; if the low pressure feeders do not cost more than 10 per cent. over and above the high pressure feeders, including transformers, chambers, switches, conduits, and rectifiers if necessary, then continuous currents should be used, because in the form of continuous current electrical energy is much more generally useful; when first laid down a high pressure system will cost much less than the other, but this difference will be less later on as the load increases; it is only when the cost of the added low pressure mains is taken into account, which are required when the distribution increases, that a true comparison between the costs can be made; the advent of an improved storage so that the plant could be worked 24 hours a day would "knock the bottom out of the whole alternating current plant;" in such a system the generating plant now in use would supply just about seven times the present annual output; the future for the alternating current system lies in large transmission plants, in which case two or three phase currents must be used. He discusses compressed air as a rival in this field, stating that wonderful progress had recently been made with it in Paris. According to Prof. Unwin, air compressed by 1,000 hp to 132.3 lbs. per square inch can be transmitted 20 miles in the 30-inch main with a loss of pressure of only 12 per cent., and an air motor at the distant end would give a brake hp of 641; under more favorable conditions it is possible to obtain a total efficiency of over 70 per cent. He also discusses luminescence and does not think high frequency is necessary to produce it, merely intensifies the effect; he believes that luminescence is an effect of harmonics; he thinks there is not the slightest doubt of the ultimate success of this principle as a means of lumination, "and that, too, before long;" he also thinks that it is quite possible that luminescence lamps may be made requiring no vacuum.

Accumulator Installation.—A system of Messrs. Siemens & Halske is described and illustrated in the "Elek. Anz.," Dec. 30. It refers to the case when two series of accumulators are used in connection with a three-wire system, in which the regulation becomes somewhat complicated during the charging. In the present system a double switch disconnects the neutral wire from the middle point of the battery when it is to be charged and inserts at that point the auxiliary dynamo for generating the extra voltage, the two batteries being then in series with their other ends still in connection with the mains and the main dynamos; in this way the cells are charged. This auxiliary dynamo may also be connected directly to one pair of mains for direct generation during the heaviest loads. (This provides merely for charging the batteries alike, no provision being apparently made in case the two sets of batteries have been discharged unequally.) In case an equalizing machine is used for regulating the voltage during the charge, it is recommended to have the auxiliary charging machine coupled directly with the equalizing machine so that the latter will also serve as a motor for the former.

Lamps in England.—The Lond. "Elec.," Dec. 4, gives some interesting graphical statistics of the lamps connected or "lampages" in London and in the United Kingdom; the present totals for London are 925,000 and for the Provinces 670,000; in both London and the Provinces these are divided almost equally between the alternating and the direct current systems, being still slightly in favor of the latter; in the Provinces, the number of lamps is about equally divided between stations operated by municipalities and those operated by private companies, but in London the difference is very largely in favor of the companies.

Central Stations in the United Kingdom.—The Lond. "Elec.," Jan. 4, publishes as a supplement a large table containing a list of the stations in London and the Provinces with a considerable amount of tabular data for each; it includes also a table of those under construction and a map showing the locations; this is doubtless the best table of the kind which has been published.

Water Power Installation.—A small water power plant in France is described in detail with illustrations in "L'Elec.," Jan. 5.

Fecamp.—The description of this station is concluded in "L'Elec.," Dec. 29.

Statistics of Electric Fires.—The "West. El.," Jan. 19, contains a summary of the causes of electric fires by Mr. Merrill, the expert of the Underwriters' Electrical Bureau of Chicago, during the year ending Oct. 1, 1894; the number of fires attributed to each of a list of different causes is given; the total number of electric fires which have come to his knowledge was 475, representing a total loss of nearly one and one-half million dollars; in 319 cases there was little or no loss; he admits that the data is somewhat incomplete but states that it is very instructive.

Nancy.—A translation of the description, with illustrations, mentioned in the Digest Oct. 20, is published in the "West. El." Jan. 19.

WIRES, WIRING AND CONDUITS.

[illegible]—Mr. Enright in the Lond. "Elec. Rev.," Dec. 28 offers an explanation of the cause of the recent [illegible] street explosion. He suggests that the heat of the conductor might distill off from the insulating material an explosive gas of some sort; he found from experiment that every insulating material yielded, on heating, an explosive gas, at a temperature of 300 to 400 degrees C.; the fact was noticed at the time of this explosion, that there was no trace of coal gas nor was this gas found in the soil in the vicinity; none of the witnesses smelt coal gas, but many of them smelt india rubber and tar; furthermore, there was a dense smoke seen, which does not occur with the explosion of coal gas, but does, with the combustion of these distilled gases.

[illegible]—In an article by Mr. Monmerqué, begun in "L'Eclarige Elec.," Dec. 15, he describes the systems which were tried and abandoned, among them being that in which bare wires were suspended on insulators in conduits.

Air Circulation in Lead Cables.—In a short article in the "Elec. Eng.," Jan. 16, it is stated that a punctured cable in Paris was repaired by passing a current of dry air through the whole cable; at the end of 41 hours the insulation was far higher than when it was laid; this process has now become part of a regular method of cable repairing and has frequently been used; it also enables a break in the lead sheath to be easily found by the whistling of the compressed air as it escapes, the cables being suspended in the sewers. The apparatus for drying the air is described and illustrated and consists of 6 cylinders containing calcined chloride of calcium; the air pressure must not be too great, that used in this case being from 14 to 42 pounds per sq. in.; paraffine cables will no longer be used in Paris, where it is proposed to use paper cables with this new system of drying; no precautions need then be made to keep out moisture in making joints.

ELECTRO-PHYSICS AND MAGNETISM.

Luminescence of Glass Due to Cathode Rays.—A paper by Mr. Burke. "On a suggestion by Prof. J. J. Thomson (see Digest, Dec. 15) in connection with the luminescence of glass due to cathode rays," is contained in the "Phil. Mag." for January. More than 100 years ago Beccaria observed that when vacuum bulbs are broken in the dark a faint glow of light was produced where the bulb lay. The present paper describes a series of researches, the object of which was to find an explanation of the phenomenon; the paper should be read in its entirety, but the following extracts will give an idea of its contents. Large incandescent lamps give a greater intensity than small ones, while very small ones produce no effect at all; by placing a plate of glass over a receiver exhausted to 20 mm. and breaking the glass a beautiful stream of white light was visible throughout the whole receiver, including a number of luminous spots; it was not possible to photograph it; the luminous spots were large when the fragments of glass were large, indicating that they had become luminous; thin, brittle plates of cast iron yielded no results; the presence of a gas is essential, although any gas sufficed to produce the effect. He investigates the three hypotheses, first, that it was due to the bombardment of the molecules of air against the glass; second, to the collision of the fragments of the glass with each other; third, an electrical phenomenon caused by the rubbing of the air against the glass. He tests each of these separately and finds that the results do not seem to harmonize with the first hypothesis; no light was produced in the absence of fragments of glass, which together with other results seem to justify the second hypothesis; no effect however could be obtained with fragments of cast iron, ebonite, sealing wax, bone, etc. The experiments do not seem to throw much light on the Crookes theory of luminescence due to the emitted particles of gas. Experiments to investigate the third hypothesis led to no interesting results.

The Future of Electricity.—An article on this subject by Mr. Walker is contained in the Lond. "Elec. Eng.," Jan. 4; he discusses the possibilities of the (somewhat remote) future, laying stress on the energy of wind, water and the sun's rays, and its possible utilization.

Alternating Current Condensers and Dielectric Hysteresis.—A paper by Messrs. Bedell, Ballantyne and Williamson read at the Madison meeting (August, 1893,) of the American Association for the Advancement of Science, is abstracted in their Proceedings (recently published). They describe investigations undertaken to determine the behavior of condensers when used on alternating current circuits, particular attention being given to hysteresis in the dielectric. The paper was printed in full in the "Phys. Rev.," vol. 1, No. 2, 1893.

Irregularities in Alternating Current Curves.—A paper by Messrs. Bedell, Miller and Wagner read at the Madison meeting (August, 1893,) of the American Association for the Advancement of Science, is abstracted in their Proceedings (recently issued). They show that instantaneous curves have marked irregularities so that one period should not be taken as typical. The whole paper was printed in full in the "Phys. Rev.," vol. 1, No. 3, 1893.

The Electric Strength of Solid, Liquid and Gaseous Dielectrics.—A paper by Prof. Macfarlane and Mr. Pierce read at the Madison meeting (August, 1893,) of the American Association for the Advancement of Science, is abstracted very briefly in their Proceedings (recently issued). It contains an account of measurements made with paraffined paper, beeswaxed paper and kerosene oil, also a discussion of these results together with those previously obtained by Macfarlane and Steinmetz. The paper was printed in full in the "Phys. Rev." for November, 1893.

Origin of Frictional Electricity.—A translation of the article, with illustrations, which was mentioned in the Digest Dec. 2, is published in the "Elec. Age," Jan. 19.

Automatic Toepler Pump.—A paper by Prof. Morley read at the Madison meeting (August, 1893,) of the American Association for the Advancement of Science, is abstracted very briefly in their Proceedings (recently issued). It is operated by water pressure and has the special advantage that the mercurial pump may be placed anywhere in a building and moved about as easily as an ordinary pump while the air pressure is permanently fixed. The paper was reprinted in full in the "Am. Jour. Sci.," 1894.

ELECTRO-CHEMISTRY AND BATTERIES.

Copper-Zinc Alkali Battery.—In the "Elektrochem. Zeit." for January Mr. Oppermann, describes the following method for making a very cheap copper oxide electrode for these cells. Plates of carbon are immersed in a saturated solution made by dissolving copper scrap in nitric acid, and are afterwards dried; this is repeated until they are thoroughly saturated; after they are thoroughly dried they are heated, slowly at first and afterwards quite hot until all the copper nitrate is changed into copper oxide, care being taken that the copper oxide is not reduced to copper; this can be done without difficulty; these plates are more porous and, therefore, are very active; they may be regenerated by being washed with water and allowed to dry for several days in the air; he adds that with this the voltage is 1.2 as against 0.8.

Boron-Carbon Battery.—The "Chemical News," Jan. 4, contains an article by Mr. Warren in which he makes great claims for a battery which he has invented "capable of producing 3 volts and giving a constant current from 2 to 2.5 for almost unlimited duration." "The cells themselves are constructed upon the flat system, with sliding carbon plates enclosed in teak wood boxes, the carbons being chemically prepared by special treatment, whereby gaseous compounds of boron are so decomposed as to allow of the boron becoming absorbed into the pores of the carbon, which are afterwards soaked in a solution of oxalate of platinum, and heated to redness in an atmosphere of hydrogen. A flat porous cell encloses the zinc element while the outer cell contains a specially prepared manganic salt in admixture with each other substances." Over 2 feet of platinum wire was raised to an incandescence by 12 cells in series; for driving motors one cell "is usually sufficient."

Primary Batteries.—According to the Lond. "Elec. Rev.," Jan. 4, Prof. Jamieson in a recent interview stated that the "Walker-Wilkins non-polarizing wet battery gave a return in ampere hours of 97 per cent. efficiency of the theoretical possible output per pound of zinc in the battery," and that it would be difficult to surpass such results.

Products of Salt Electrolysis.—The Lond. "Elec. Rev.," Jan. 4, mentions some improvements regarding the method of dealing with the products, devised by a French company; the chlorine and alkali solutions being brought together outside of the apparatus, are used in the manufacture of hypochlorite of sodium, or the chlorine is used separately and the soda is mixed with litharge in a digester in which the hot solution is then carbonated, forming white lead, the liquid being further carbonated for the production of insoluble carbonate in solution of sodium chloride, the mother liquid being afterwards returned to the electrolyzer.

Plating Baths.—The paper of Dr. Krueger describing simple methods for determining the condition of electroplating baths is continued in the "Elektrochem. Zeit." for January; he discusses copper sulphate cyanide baths.

Diaphragms.—An article in the "Elek. Anz.," Jan. 3, gives a brief summary of the descriptions of diaphragms which have been proposed and patented, for various electrolytic purposes.

Manganese.—According to the "Ind. and Iron," Jan. 4, a firm in Hanover have succeeded in obtaining absolutely pure manganese in the form of a fine powder by an electrolytic separation from its compound; alkaline chlorides and chloride of manganese are employed in the crucibles.

Quantitative Analysis.—A description of a laboratory for electrolytic analysis, by Prof. Classen, is abstracted in the Lond. "Elec. Eng.," Jan. 4.

Cathodic Polarization.—A paper by Roszkowski from the "Zeit. f. Phys. Chem.," vol. 15, page 267, is abstracted at some length in the "Elektrochem. Zeit." for Jan.

Electrolytic Polarization.—A paper by Prof. Daniel read at the Madison meeting (August, 1893,) of the American Association for the Advancement of Science, is abstracted at some length in their Proceedings (recently issued). The abstract gives a summary of the results of experiments to study the polarization phenomena on very thin metal partitions in different electrolyte and under various conditions as to thickness of partition, current strength, temperature, etc. The paper was printed in full in the "Phys. Rev." and "Phil. Mag."

Generations of Oxygen and Hydrogen.—A paper by Prof. Nichols and Mr. Moler read at the Madison meeting (August, 1893,) of the American Association for the Advancement of Science, is abstracted very briefly in their Proceedings (recently issued). They describe the apparatus used at the Cornell University where the gases are stored for lecture purposes; after mentioning the difficulties in using various apparatus, he describes the present very successful form, the essential features of which are, very deep glass jars with electrodes inserted separately in long vertical tubes, the use of platinum for the oxygen side and lead for the hydrogen side.

Electro-deposition of Iridium.—A paper by Prof. Dudley at the Madison meeting (August, 1893,) of the American Association for the Advancement of Science, is abstracted very briefly in their Proceedings (recently issued). A solution of sodium iridichlorid, ammonium iridichlorid, ammonium iridisulphate, were found to give good results; the bath was kept at uniform strength by using anodes of carbon surrounded by linen bags containing iridium hydrate which dissolves as fast as the acid is set free, a method which is generally applicable when the anode is insoluble.

Electroplating Hulls of Vessels.—A test of a process was recently made in Jersey City, a short description appears in the "Elec. Age," Jan. 19; the vessel was badly corroded and covered with incrustations. Tanks 5 feet square are applied to the side of the vessel, they are about 18 inches deep; the tank is first filled with strong acid for 24 hours, then with a solution of cyanide of copper for 24 hours and a current of 900 amperes at 6 volts is used, after this a solution of sulphate of copper is used with a current of 900 amperes at 3 volts for 4 days, after which the thickness of the coating is 1-16 of an inch. It is stated that the Government inspectors have expressed the opinion that the process is practicable and effective; it is stated that at present it costs the Government $100,000 for cleaning and painting the cruiser Chicago for a three years' cruise.

Electrosynthesis.—The "Amer. Chem. Jour." for December contains a long paper by Mr. Weems on "Electrosynthesis by the Direct Union of Anions and Weak Organic Acids."

Hermite System.—The conclusions of the Havre commission regarding this process are published in the "Elec. Age," Jan. 19.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Specific Heat of Water.—A Royal Society paper by Messrs. Schuster and Gannon is abstracted in the Lond. "Elec.," Jan. 4. They describe their determination of the specific heat of water in terms of the international electric units; the electrical energy was measured by measuring the voltage at the terminals and the quantity of the current by a silver voltameter, in which case it is not necessary to know the resistance of the wire nor to measure time. Their final value for J is 4.1804 Joules on the mercury thermometer scale, 4.1905 on the nitrogen scale, all at a temperature of 19.1 degrees. They refer to the recent value of Griffiths, which is exactly one-tenth of a per cent. larger. They discuss the various values of Joules equivalent; they give the equivalent in foot-pounds at Greenwich at 19.1 degrees referred to the Paris nitrogen thermometer as follows: Joule 774, Rowland 776.1, Griffiths 779.1, Schuster and Gannon 778.5. There seems to be a difference in the values obtained by the electrical and those obtained by the direct methods; whether this difference is due to some remaining error in the electrical units or to some flaw in the methods adopted by Griffiths and by themselves, remains to be decided by further investigation.

Simple Students' Apparatus.—The question whether labor saving apparatus should be used as an instrument of education, which was brought up by the recent paper of Prof. Ayrton and Mr. Haycraft (see Digest, Jan. 12) is discussed by Mr. Griffiths in Lond. "Elec.," Jan. 4. He contends that the student should at no time use an instrument until he has thoroughly mastered the principle on which its action is based; he should also be instructed how to ascertain the errors even with simple instruments like the balance.

The same subject is discussed editorially in the Lond. "Elec. Rev.," Jan. 4, the ground taken being, that the object of the experiment was to give a concrete idea of the mechanical equivalent of heat, in the simplest way and free from all elements of perplexity, and that it was not intended to be a lesson in calibration; it should be termed an experiment as it is in no sense a determination.

Quartz Fibres.—The Lond. "Elec Rev.," Jan. 4, recommends those who intend to use such fibres to consult the very full and clear directions given by Mr. Boys in the "Proceedingsof the Phys. Soc.," Vol. 13, part 1st, page 69.

Muzzle Velocity of Shot.—A description of a method for determining this, taken from a Cantor lecture by Prof. Lewes, is briefly described in the Lond. "Elec. Eng.," Jan. 4.

Photometry.—An abstract of a note by Mr. Ferry read at the Madison meeting (August, 1893,) of the American Association for the Advancement of Science, is abstracted in their Proceedings (recently issued). He gives the results of tests made to find out whether it is correct to interpose a rotating disk having sectors removed in known proportion to the area of the whole disk and then to assume that the ratio of the light which passes through to the whole light is the same as that of the open part to the whole disk. He concludes from the tests that: (1) the effects of this light upon the retina will not always be in this proportion; (2) with mixed light containing elements of different luminosities it will appear not to cut off all the elements in equal proportion but will intercept most strongly the elements of low luminosity; (3) with any given light the error introduced by the use of the disk increases as the aperture of the disk diminishes; (4) with ordinary illuminants the error is negligible when the total aperture of the disk is more than one-half of the entire disk, but rapidly increases as the aperture diminishes.

Electrostatic Volt Meter.—A simple portable form devised by Prof. Rowland is described and illustrated in the "Elec. Eng.," Jan. 16; it appears to consist simply of the usual quadrants and needle, but they are immersed in a liquid of sufficient insulation and high specific inductive capacity, such as various kinds of oils.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Long Distance Telephone.—From a brief summary, on long distance lines, published in Lond. "Engineering," Dec. 4, it appears that communications could be carried on very distinctly between Hamburg and Trieste, via Berlin and Vienna; the lines in Scandinavia opens up a theoretical possibility of connecting Northern Sweden with Southern Austria.

Grapnel.—A new form of submarine cable Grapnel, for use in recovering cables lying on rocky bottoms, is described and illustrated in the Lond. "Elec. Rev.," and Lond. "Elec.," Jan. 4.

Accumulators for Telegraphy.—In an article by Mr. Gray in the "Elec. Eng.," Jan 16, he gives a brief description of the plant of chloride accumulators installed at Albuquerque which supply the current for the circuits of the Postal Telegraph Company between Chicago and San Francisco.

Railroad Signaling.—The "Tran. Am. Soc. Civ. Eng." for Nov. contains a long paper by Mr. O'Donnell on railroad signaling with special reference to the block system; the paper seems to be limited almost entirely to the English systems; it is accompanied by a number of illustrations and by discussion of some considerable length.

Cable Signaling.—The recent paper of Mr. Delany (see Digest, Dec. 22, Jan. 5,) is reprinted in "El'ty," Jan. 16.

Transmitting, Recording and Seeing Pictures.—A selenium apparatus invented by Mr. Carey in 1877 is described and illustrated by him in the "Elec. Eng.," Jan. 16.

Peculiar Telephone Troubles.—The article by Mr. Mix abstracted in the Digest last week is reprinted in full in "El'ty," Jan. 16.

Telephone.—The one described in the Digest Dec. 8 is described and illustrated in the "Elec. Eng.," Jan. 16.

MISCELLANEOUS.

Carbons.—According to an English patent to Girard & Street the ordinary carbons for lights, batteries and electrolysis, are heated in an electric furnace to such a high heat "that they become soft and melt" the carbon being thereby transformed into graphite.

Graphite.—An academy paper of some length by Mr. Moissan is reprinted in the "L'Elec.," Jan. 5. He gives a review of a number of researches which he has made with this variety of carbon.

Electrical Events in 1894.—A list of the most important electrical events during the past year, in chronological order, is published in the Lond. "Elec.," Jan. 4.

New Product of the Electric Furnace.—The "Jour. Frank. Inst." for Jan. contains an interesting abstract from the Secretary's report. He refers in general to some of the new products and more particularly to the reproduction of calcium carbide (CaC^2) which is produced by mixing lime and carbon together and heating it in the electric arc. He attributes the discovery of this to Mr. Willson and quotes largely from an article in the "Eng. and Min. Jour.," Dec. 15. The current in the arc used was 4,000 to 5,000 amperes; arrangements have been made for the manufacture of this product on a large scale; it is stated that one short ton of the product requires 1,200 lbs. of fine coal dust, 2,000 lbs. of burnt lime and 180 electric hp per hour for 12 hours, which is not far from that required by theory; allowing $2.50 for the coal, $4 for the time, $6 for the energy and $2.50 for the labor, etc., makes a cost of $15 per ton; this refers to a place where there is cheap water power, coal, lime and labor; he believes that it will soon be manufactured extensively in this and other countries; the chemical combination involves heat to the amount of 61,000 units; he gives the properties of this material the chief one being that when dropped in the water it generates pure acetylene, one of the richest illuminating gases; to produce 2,000 lbs. of this gas will cost $37 on a basis of $15 per ton for the calcium carbide. He gives the properties of the gas which is much more luminous than olefiant gas; by passing electric sparks through a mixture of this gas and nitrogen, hydrocyanic acid is produced. He believes that this opens up such a scope for researches, the results of which will undoubtedly be revolutionary; one short ton of calcium carbide will produce about 10,500 cu. ft. of acetylene equal in illuminating value to 100,000 cu. ft. of city gas of 22 to 25 cp per 5 ft. burner; allowing for freight, profit, etc., such a gas could be obtained at nearly all points for 30c. per 1,000 cu. ft.; the ease with which the carbide can be shipped and the gas be prepared, should enable it to be adopted if not for the common supply of large cities, to supply the requirements of country hotels, dwelling houses and railway cars.

Carborundum.—The "Sch. of Mines Quart." for Nov. contains a short paper by Mr. Mathews on its history, physical properties and chemistry.

How Does Electricity Kill?—The "Elec. Eng.," Jan. 16, contains an article by Mr. Rosa in reply to the one by Mr. La Roche (see Digest last week.) He gives the results of 12 different measurements of the human body from hand to hand under different circumstances showing it to vary from 57,000 ohms with dry fingers grasping fine copper wires to 1,570 with wet hands grasping brass tubes or hands immersed in water containing salammoniac; with alternating currents and probably better contacts, it was 1,100 ohms, in which case 11 volts gave as strong a current as he cared to take, and that was only 0.01 ampere. He therefore cannot see how the resistance may be as low as 800 ohms with an accidental contact. Experiments with animals in which the voltage only is given are worth almost nothing and are even misleading, as it is the current that effects the body and not the voltage; he describes an experiment with a cat showing how important it is to state the current as well as the voltage. In reply to Mr. La Roche he adds that volts do not pass through anybody; also that with a long spark through the air probably only a small fraction of the total voltage is spent on the body. In high voltage discharges obtained from Leyden jars, the oscillations are separated by periods of rest, hence the maximum values of the current may be many times as great as the average; a Leyden jar discharges in so short a time that the current might be as great as 10 or even 100 amperes, and under some circumstances might flow back and forth many times before the discharge is completed. He distinguishes between two kinds of high potential discharges, those produced by Tesla with an alternator and those produced by Thomson with Leyden jar discharges; in the former case the oscillations will be even and of small amplitude, while in the second case there will be periods of rest and the amplitude will be much greater, the maximum current will, therefore, be much greater in the second case than in the first; it seems probable that the physiological effects are due to the maximum current; in either case, however, the effect is vastly less than when a Leyden jar is discharged through the body, for the current is relatively small, the larger part of the voltage being dissipated in the air.

So-called Negative Lightning.—A paper by Prof. Stevens read at the Madison meeting (August, 1893,) of the American Association for the Advancement of Science, is abstracted very briefly in their Proceedings (recently issued). In several lantern slides obtained by the aid of the camera, there were revealed black branches sent forth from the main lightning stem; for these he discusses two hypotheses, that it was due to chemical reversal on the photographic plate, or that it was due to atmospheric absorption; he prefers the second.

Ozone.—A portion of the recent paper of Dr. Froelich abstracted in the Digest Nov. 17 is reprinted in "El'ty.," Jan 16.

New Books.

The Elements of Physics. By Henry S. Carhart, M. A., Professor of Physics in the University of Michigan, and Horatio N. Chute, M. S., Instructor of Physics in the Ann Arbor High School. Boston: Allyn and Bacon. 382 pages, 298 illustrations. Price, $1.50

This is a book for the class-room as distinguished from a manual for the laboratory. The experiments are mostly qualitative to illustrate principles. The sequence of topics is such that the pupil may pass from subject to subject with the aid of what he has already acquired. It is claimed with justice that every experiment, definition, and statement of principle is the result of practical experience in teaching classes of various grades. As a result we have a clearly formulated statement of facts such as every student should be thoroughly acquainted with before he sets out to explore for himself. If all were teachers like these, we should have no more of the silly method of putting to work an ignorant student to re-discover the laws of physics without benefit from the experience of others. The get-up of the book is in keeping with its other claims for clearness. At the head of a paragraph the subject is given in full-faced type. Laws are given in italics, as well as words and terms defined. Directions for experiments are put in type a size smaller than the context. The reviewer can unhesitatingly commend this book to teacher and pupil.

Telephone Patents.

The counsel of the Harrison International Telephone Company has addressed a letter to the Central Union Telephone Company, Chicago, in regard to a circular issued by the latter, giving notice that "the American Bell Telephone Company owns Letters Patent No. 463,569, granted to Emile Berliner, Nov. 17th, 1891, for a combined telegraph and telephone, and controls Letters Patent No. 474,231, granted to Thomas A. Edison, May 3d, 1892, for a speaking telegraph, which patents cover fundamental inventions and embrace *all forms* of microphone transmitters and of carbon telephones," and which rights the Central Company controls in its territory.

"The reception of these circulars and alleged infringement notices are a constant annoyance, damage and injury to our clients, their customers and their business affairs," says the counsel of the Harrison Company. "These notices cannot be intended for any other purpose or effect than a threat of intimidation to the parties to whom they are sent, and an attempt upon your part to scare out and drive away buyers and users, present and prospective, of our client's telephones, and to harass and embarrass their business arrangements in all parts of the country, present, contemplated and prospective. We are well aware that the equity courts of this country are powerless to prevent these vicious and unwarranted proceedings upon your part, but we are aware, also, that both the civil and criminal courts of this country are open to our clients, upon their part, to stop this performance. Neither the American Bell Telephone Company, your company, or any other company, corporation or individual has any patents upon 'fundamental inventions that embrace all forms of microphone transmitters and of carbon telephone.' The Patent Office of this country issues no such patents and you certainly have none, or the protection of any such patents, and the American Bell Telephone Company owns no such letters patent, nor do you own or act under any such patents. One of the letters patent, viz.: The Emile Berliner patent of Nov. 17th, 1891, made prominent in your circular as one of these patents, has just been branded by a high federal court of this country as a fraud, and its judicial extinction ordered. No suit has ever been brought by the American Bell Telephone Company or yourselves, jointly or severally, under either of the patents identified in your notice, nor will ever be brought against our clients or any of their patrons. We have simply to state to you that upon any further action upon your part, in sending out these notices to our clients, or their patrons, you will be held personally responsible in every form of action civil or criminal, known to the law for such procedures, and we have been thus definite with you as to this matter so that hereafter there can be no mistake as to your position or ours."

Telephone Switchboard.

We illustrate herewith a diagram of the switchboard system of the National Telephone Manufacturing Company, of 620 Atlantic avenue, Boston, Mass. This system has been the subject of much thought and it is claimed that in no particular does it infringe any of the numerous switchboard patents of the American Bell Telephone Company. To illustrate the operation of the switchboard, we will suppose that station No. 50 desires to talk with station No. 75; placing the receiver to his ear the former presses the bell box button or depresses key *R* and calls into the transmitter. This connects him with the exchange, and he asks the operator to connect "75 on 50", then releasing the button or key. The operator then makes the desired connection at the switchboard, and the subscriber replaces his receiver in the holder and rings up 75; the operator may do the ringing up, but it is thought more desirable, in order to save the operator's time, to have the subscriber attend to this. A relay or night alarm is attached to the switchboard, which enables the operator's services to be dispensed with, as the alarm will call a clerk to the board to make the desired connections, and afterwards the subscriber can do his own ringing.

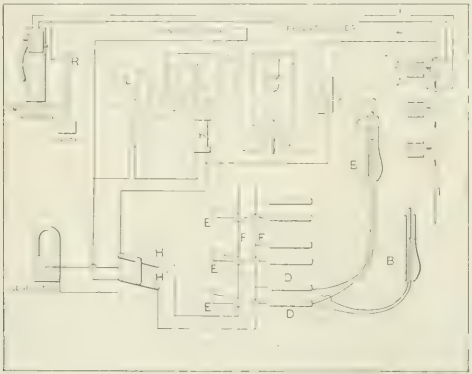
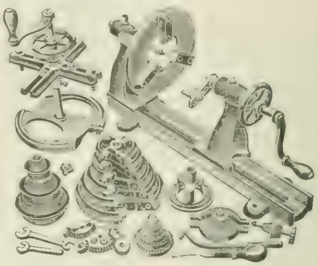


DIAGRAM OF TELEPHONE SWITCHBOARD.

Switchboards of this system for twenty-five to fifty stations can be placed in country stores or post-offices where clerks are in constant attendance. They take up very little room, the dimensions of a board for from 25 to 200 stations being not over five feet high, three feet wide and two feet in depth. Boards for 200 subscribers and upwards are made in the form of tables, with transmitters at each corner.

Valve Reseating Machinery.

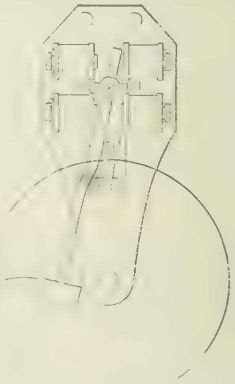
We illustrate herewith a valve seating machine with its outfit of parts, manufactured by F. S. Dangerfield, Auburn, N. Y. These machines are designed to repair steam, water, oil and ammonia valves, both flat and taper or conically seated, and without disconnecting the valve shells from the pipes. By this process it is claimed that valves may be renewed 10 or 15 times and with very little time required at each removal. The machine illustrated has an extension frame for an entire length of valve stem and the various parts shown are adjustable cutters, blanks for the inside of valve discs, a device for cutting flat or taper seats without disconnecting the valve shells, taper guides of various sizes, a guide for ammonia valves, a dog for check valves, extra spindles, collars, etc. The size of the machine illustrated will reseat 15 different sizes of valves from [illegible] to [illegible] inches



VALVE RESEATING MACHINE AND PARTS.

A New Electric Bell.

No kind of simple electrical apparatus is more generally known or made than electric bells, and it would seem that all possible changes had been rung in the various forms given to this staple article. Recently, however, a new form has been introduced by J. H. Bunnell & Company, 76 Cortlandt street, which is claimed to mark a distinct advance in this line of electrical appliances.



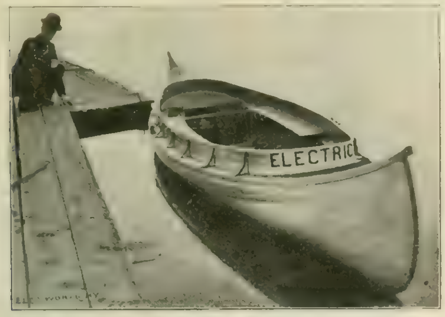
NEW VIBRATING GONG.

The action of this bell differs from that of other forms, in being independent of springs. The hammer is withdrawn after its forward stroke, by the attraction of an extra pair of magnets, thus placing it in position to give a strong rebound to start and assist the forward stroke, which is then made with the added attraction of a separate pair of magnets.

The hammer moves twice as far, and is about three times as heavy as in old forms. It does not have to overcome the force of any spring in its forward stroke, but is helped instead by a powerful recoil from the backward movement. The result claimed is that, with an equal amount of battery power, the blow delivered on the gong is fully trebled as compared with the old method. The illustration gives a view of the mechanism of the new bell.

A Small Electric Launch.

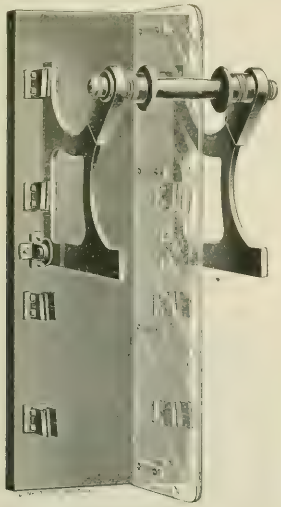
The electric launch illustrated herewith is owned by Mr. W. H. Chapman of Oldtown, Me., and has been in successful operation during the past season. The length over all is 21 feet 6 inches, the width—sponson included—4 feet; the width inside is 3 feet, and the depth, 14 inches. The launch or canoe is made of canvas and lined inside with cedar. It carries fourteen cells of chloride storage battery of 150 ampere hours capacity. The motor is of the multipolar type, geared down four to one, and runs without noise. With four persons, a speed averaging eight miles per hour for ten hours has been made. The operator has full control of the craft from the bow. The rudder is connected with a small flexible shaft worked by a steering wheel in the bow.



SMALL ELECTRIC LAUNCH.

A New High Potential Switch.

We illustrate a new type of high potential knife switch designed by Mr. Charles H. Herrick, and manufactured by the W. S. Hill Electric Company, 133 Oliver street, Boston, Mass. The engraving shows one of a group of six switches now in use by the Narragansett Electric Lighting Company, of Providence, R. I., where they are successfully carrying alternating currents of 400 amperes and 1,000 volts. The switch has a very quick break, with a flash guard between its opposite poles; it breaks both machines and circuit, and has its yoke at a point of absolute safety, both to operator and switch. In operation there is no flash when the switch is thrown, and only the slightest possible "wink" in the lamps to which it supplies current.



HIGH POTENTIAL SWITCH.

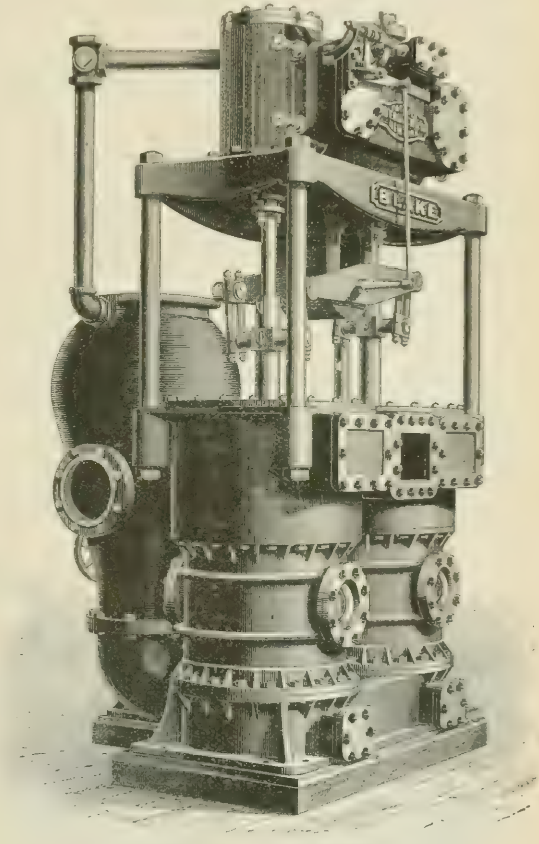
The switch shown is adapted for use on the front of switchboards, but designs have been completed for the same type of switch to be placed on the rear of the board. This latter type is operated by a lever and handle extending through a slot cut in the switchboard. The switch has solid cast copper blades, micanite insulation on the yoke, and the Hill reinforced contacts, and will be given a carrying capacity of 50 per cent. in excess of its regular duty to allow for all reasonable overloads. It is adapted for all varieties of duty from 110 and 500 volt circuits, to alternating circuits of 2,000 volts and over.

It is the intention of the manufacturers to build these switches, to which the name of "the Herrick High Potential Switch" has been given, in all sizes and types as demand may arise for them, and to perform any special duty.

The alternating switchboard designed by Mr. Herrick for the Narragansett Electric Lighting Company, on which the switch is shown, is capable of handling 50,000 to 100,000 16-cp lamps. The board is of Italian marble, 28 feet long and 6 feet high, and is so designed that all changes of machines and circuits may be made instantly and without the use of plugs or cables of any sort, and to admit of the generators being arranged to run in multiple or independently as desired.

Vertical Twin Air Pump and Jet Condenser.

The accompanying illustration shows the well-known Blake vertical twin air pump of the Geo. F. Blake Manufacturing Company, 95 Liberty street, New York, with the addition of an automatic jet condenser. This air pump, in connection with a surface condenser, is similar to those that have been so successfully applied to all the later large United States naval vessels, like the "New York," "Columbia," "Minneapolis," "Indiana," "Massachusetts" and others. The power necessary to run the pumps as taken from the official tests was only about one-fourth of one per cent. of the total power of the main engine, while in the case of the last vessel tried, the "Minneapolis," this power ran as low as one-sixth of one per cent.



AIR PUMP AND JET CONDENSER.

Owing to this remarkable success the Blake Company was induced to apply its air pumps to stationary engines, and for this purpose attached to them its automatic jet condenser. This form has now been adopted by many large electric light and power plants in San Francisco, Chicago, St. Louis, Cincinnati, Baltimore, Philadelphia and Boston. Not only is this arrangement adapted to stationary engines, but the application to marine engines, especially for fresh water service, is very desirable, as compactness, minimum weight and efficiency are all indispensable qualities for this class of service.

The composition lined air cylinders are furnished with single acting buckets containing small disc valves. The foot valves are similar to these and are placed in the lower suction base of the pump. The pistons of the steam cylinders are connected rigidly to the air buckets through the medium of the bucket rod and piston rod, which are both securely keyed in a common crosshead. The two crossheads are attached to the working beam by means of two pairs of links, thus making the two sides of the pump act together and producing a very steady and uniform motion. The steam pistons are controlled by ordinary "D" slide valves connected together by levers and links, receiving their motion from an auxiliary piston which works in a horizontal cylinder shown in front of the main steam chest. The steam to work this auxiliary piston is distributed by a small auxiliary slide valve also of the ordinary "D" shape, which is attached to the exposed valve stem. The latter has two small adjustable collars engaging with one lever of a bell crank, which receives its motion from a connection attached to the working beam. By adjusting these collars on the auxiliary valve stem, the pump can be made to run short or long stroke at will with no possibility of stoppage, however slow it may be running.

The steam consumption can also be reduced to a minimum by utilizing the heat of the exhaust steam from the pump cylinders in raising the temperature of the feed water, or passing the exhaust into a receiver of the main engine if of the compound or triple expansion type.

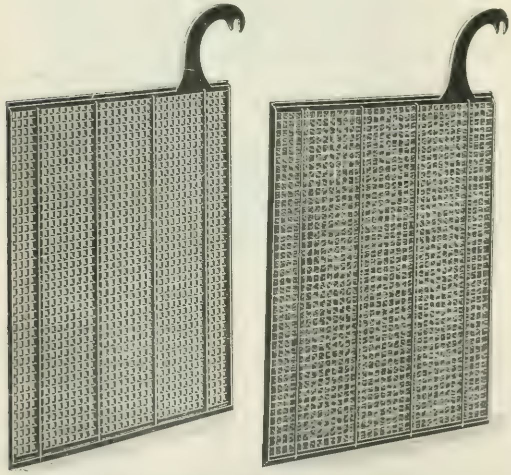
The Hess Storage Battery.

The storage battery we illustrate, manufactured by the Hess Storage Battery Company, 246 Arch street, Philadelphia, is claimed to differ fundamentally from other storage batteries through the employment of a double electrode.

The active material in this battery is not pasted upon a single lead plate, exposed directly to the action of the elecrolyte, but the lead plates are in pairs, forming what is termed a double electrode or conducting body for the active material, which is interposed between the two plates. These plates are perforated, as shown in Fig. 1, and are entirely covered with an insulating material, excepting those portions of the inner faces of the plate indicated by the light lines in Fig. 2.

The perforations of the plates are filled with a non-conducting material of great porosity, composed of quartz sand, the particles of which are held together by asphalt. These plates are used in pairs—two being necessary to form one electrode. They are put together with the exposed lead surfaces facing each other, and are so arranged that the exposed lines, both vertical and horizontal, of one plate are not directly opposite the corresponding lines on the other plate, but half a space removed, thus reducing the dimensions of the squares formed by the exposed lines one-half and doubling the amount of conducting surface. By this arrangement it is claimed that no more metal is required for a double electrode than is customarily used in the accumulator type of pasted grid. The plates are provided with projecting ribs, shown in Figs. 1 and 2, which form a space for the introduction of the active material.

The electrodes are assembled in the usual manner, the double electrode with its two plates representing one element. The insulators or separators between the electrodes are hard rubber strips, with buttons at intervals of two inches. The object of using separators of this peculiar construction is to allow a free circulation of the electrolyte from all parts of the cell between the plates. The electrodes are held together as indicated in Fig. 4, soft rubber washers being used to allow for expansion.



Figs 1 and 2.—Hess Storage Plates.

After the assembling of the electrodes they are placed in a cell, which is constructed of wood and lined with thin sheet lead. The electrolyte is then introduced, completely immersing the electrodes, and then the plates are ready for receiving the active material.

In the application of the active material an appliance called a conveyer is used, as shown in Fig. 3. The illustration shows the conveyer applied to a single cell, but in setting up a battery installation the material is applied to the entire set of cells by the operation of a continuous conveyer. This conveyer forces the active material into tubes or conductors, which register with the spaces between the two plates of each electrode; from these conductors the active material falls between the plates, until the space is filled, thus being brought into contact with the exposed conducting surfaces of the plates shown by the lines in Fig. 2, and the cell is now ready for the charging current. Fig. 3 is made from a photograph of a completed cell whose dimensions are 19x21x24 inches, composed of nineteen electrodes 18x20 inches, with conveyer for the introduction of the active material.

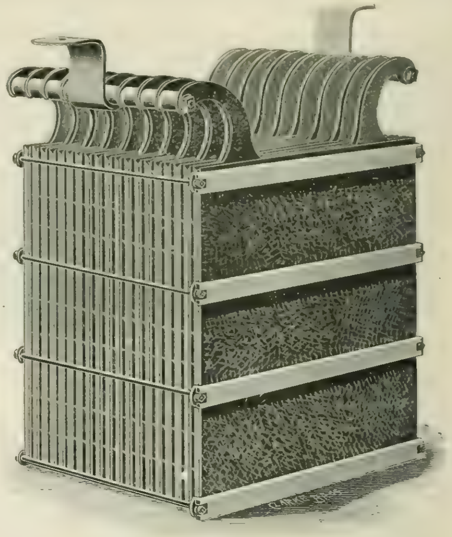


Fig. 4.—Completed Cell.

The manufacturers claim that the Hess storage battery is the only one in which there are no exposed metallic surfaces, in which the conducting plates are protected from consumption, and that has a protection to prevent disintegration and falling of the active material, without the necessity of filling up the spaces between the electrodes. Other claims are that it is the only storage battery to which the active material is fed after the plates are immersed in the battery fluid, and in which the perforations of the conducting plates are filled with a non-electric conducting porous material.

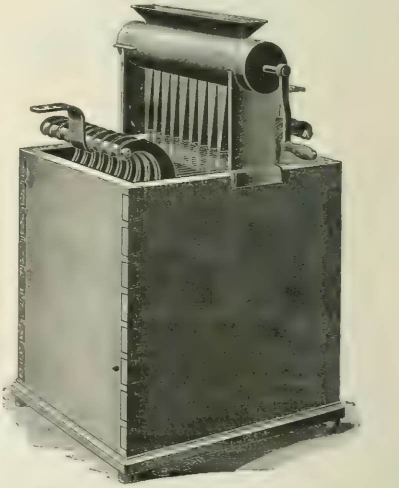


Fig. 3.—Applying Active Material.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Jan 19, 1895.

GENERAL ELECTRIC, ordinarily, could be depended upon to make itself conspicuous in any such upward movement as has been recorded this week, but several things have conspired to hold the stock in check. For one thing, it is freely prophesied that decisions close at hand in several current matters of litigation will be adverse to the General Electric Company. It is expected that the court will rule against the company in the finding on the Bate refrigerator case. It is also reported that the decision expected shortly in the suit over the filament used in electric lights will be adverse. Just how these reports can be substantiated ere the decisions are made public, is hard to tell, but they have carried weight enough to induce some heavy selling of the stock, the Equitable Life Insurance being prominent among those holders that have been induced by the week's attacks to let go their stock. Then, again, there are the most positive assertions that the $1,000,000 debentures purchased by the company were not bought with cash from surplus earnings, but with the proceeds of the sale of treasury assets. The company's officials hold that its policy, financial and otherwise, has been conducted on a businesslike basis, and that there is nothing reprehensible in the conduct of the company in any respect or quarter. They assert that the company is doing a large and increasing business. There are now employed at the Schenectady works of the General Electric Company about 3,200 hands, and at Lynn about 1,600 hands, as compared with a regular working force ayear ago of 1,300 at Schenectady, and 800 at Lynn. It is freely admitted that treasury assets are sold whenever a good chance presents itself, as, for instance, when the company sold this week, to Messrs. Tucker, Anthony & Co., of Boston, the Macon Consolidated Street Railway Company, with $300,000 bonds, and $500,000 stock. The price is not given, but it is stated that the General Electric Company did not get the short end of the transaction. Sales of this kind will be made whenever possible, as it is the intention of the company to confine itself to its own business of manufacture, and have as little as possible to do with subordinate companies or their operation.

EDISON ELECTRIC ILLUMINATING (New York) stock is very strong on the excellent showing made during the past year. Treasurer Jos. Williams furnishes THE ELECTRICAL WORLD with the following figures of receipts and expenditures, and a goodly showing they make, indeed. Gross earnings for the month of December, 1894, were $165,994, an increase of $22,802, and net earnings amounted to $81,358, a gain of $6 390 over December, 1893. The results for the year ending December 31, 1894, are: Station earnings $1,369,066, an increase of $175,727; operating expenses, $550,426; net earnings of stations, $818,639; earnings from other, $32,944, and income derived from investments, $62,325, as compared with outside income in 1893 of $52,186; total net receipts $913,909; general expenses and taxes $124,443; net earnings of company, $789,466, a gain of $183,828 over the previous year's showing; royalties accruing previous to 1894, $46,000; total applicable to interest and dividends $835,466. Interest payments called for $207 266, and dividends required the distribution of $476,196, so that there is left as a result of the year's operations the tidy surplus of $152,004. The number of customers on the first of January was 5,837; number of lamps 16 candle power, 234,494; motors (horse-power) 7,616; arc lamps, 3,014; installations equal to 340,784 lamps of 16 candle power. The stockholders showed their appreciation of the management's efforts by re-electing the old Board of Directors, except that Mr. Arthur C. James, of Phelps, Dodge & Co., bankers, was selected to fill the vacancy caused by the death of Mr. J. Hood Wright, head of the old firm o Drexel, Morgan & Co., and Mr. G. F. Gregory, of the Standard Oil Company, replaces Mr. E. H. Johnson. Other members of the directory are: A. A. H. Boissevain, R. R. Bowker, C. H. Coster, Charles E. Crowell, Thomas A. Edison, W. R. Glyn, D. O. Mills, Geo. Foster Peabody, W. A. Read, F. S. Smithers, and Spencer Trask.

THE STREET RAILWAY AND ILLUMINATING PROPERTIES' trustees have again purchased and cancelled 939 shares of the preferred stock, paying therefor an average price of 110½, the highest yet paid, and way in advance of what was paid for the first lot, which were bought under 90. The present purchase makes a total of 23,500 shares purchased to date, and leaves outstanding but 21,500 shares. Within a few days a semi-annual dividend of 3 per cent. will be declared on the preferred stock, payable February 1. The dividend on the outstanding stock calls for but $64 500, and the company has the money in bank. Under the circumstances there is a great demand for the common stock, but it is very closely held, and rules very strong.

WESTERN UNION TELEGRAPH is awakening to new life, but no great speculative, such as marked the old time course of the stock under the late Jay Gould's skilful manipulation, is likely to occur. The floating supply of stock is as small as ever, and with the continuation of the investment demand for the stock, it is destined to lose its once notorious reputation as a stock exchange football.

AMERICAN BELL TELEPHONE still sags; the cloud thrown on it by the stock subscription fiasco still casts a depressing shadow on quotations. Added to its other current foes, there are revived reports of coming competition, and some basis is formed for them in the incorporation at Chicago of the Cushman United Telephone Company, capital $20,000,000, to manufacture telephone supplies, and to construct and operate telephone and telegraph exchanges. Nonetheless, the Bell Telephone Company is to-day a paying institution and its profit making opportunities are not in any immediate danger of curtailment. Accordingly, there is not much likelihood of the stock selling much under current prices unless some unexpectedly adverse blow be received from what is at this writing an unknown and improbable quarter.

WESTINGHOUSE ELECTRIC issues are very quiet; speculation in them seems for the moment to have entirely died out. The removal to the new Brinton shops is steadily progressing; it will be sometime, however, ere everything is in apple pie order.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	128	130
Cleveland General Electric	100	80	90
East River Electric Light Co.	100	—	50
*Edison Electric Ill., New York	100	101	102
* " " " Brooklyn	100	110	112
" " " Boston	100	122	124
" " " Philadelphia	100	120	125
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	35	40
Electric Construction & Supply Co., com.	15	7⅛	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	1½	2
General Electric	100	34	34⅛
General Electric, pref	100	67	70
Westinghouse Consolidated, com.	50	32⅛	33
* " " pref	50	49½	50

BONDS.

	Par.	Bid.	Asked
Edison Electric Ill., New York	1,000	108	109
Edison Electric Light of Europe	190	75	85
General Electric Co. deb. 5's	1,000	92⅛	93

TELEGRAPH AND TELEPHONE.

	Par.	Bid.	Asked
*American Bell Telephone	100	190	191
American District Telegraph	100	35	40
American Telegraph & Cable	100	92	93
Central & South American Telegraph	100	102	105
Commercial Cables	100	138	145
Erie Telephone	100	52½	53
Gold & Stock Telegraph	100	103	105
*Mexican Telegraph	100	180	190
Mexican Telephone	100	75	80
New England Telephone	100	67	69
New York & New Jersey Telephone	100	97	98
Postal Telegraph-Cable	100	50	55
Western Union Telegraph	100	88	88¼

*Ex div.

ELECTRIC TRACTION STOCKS.

	Bid.	Asked
Union Ry. Co. (Huckleberry)	120	130
Brooklyn Traction, pref	60	63
" " com	12⅛	13
Long Island Traction	11	13
Rochester St. Ry	36	38
Columbus St. Ry	45	50
Louisville St. Ry. pref	87	88
" " " com	37	39
Cleveland Electric Ry.	59	60
Cleveland City Ry.	68	70
North Shore Traction	23	25
New Orleans Traction	58	60
New Orleans Traction pref	58	60
Worcester Traction pref	80¾	82
" " com	12½	14
Metropolitan Traction, Philadelphia	101⅛	102
Philadelphia Traction	95	96
People's Traction	51	52
Binghamton R. R. common	100	—

BONDS.

	Bid.	Asked
*Union Ry. 1st. mtge 6s.	105	108
*Westchester Electric 1st. mtge. 5s.	98	101
Rochester St. Ry. 1st. 5s.	95	97
*Columbus St. Ry. 1st 5s.	95	97
Columbus Crosstown 1st. 5s.	95	97
*Binghamton Railroad Co. 5s	99	100

*With accrued interest.

ELECTRIC TRACTION STOCKS have been unusually prominent this week. Here in New York interest has been chiefly centered in Brooklyn Traction and Long Island Traction, both of which are lower by reason of the serious strike now in progress on their lines. New Orleans Traction, another security, dealt in here, is higher, however; large local banking houses interested in it have within recent days asserted themselves to the extent of assuming the entire management, and much promise of future prosperity is held out thereby. In Boston there has been a deal of buying of West End common, and the belief still holds good that New York interests are in a deal to secure control. New England Street Railway stock is lower on the agitation started in New Haven to tax Connecticut street railways 3⅛ per cent. of gross earnings, to keep in repair streets and sidewalks. In Philadelphia selling of the traction stocks continues, to the detriment of prices Philadelphia traction being the chief subject of liquidation. It is stated that the local politicians are unloading in anticipation of a legislative inquiry into their dealings with the traction companies. Another item of interest is to the effect that the stocks of two more railroads can soon be treated of as electric tractions; these stocks are Kings County Elevated, of Brooklyn, and North Chicago Street Railway. The Brooklyn road has decided to operate by trolley, and is only awaiting the submittal of satisfactory plans. Concerning North Chicago, President Charles T. Yerkes has this to say: "'By July 1 three-fourths of the horse lines will be run by electricity. Formerly a set of motors cost $2,500, and their life was short. Now they cost but $800. What is more, we now can get 90 per cent. of the steam power in electric form instead of 60 per cent. and the cost of machinery connected with the power plant has been reduced over one-half. Wherever you have electric cars, travel will increase fully 30 per cent." And this is from an experienced street railway man. The earnings of the Binghamton Railroad Company, reported in the last issue of The Electrial World, were for the last six months of 1894, instead of for the year as stated. They are as follows: gross, $70,913 increase $13 258 Net $32 958 increase $8 131 Operating expenses were decreased 3¼ per cent.

Special Correspondence.

New England Notes.

Branch Office of The Electrical World,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, January 18, 1895.

THE BROOKLINE GAS LIGHT COMPANY, of Boston, has been granted by the Massachusetts Gas and Electric Light commissioners the $1,000,000 increase of capital stock petitioned for, upon which numerous public hearings have been given, and in connection with which the company's books were subjected to an examination by the commissioners, which occupied three weeks. The vote of the corporation declares that the new stock will be used in increasing the plant of the company, and paying off its debts.

MR. FRANK X. CICOTT, manager of the railway department of the Pettingell-Andrews Company Boston, has returned from his European trip, looking the picture of health and happiness. He says that he had altogether an enjoyable trip, and reports the electrical business in Europe, in all branches, as improving, particularly in France, Germany, Russia and Belgium, where the electric railway is receiving rapid recognition, the trolley becoming more popular, and American electrical appliances, generally, in better demand.

MURDOCK & TABER, a new electrical firm, with headquarters at 185 Franklin street, Boston, commence business under very favorable auspices, and with the best wishes of hosts of friends. They propose making a specialty of manufacturing and dealings in telephones and telephone supplies and their long experience in telephone work should enable them to present efficient and creditable productions. They are now offering to the trade, of their own manufacture, a new adjustable watch receiver, and also a new automatic switch for telephones, both of whch possess excellent advantages. The manufacture of dies, moulds and experimental work will also be a feature of their business.

English Notes.

(From our own Correspondent.)

London, Jan 5, 1895.

TRANSFORMER PITS.—As I stated in a recent letter, the Board of Trade was appealed to with reference to a dispute between the County of London & Brush Provincial Electric Lighting Co. on the one hand, and the London County Council on the other, with reference to the construction of transformer pits under the pavements and roadways. The County Council alleged that such structures would be a public danger, a public nuisance, and were not necessary to the carrying on of the company's business. The case was argued before the Board of Trade on Thursday, Dec. 13 and 20, and at the conclusion the permanent secretary of the Board of Trade, Sir Courtenay Boyle, gave his decision, or to be absolutely accurate, stated the "nature of the advice that he proposed to give to the Board of Trade." Briefly put, the Board of Trade will not veto the principle, but, as regards the construction of particular transformer pits, the Board of Trade will take care that all due regard is paid to the public safety, the public convenience, and the rights of local authorities. This, I think, must be considered as a "famous victory" for the company. No doubt the system of transformer pits placed under the pavement enables a supply company to indefinitely multiply its feeding points, and in this way tends to produce a very uniform pressure throughout its entire network, and it tends also to minimize the chance of a big break down. At the same time, there can equally be no doubt that the main advantage of the system is its cheapness. In connection with this subject, it is of interest to note that the Board of Trade have already issued regulations with regard to transformer pits in several instances; the following is a sample: No single transformer pit is to contain a transformer of higher hp than 100; the entrance to the chamber is to be only large enough to admit the entrance of a man; the covers are to be metallically connected on either side to the sheathing of the mains; beneath the first cover, there is to be a second metal cover independently supported and free from metallic connection with the external cover, and effectually connected to earth.

General News.

New Incorporations.

THE AMERICAN TELEPHONE COMPANY, Johnstown, Pa., has been formed with a capital stock of $15,000.

THE WATSEKA AUTOMATIC TELEPHONE COMPANY, Chicago, Ill., capital stock $10 000, has been incorporated by W. H. Harry, H. Darlington and E. E. Wood.

THE LASALLE CONSTRUCTION COMPANY, Chicago, Ill., capital stock $100,000, has been incorporated by W. E. McClurg, C. H. Bumstead and F. S. Donnell.

THE ATHENS ELECTRIC RAILWAY COMPANY, Athens, Ga., capital stock $50,000 has been incorporated by W. S. Holman and others to construct an electrical street railway.

THE TRI-VILLAGE TELEPHONE COMPANY, Fort Edwards, N. Y., capital stock $2,500, has been incorporated to connect Fort Edward, Sandy Hill, Glens Falls and South Glens Falls.

THE ECONOMY STREET RAILWAY COMPANY, Baden, Pa., capital stock $2,000, has been incorporated by Henry L. Carter and others, for the purpose of constructing and operating an electric railway.

THE W. J. DAVIS ELECTRIC COMPANY, Pittsfield, Mass., has been incorporated by Jacob Gimlich, Wm. P. Wood and W. J. Davis, to manufacture and install electrical and gas fixtures apparatus, etc.

THE NATIONAL GLASS COMPANY, Portland, Me., has been incorporated by L. T. Dolan and C. H. Jenkins to manufacture glass insulators and a general line of glass electrical goods. The capital stock is $250,000.

THE MILWAUKEE DYNAMO COMPANY, Milwaukee, Wis., capital stock $15,000, has been formed to do a general electrical manufacturing business. The incorporators are W. A. Ehlman, John Koerta and Theo. Egelhoff, Milwaukee.

THE NATICK GAS AND ELECTRC COMPANY, NATICK, Mass., capital stock $125,000 has been formed to generate and sell electricity for light, heat and power. Guy Wilkinson, Arthur Appleyard and Crayton N. Wilkinson are interested.

THE DRAVOSBURG AND ELIZABETH ELECTRIC STREET RAILWAY COMPANY, Dravosburg, O., capital stock $40,000, has been incorporated by H. W. Juergen, and others, for the purpose of constructing and operating an electric railway.

THE TILLAMOOK ELECTRIC RAILWAY, POWER AND LIGHT COMPANY, Tillamook, Ore., capital stock $500,000, has been formed to build, own and operate an electric railway. W. H. H. Cary, David Hess and William Squires, all of Tillamook, are interested.

THE CERAMIC CITY LIGHT COMPANY, Chicago, Ill., capital stock $50,000, has been incorporated to generate electricity for light, heat and power. The promoters are Philip M. Smith, Charles M. McKeehan, William E. Smith, Alex R. Wells and A. Curtis Vandyke.

THE WORLD'S FLASH COMPANY, Chicago, Ill., capital stock $20,000, has been formed to manufacture and sell electrical appliances of all kinds, and also electrical machinery. The interested parties are Leroy D. Thoman, Fred W. Harnwell and Walter S. Holden.

THE NUTTING ELECTRIC COMPANY, Chicago, Ill., capital stock $50,000, has been incorporated to manufacture, buy, sell and deal in merchandise and do a general contracting business. Carl K. McFadden Frank W. Smith and James W. Hedenberg are interested.

THE NANTUCKET ELECTRIC COMPANY, Nantucket, Mass., capital stock $20,000, has been formed to generate and sell electricity for light, heat, power, etc. Fred Howard Porter, John R. Bacon, W. A. Clark, Jr., George L. Smith and Henry A. Burnham are the promoters.

THE COUNTY ELECTRIC LIGHT AND POWER COMPANY, Clayton, Mo., capital stock $5,000, has been formed to generate and sell electricity for light, heat and power. M. B. Greensfelder, Central P. O.; E. W. Warfield, Clayton, and E. H. Bennett, Sutter, Mo., are interested.

THE STATEN ISLAND TERMINAL ELECTRIC RAILROAD COMPANY, New Brighton, N. Y., capital stock $50,000, has been incorporated to build an electric street surface road in Richmond County. Herman Bergholtz, DeF. Van Vlet and F. C. Cornell, Ithaca, N. Y., are interested.

THE CUSHMAN UNITED TELEPHONE COMPANY, Chicago, Ill., capital stock $20,000,000, has been incorporated to manufacture telephone appliances, and to construct and operate telephone and telegraph exchanges. I. M. Cushman, O. O. Leabhart and Joseph Barton are the promoters.

THE ELECTRIC BELL AND RESISTANCE COMPANY, Newark, N. J., capital stock $10,000, has been incorporated to manufacture and deal in electrical devices and supplies. George F. Atwood and Isaac M. Williams, both of Orange, N. J., and James P. McKenna, Newark, are the promoters.

THE AMERICAN ELECTRIC METER COMPANY, Camden, N. J., capital stock $100 000, has been incorporated to manufacture, buy and sell electric meters, electrical machinery, appliances, etc. Wm. D. Marks, Walter F. Smith and Jas. F. Gray, all of Philadelphia, Pa., are the organizers.

THE NATIONAL GLASS COMPANY, of Portland, Me., has organized for the purpose of manufacturing glass insulators and a line of glass electrical goods. The capital is $250,000, and the officers are: President, R. J. Dolan, of Boston, Mass., and Treasurer, C. H. Jenkins, of Boston, Mass.

THE PHOENIX TELEPHONE AND ELECTRIC COMPANY, Denver, Col., capital stock $750,000, has been formed to sell, deal and lease telephones, lines, systems, electric and magnetic appliances, instruments, etc. Gurnsey Walker, Preston H. Barker and Alfred W. Chamberlain, Denver, Col., are the promoters.

THE FRANKLIN TELEPHONE AND ELECTRIC COMPANY, Jersey City, N. J., capital stock $200,000, has been formed to manufacture, sell and use electrical machinery, instruments, etc. A. O. L. Havens, Point Pleasant, N J.; John McG. Goodale and John R. MacArthur, of New York, are the interested parties.

THE DENVER HEAT AND LIGHT COMPANY, Denver, Col., capital stock $1,000,000, has been formed to operate and maintain electric generating stations, machinery and wires for transmitting electricity for furnishing light, heat and power. The promoters are John C. Feldwisch, F. Cobb and Thos. Mohr, of Denver.

THE WEST SHORE ELECTRIC LIGHT COMPANY, Fort Lee, N. J., capital stock $100,000, has been formed to construct, maintain and operate works for supplying and distributing electricity for light, heat and power. John A. Dempsey. Guy C. Dempsey, New York, and Leon Abbott, Jr., Hoboken, N. J., are interested.

THE KNOELLER CAR IMPROVEMENT COMPANY, Jersey City, N. J., capital stock, $5,000, has been formed to purchase patents and patent rights for improvements for use in electric and cable street cars, etc. James Riley, Patrick H. Kilroy, Daniel Y. Lewis, and Geo. B. Fielder, Jersey City, N. J., are the promoters.

THE SAN DIEGO, PACIFIC AND EASTERN RAILROAD COMPANY, San Diego, Cal., capital stock $1,000,000, has been incorporated by H. L. Storey and others to build and operate a railroad to be operated by electricity, steam or otherwise from San Diego to El Cajon, Santa Maria, San Filip, Escondido and other points.

THE GREAT NORTHERN ELECTRICAL MANUFACTURING COMPANY, St. Paul, Minn., capital stock $100,000, has been formed to manufacture and sell automatic electric annunciators, electric fire, police and burglar alarms, etc. The promoters are Henry F. Hoyt, John F. Hoyt, St. Paul, and Robert L. Hunter, Minneapolis, Minn.

THE COMBINATION POWER COMPANY OF CHICAGO, Chicago, Ill., capital stock $500,000, has been formed to acquire patents protecting power devices, to lease on royalty, or sell the right to use same on railway engines; power plants, vessels, and manufacturing power. John E. Anderson, Isaac T. Dyer and L. L. Blades are the interested parties.

THE ELYRIA, OBERLIN AND WELLINGTON ELECTRIC RAILROAD COMPANY, Elyria, O., capital stock $100,000, has been formed to construct and operate an electric railroad between the three towns mentioned; also to furnish electric light and power. A. R. Webber, W. A. Braman, R. T. Reefy, W. B. Bedortha and Chas. A. Metcalf are the promoters

THE WHITE RIVER WATER POWER COMPANY, Newark, N. J., capital stock $1,500,000, has been formed to develop water power for commercial purposes, and to operate plants for furnishing light, heat and power. Edw. Henry Brush, 741 DeKalb avenue, Brooklyn, N. Y.; Thos. A. Quillin, 925 Garden street, Hoboken, and Thos. F. Brothers, Mt. Pleasant avenue, West Orange, N. J., are the promoters.

THE TILLAMOOK ELECTRIC RAILWAY, POWER AND LIGHTING COMPANY, Salem, Ore., capital stock $500,000, has been incorporated by W. H. Cary, David Hess and William Squires, to operate an electric railway from a point on the line of the Oregon Central Railway, in Yamhill County, at or near orth Yamhill, and follow the course of the North Yamhill, Nestucca and Tillamook rivers to a point on Netarts Bay, Tillamook County.

TELEGRAPH AND TELEPHONE.

NEVADA, MO.—W. F. Tizgard, of Rich Hill, has been granted a franchise to put in a telephone system at Nevada.

APPLETON, WIS.—The Northwestern Telephone Company of Milwaukee has petitioned for a franchise to put in a telephone exchange at Appleton.

SYRACUSE, N. Y.—The Central New York Telephone and Telegraph Company will erect a building for its exclusive use, and put the telephone wires of the city underground.

ELECTRIC LIGHT AND POWER.

PAWNEE CITY, NEB., is to build a municipal plant.

BRONXVILLE, N. Y.—Brouxville is discussing electric street lights.

GROTON, VT.—The subject of street lights for the village is being discussed.

GADSDEN, ALA.—The Queen City Electric Light Company is to enlarge its plant.

HAMILTON, MO.—The establishment of an electric light plant is contemplated.

LEWISTOWN, ILL.—The city of Lewistown will place arc lights in the streets at once.

PLATTSBURG, MO.—The citizens are discussing the building of an electric light plant.

VENICE, ILL.—An electric light plant has been established at the chain or Rock Water Works.

PHILADELPHIA, PA.—The new Belmont Avenue Baptist Church will be lighted by electricity.

ARCADIA, FLA.—F. H. Jeannin, St. Louis, Mo., is to establish an electric light plant in Arcadia.

MARTIN'S FERRY, OHIO.—A meeting was held December 29 to discuss the electric light queston.

PETERSBURG, VA.—A $10,000 stock company is being organized to establish an electric light plant.

SYCAMORE ILL.—The Sycamore electric light plant will be enlarged. John W. Whalen is president.

WICHITA FALLS, TEX.—The erection of an electric light plant is contemplated. Address the Mayor.

QUINCY, MASS.—Mayor Hodges recommends the adoption of a more economical system of street lighting.

JONESBORO, ARK.—The establishment of an electric light plant is being considered. Address the Mayor.

EARLVILLE ILL.—Earlville is figuring on an electric light plant to light both stores and streets of the city.

OREGON, MO.—Address James Cummings, Mayor, concerning contemplated establishment of an electric light plant.

WHITE CASTLE, LA.—Address Mayor G. M. Bowie, regarding the erection of an electric light plant and water works.

FRANKFORT, ILL.—Porter & Covit, of Joliet, are working up matters with a view of putting in an electric light plant.

RALEIGH, N. C.—Address the mayor concerning the issuance of [illegible] worth of bonds to purchase an electric light plant.

ARCADIA, FLA.—F. H. Jeannin, of St. Louis, Mo., is said to be interested in a plan to erect an electric light plant in Arcadia.

WHITE CASTLE, LA.—The erection of electric light plant and water works is being talked of. Address G. M. Bowie, Mayor.

KANSAS CITY, KAN.—The Board of County Commissioners is contemplating lighting of the county buildings with electricity.

SANTA ROSA, CAL.—The City Clerk has been authorized to advertise for bids for street lighting for a term of three years.

CHATTANOOGA, TENN.—An electric crane will be put in the boiler works owned by Casey & Hedge Manufacturing Company.

FERGUS FALLS, MINN.—A franchise has been granted to L. Von Bornstad, and his associates, to put in an electric light pant.

BALLARD, WASH.—The Ballard Electric Light Company's plant has been purchased conditionally by the Ballard City Council.

CEDARBURG, WIS.—The Common Council of Cedarburg has granted J. W. Raeder a franchise for an electric light plant in that city.

PALESTINE, TEX.—John R. Hearne has bid in the Palestine electric light plant, and will operate it, the price paid is said to be $4,300.

NORTHPORT, L. I., N. Y.—The village of Northport is to be lighted by electricity, and the plant will be in operation by March 1st.

GRAND FORKS, N. D.—The Board of the State University have decided to put in an electric light plant. Address the President of University.

NEWCASTLE, PA.—The subject of a new electric light plant to be owned by the city will probably come up before the Council for discussion.

ARLINGTON, MASS.—A committee has been appointed to consider the matter of municipal electric lighting, and report at the March meeting.

ATHENS, GA.—Messrs. W. A. Mallory and Lamar Pyndon have leased the Athens Gas and Electric Light Works, and will improve the system.

DICKINSON, N. D.—Ed. Hughes, of Bismarck, and Senator McGillivray are completing a deal for putting in an electric light plant in Dickinson.

ANDERSON, S. C.—The Anderson Electric Light and Power Company will remove its machinery to a larger building, and increase its facilities.

BELLWOOD, PA.—It is rumored that the Bellwood Electric Light Company proposes to erect a new boiler and purchase a new engine for its plant.

NORWICH, CONN.—A petition has been presented to the incoming legislature requesting power to construct and maintain electric light and gas plants.

NORTH TONAWANDA, N. Y.—Senator Pound has introuduced a bill authorizing the establishment of an electric light system in North Tonawanda.

OWENSBORO, KY.—The City Council will make arrangements to erect a municipal electric plant.. The present franchise will be out September, 1895.

QUINCY, ILL.—The Empire Electric Light Company is seeking for a site for an electric light and power plant. W. H. Channon is a member of the company.

TAMAQUA, PA.—At a municipal election on February 15 Tamaqua will vote on the question of increasing the borough debt $15,000 for the purpose of erecting an electric light plant.

READING, MASS., has in the process of erection one of the most complete municipal lighting plants in the State. The plant will cost $50,000, and there will be 135 arc lamps, and also incandescent,

WILMINGTON, DEL.—The trustees of the Delaware State Hospital and County Almshouse have contracted with the Wilmington City Electric Company to furnish the electric light for the buildings of these institutions at the rate of 7½ mills per 16-cp-hour.

CROWLEY, LA.—Sealed proposals for the construction of the electric light plant will be received until February 4. The work comprises dynamos and installations of 22 arc lights for streets, and an incandescent commercial circuit. P. J. Chappuis is Mayor.

SIOUX FALLS, S. D.—The City Auditor has been asked for bids for the lighting of the city, either with gas or electric light. Bids to be returned to the Council at the regular February meeting. Neither the gas nor electric light plan at present has a contract.

CHADWICKS, N. Y.—It has been decided that the water power at Clayville is insufficient for the proposed electric light plant in the Sanquoit Valley, which has necessitated a change of plan. The plant will probably be located either in Chadwicks or Washington Mills.

ASBURY PARK, N. J.—Several moneyed men who have become interested in A. S. Hickley's new electric launch at Asbury Park have agreed to form a company and furnish the capital necessary for the manufacture of at least a hundred of these boats and motors.

BALTIMORE, MD.—The Great Kanawha Falls Water Power, Electrical and Land Company has been organized, and incorporation effected under the laws of West Virginia. Charles M. Reeder, of Chas. Reeder & Sons, engineers, machinists and ship-builders, 334 Hugh street, is interested.

PATERSON, N. J.—The Phillips Electric Water Company will in a short time start a dynamo and water factory in Paterson. The company has been incorporated with a capital stock of $100,000. F. H. Leonard, Paterson; Simon L. Phillips, New York, and Floyd B. Wilson, of East Orange, are interested.

WEYAUWEGA, WIS.—There is a fair prospect that an electric lighting system will be put in this village within a few weeks by the Weed & Sumner Manufacturing Company and the Badger Manufacturing Company. They have every facility for putting in a system and are now making arrangements for the work.

SAN FRANCISCO, CAL.—H. H. Taylor, of the Mills Building, is now supplying several adjoining buildings with electric lighting power from the big dynamo in the basement of the Mills Building. He plans to enlarge his system and has filed three bonds with the Supervisor for proposed laying of conduits in the centre of the city.

ATLANTA, GA.—The Machinery Committee of the Atlanta Exposition has decided to engage at once an electric and mechanical engineer, and to send a representative North to buy equipment for the proposed electric light plant. The electric lights and operative exhibits will require 3,000 to 5,000 horse-power. J. L. Allen is chairman of committee.

MOLINE, ILL.—At the annual stockholders' meeting of the Peoples' Power Company held in Rock Island, it was decided to expend several thousand dollars in the extension of gas mains and electric circuits and to make a general cut in the rates when the consolidation of the Rock Island and Moline plants is perfected. C. H. Deere is president.

SHELBYVILLE TENN.—The National Water Works & Construction Co., of Pittsburg, Pa., has secured the contract to erect a water plant and electric light plant at Shelbyville, Tenn. W. W. Cunningham is manager. It is the intention of the stockholders to build works all over the United States, and it is expected to have the works in question finished and in operation by July.

KINGSTON, N. Y.—Four men, whose names are withheld, and who are now engaged with one of the largest concerns for manufacturing electrical appliances in this country, desire to locate here and establish an extensive plant for making electrical appliances. They desire to organize a company with a capital of $250,000, $125,000 of which must be provided by the people.

THE PACIFIC MINERAL REDUCTION COMPANY, San Francisco, Cal., capital stock $1,000,000, has been formed to mine and mill; deal in water rights, construct ditches, electric light plants and to supply power for manufacturing purposes. The interested parties are T. J. Ryan, W. Walts, F. Milton-Johnson, G. W. Fleming, and Harvey W. Snow, all of San Francisco.

WRIGHTSVILLE, PA.—Arrangements have been made by the Conewago Light & Water Power Company that will enable it to furnish Wrightsville with electric light and water, if that town wants it. The radius of country which the company proposes to reach comprises a population of nearly 400,000 people. It embraces York, Berks, Dauphin, Cumberland and Lancaster counties.

MORRISVILLE, VT.—At a village meeting it was voted to purchase the plant of the Warren & Somerville, known as the Morrisville Aqueduct Company, for $7,000. It was also voted to bond the village of Morrisville for $45,000 to cover expenses of water works and electric light plant. Hon. P. K. Gleed was elected a trustee to attend to the legal matters and H. M. Rich as agent in placing the bonds, which will bear interest at 4 per cent.

TACOMA, WASH.—It is the plan of A. J. Hayward and associates to transmit electric power into the city from a point on the Nisqually River near by. A petition was filed by the Pierce County Power and Telegraph Co., asking for the right to erect poles and string wires along the country road, extending from the city to the point on the Nisqually River where it is intended to make the improvements necessary to develop the intended power. A dam will be built across the Nisqually in order to get a fall of water to run the dynamos. A large amount of expensive machinery will be put in by the Pierce County Power and Telegraph Company. The money necessary to go right ahead with the work is said to be all ready. It is expected to have the plant ready for operation next summer. It is said that $200,000 will be spent in developing the plant.

THE ELECTRIC RAILWAY.

ITHACA, N. Y.—West Hill is to secure an extension of the trolley service.

BELLEVILLE, ONT.—Belleville is to have an electric street railway next summer.

SAYBROOK, CONN.—A project is on foot to connect Saybrook and Lynn by an electric road.

WEBB CITY, MO.—The Interurban Railway Company has begun grading its electric road from Webb City to Carthage.

PLAINFIELD, N. J.—The Common Council approved the plans for the electric railway extension to all parts of the city.

ATLANTA, GA.—Surveys are being made by the Atlanta Electric Company for the proposd extension to Lakewood, in the suburbs.

SPRINGFIELD, MASS.—The stockholders of the Springfield Street Railway Company are contemplating the extension of their lines.

MOHAWK, N. Y.—The consent of the property owners on Main street is being obtained to change the present horse railway to an electric road.

WATERTOWN, N. Y.—The Watertown Electric Railroad has decided to extend its line from Brownville to Dexter, a distance of three miles.

VENICE, ILL.—The Village Board has granted a franchise to Jenks, Meyer & Co., of St. Louis, for the construction of an electric road in this city.

ASHEVILLE, N. C.—The Asheville & Baltimore Street Railway Company has been granted a franchise to build a line two miles long to the Vanderbilt estate.

VICKSBURG, MISS.—The Interstate Transportation Company will build a trolley electric line from its gravel pits near Vicksburg to the Mississippi River.

CARLSTADT, N. J.—The borough council has determined to submit to the public the application for a right of franchise for a trolley line through Carlstadt.

MADISON, IND.—The Madison Street Railway Company's lines have recently been sold to an Eastern syndicate, the New York Standard Construction Company.

SAYVILLE, L. I., N. Y.—Sayville citizens are considering the building of a trolley road to connect Sayville with Bohemia, New Village, St. James and Port Jefferson.

ASHLAND, WIS.—The Ashland Terminal Company of Ashland, Wis., has decided to build a belt line of 18 miles around Ashtabula and will begin the work next April.

NANTASKET, MASS.—The Nantasket and Warren and Bristol branches of the New York, New Haven and Hartford Railroad are to be equipped with electricity.

LIMA, O.—The entire equipment of rolling stock of the Lima Electric Street Railway was destroyed. The car stable and eleven cars were burned up. The loss is about $30,000; only half covered by insurance.

NORWALK, CONN.—The Norwalk Tramway Company has purchased about 10 acres of land at Wilson Point road, on which it proposes to erect a power plant for its road.

ATLANTA, GA.—Dayton Hale, on behalf of the Atlanta Electric Railway Company, will apply to the City Council for a franchise to build and operate an electric street railway.

ALBANY, N. Y.—Surveyors Allen, of Altamont, and Ingraham, of Clarksville, have commenced surveying the route of the proposed electric road between Albany and Schoharie.

GRAND HAVEN, MICH.—Ald. Joseph Koeltz, of this city, will apply for a franchise to operate an electric railroad in Grand Haven. If granted, the road will be in operation by June.

COLUMBIA, PA.—It is reported that the Columbia and Donegal Electric Railway Company will extend its road from the square in Marietta to the square in Maytown, a distance of three miles.

WASHINGTON, D. C.—The contract for constructing the electric Ninth street line of the Metropolitan Railway was let to Edmund Saxton, who will quickly push the work to completion.

WARRENSBURG, MO.—It is proposed to build a motor line encircling the lake at Portie Springs before the beginning of next season. The scheme is being engineered by a local capitalist.

HULL, MASS.—The Hull Selectmen have granted the franchise asked by the Hull Electric Railway Company. The route of the new street railroad will be from Hull village to the Hingham line.

GRAND HAVEN, MICH.—At its next meeting the Council will adopt an ordinance granting privileges to a street railway company composed of local men. The road will be built to Spring Lake.

CAPAC, MICH.—The citizens of Capac are beginning to agitate the question of lighting their streets by electricity, and they desire to hear from reliable parties as to the probable cost of putting in a plant.

ASHEVILLE, N. C.—J. A. Neville, of New York, is representing Philadelphia capitalists interested in building the proposed Asheville & Baltimore electric road. J. S. Adams at Asheville may be addressed.

SHARPSBURG, PA.—At a meeting of the Councils the question of the ordinance granting the Pittsburg and Manchester Street Railway the right of way through Sharpsburg and Millvale was to have come up but was postponed.

ALEXANDRIA, IND.—Jos. E. Jeffries will build six miles of electric railway within the city limits and, in conjunction with Chas. L. Henry, a line between Anderson and Marion. Active work will be begun about April 1.

OCALA, FLA.—R. A. Teague, A. McIntyre and others have formed a syndicate to build a six mile line to Silver Springs. It is to be called the Silver Springs & Western Railway, and is to be operated by electric motors.

NEW ORLEANS, LA.—H. T. Beauregard and J. T. St. Alexander are interested in a proposed suburban road to connect with the New Orleans City & Lake Railway. The line is in St. Bernard parish. Surveys have been made.

ATLANTIC CITY, N. J.—Congressman John Gardner, ex-Postmaster Levi Albertson, Judge Joseph Thompson, and I. G. Adams & Company have applied for a franchise to construct a trolley line along the beach to various points.

LINCOLN, NEB.—The Lincoln Street Railway Company is in the hands of a receiver in default of the payment of $12,000 interest on certificates and the awarding of a judgment for $140,000 in favor of Joseph Sampson of Sioux City.

SAN FRANCISCO, CAL.—The right of way for an electric railway from Merced to the Yosemite Valley has been secured. The capital stock, it is stated, will be $2,500,000. The power is to be established at three points on the Merced River.

BALTIMORE, MD.—The Edmondson Avenue, Catonsville and Ellicott City Railway Company has purchased a lot of ground at the corner of Ingleside and Edmondson avenues from Charles Livezey, upon which will be erected a power house.

SCRANTON, PA.—At a meeting of the Select Council, Mr. Wm. Williams, of the Railway Committee, reported favorably on the ordinance granting a franchise to the Valley Passenger Street Railway Company over certain streets of the city.

YONKERS, N. Y.—The management of the Yonkers Electric Railway are contracting for a piece of land along the river front, on which they expect to erect a plant of 4,000 horse power in the spring. The manager is Jilson J. Coleman.

SEATTLE, WASH.—Contracts for the electric machinery for the Snoqualmie Falls Electric Company will be let within thirty days. D. H. Gilman has returned from the East, where he has succeeded in securing money for the erection of the plant.

AKRON, O.—A $600,000 mortgage was filed by the Akron Street Railway Company to secure the issue of 6 per cent. bonds, thus insuring the construction of electric lines from Akron to Cleveland, Akron to Kent, and Akron to Barberton, a total of 57 miles.

PORTLAND, ORE.—The Portland Consolidated Street Railway Company is in the hands of a receiver, O. F. Paxton. This company operates over 20 miles of street railways, and its property is valued at between one and a half and two millions of dollars.

MONTICELLO, N. Y.—A Mr. Van Cleft, of Newburgh, is interested in a proposed trolley line from Monticello via Fallsborough to Woodbourne and Neversink. It is said the road can be built for $6,000. Water power will be used to generate electricity.

MT. STERLING, KY.—John P. Mattin, of Xenia, Ohio, states that he will build eleven miles of standard-gauge steel track for electric motors from Mt. Sterling to Sharpsburg, Ky. Electricity will be generated by a water power and steam plant.

WASHINGTON, D. C.—A bill has been introduced in the House by Mr. English, of California, authorizing the Rock Creek Railway Company of the District of Columbia to make some important extensions of its line, and to change the name of the company.

NEW SWEDEN, ME.—The latest proposition for giving New Sweden better transportation facilities is to build an electric railroad from there to Caribou, eight miles, and have sidings at frequent intervals. With the exception of a mile and a half the road will be level.

LEWISTON, ME.—The private electric railway which the Lewiston bleachery wants the right to build to connect the establishment with the Maine Central tracks will be of considerable importance. In 1894 it took over 3,000 freight cars to do the traffic over the Maine Central for this concern.

GREENSBURG, PA.—Application has been made for a charter by the Westmoreland & Allegheny Traction Company, which proposes at an early day to commence an electric line from Greensburg to Wilmerding, where it will connect with the Second Avenue Traction Company's road.

ELYRIA, O.—The farmers and truck raisers of Erie and Lorraine counties have organized to construct an electric railway line between this city and Milan, Erie County. The distance is about 30 miles. The following towns will be tapped by the road: South Amherst, Henrietta, Birmingham, Florence and Derlinville.

LOCKPORT, N. Y.—County Clerk Compton has received a communication from Chicago capitalists relative to building an electric railroad from here to Olcott. Mr. Compton is looking the situation over with the view of answering the queries put to him, but as yet has not quite determined as to making his response encouraging or otherwise.

MILWAUKEE, WIS.—At the meeting of the Council a petition was introduced by Alderman Starkweather from the Milwaukee and Wauwatosa Motor Railway Company, asking for a franchise to lay tracks on certain streets and to build an electric line from Wauwatosa and North Greenfield to Milwaukee to the corner of Cass and Wisconsin streets.

BARABOO, WIS.—An electric line may be built between Devil's Lake and the Dells, passing through this city. Men of money are here looking over the field, and if all arrangements can be made work will be commenced soon. A few years ago the right of way was secured, and a franchise to build through the city is now held by Marsh & Jackson, who are working on the project.

LOCKLAND, O.—At the meeting of the Lockland Council to consider the electric railway matter, an ordinance was passed establishing an electric route on certain streets, and the clerk was instructed to advertise for bids at once. This action was taken with the hope that the same parties who received the contracts to do the same work through Hartwell would be given the contract here.

BRIDGEPORT, CONN.—The Bridgeport Traction Company has applied for permission to build extensions to the West Haven and Westfied electric street railway; the Windsor Locks and Suffield Company to build to Windsor to connect with the Hartford company's tracks, and for the incorporation of the Westport and Southport road to operate in Weston, Southport and Fairfield.

READING, PA.—The Reading & Womelsdorf Railway Company gave to the Lancaster Electrical Construction Company the contract to build the road from the western bank of the Schuylkill, opposite this city, to Womelsdorf, to be completed for operation by June 1st. The road will be fifteen miles long, and negotiations are in progress to extend it to Schaefferstown, Lebanon County.

VENICE, ILL.—A franchise has been granted to the Madison, Venice & East St. Louis Railway Company, whose office is in the Bunte Building; Ferdinand Meyer is President. The construction will begin early next month, first on the Edwardsville rock road. The Venice electric light plant will temporarily furnish the power. The company's new plant will probably be located at Madison.

CENTRALIA, KAN.—The Centralia, Seneca and Pawnee Electric Railway Company has been chartered to establish and maintain an electric motor railway between the cities of Centralia and Seneca in the State of Kansas. The capital is $200,000. The directors are: A. W. Slater, J C. Clark, S. W. Burtch, A. K. Coleman, John S. Hidden, F. A. Stickel and W. S. Domer, of Centralia, and R. M. Emery and A. Wells, of Seneca.

PORT JERVIS, N. Y.—The building of an electric railway in Port Jervis is an assured fact. A meeting of the Port Jervis Suburban Street Railway Company was recently held for the purpose of transferring the propery to its new owners. The new Board of Directors are: P. J. Horan, T. B. Howe and H. H. Archer, of Scranton, Pa.; S. A. D. Whittaker, of New York City, and Benj. Nearpass, of Port Jervis, and others. The new board elected the following officers: President, P. J. Horan, of Scranton, Pa.; Vice-President, Benj. Ryall, of Port Jervis; Secretary, H. H. Archer, of Scranton.

ANDERSON, IND.—C. L. Henry, through his agent, E. C. Carpenter, has secured a franchise for an- electric street railway through Summitville, who also secured similar grants at Fortville, Pendleton and Alexandria. These franchises are for the Gas Belt Electric Railway, from Indianapolis to Marion, a distance of 80 miles. The surveys began Jan. 14, and the contract for grading the line between Anderson and Marion was let Jan. 15. The Clodfeller syndicate announces that it has also secured its right of way. C. E. Loss & Co., Pullman Building, Chicago, have a contract to complete the road before Sept. 1, 1895, for $575,000.

PITTSBURG, PA.—A company of Pittsburg capitalists has been organized to extend the electric street railway line from Washington, Pa., through the numerous towns on the Chartiers branch of the Panhandle Railroad into Pittsburg. An application has been made for a charter, and work on the line will be begun at an early date. The new company is composed of President Francis J. Torrance, Treasurer and General Manager of the Standard Manufacturing Company; Thomas R. Hutchinson, a prominent local structural iron and steel manufacturer; A. E. Townsend, President of the Washington Railway, and Senator Arthur Kennedy, a director in the Allegheny Valley Railroad and the Bellevue Land Company.

MISCELLANEOUS NOTES.

THE REV. EDWARD R. KNOWLES, LL D., of Worcester, Mass., a priest of the Old Catholic Church, has in press a book intended to lead to an ultimate philosophy of being, and in which he considers the origin of electrical phenomena. Father Knowles claims to follow the views of Lodge regarding the non-dissipation of energy in the infinite continuance of magnetic induction between centres of force or atoms; from these considerations he deduces principles which he claims, show the absurdity of molecular motion as an essential in an electrical current, and also asserts that they indicate the true nature of electricity and lead to an ultimate philosophy of the existence of matter and of sense perception.

Trade and Industrial Notes.

THE NEW YORK STANDARD CONSTRUCTION COMPANY, 97 Nassau street, New York has received a contract to equip the Madison Ind., street railway for electric traction.

H. B. COHO & CO., 203 Broadway, New York, have just closed a contract for a 45-kw multipolar generator for the Cooke Engine Works, through the John E. Beggs Machinery Company.

THE STANDARD PAINT COMPANY 2 Liberty street New York, is sending to its friends and patrons a neat grass-woven card case, which also contains a silicate surface for memorandums.

THE WESTERN ELECTRIC COMPANY, Thames street, New York, is presenting its friends with a handsome leather card case containing a calendar of the year, neatly printed on celluloid.

THE FITCHBURG STEAM ENGINE COMPANY, Fitchburg, Mass., has recently opened an office in Boston, at 137 Purchase street, which will be in charge of Mr. W. E. Sheldon, treasurer of the company.

C. W. HENDERSON, 44 Blewry street, Montreal, has issued an "At Home' card, informing his friends and patrons that he will be glad to receive and "shock" them with electrical compliments of the season.

WALLACE & SONS, Ansonia, Conn., announce that they have now in press their 1895 catalogue of brass and copper wire and other manufactures in the same materials, and will be pleased to send a copy to all applicants in the trade.

THE LA ROCHE ELECTRICAL WORKS, of Philadelphia, has made an assignment for the benefit of its creditors to its secretary and treasurer, J. F. Stevens. The company was organized several years ago with a capital of $200,000.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., has issued a third and revised edition of its pamphlet on "Graphite as a Lubricant," in which the subject is treated scientifically and practically for engineers and machinists.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., has completed the new electric light station of the North Attleboro Steam and Electric Company, at Attleboro, Mass. The building is 62 ft. wide and 100 ft. long, entirely fireproof, and covered with anti-condensation corrugated iron.

THE ELECTRIC APPLIANCE COMPANY, Chicago, states that the demand for Packard transformers continues brisk, and that where it has installed the original equipment of transformers it is always sure of the orders for renewals, and has yet to reccord the first case where the "Packard" has been displaced.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has moved its New York office from 45 Broadway to the Manhattan Life Insurance Company's Building, 66 Broadway. The change was made to meet the increase of business of the company, and the office remains in charge of Mr. Chas. Blizard.

MAXWELL M. MAYER, manufacturer of dynamos and motors, 414 One Hundred and Seventh street, New York, although only established for a short time reports that he has already received a large number of orders for his machines. These are of the 2-pole iron-clad type, with the fields cast in a single piece of cast steel.

ELMER G. WILLYOUNG & CO., 1210 Betz Building, Philadelphia, Pa., who, as we lately announced, are the sole American agents of Nalder Bros. & Co. and L. Oertling, of London, and James White, of Glasgow, Scotland, are meeting with much success in handling the standard measuring instruments made by these celebrated firms.

THE DEARBORN ELECTRIC COMPANY, 19 Quincy street, Chicago, Ill., in a compactly printed 128-page book, presents a very complete catalogue of general electrical supplies. The catalogue, which is the first of the kind issued by this firm, is well illustrated and includes among its contents an almost exhaustive variety of electric lighting and house goods.

CHAS. E. CHAPIN, 136 Liberty street, New York, manufacturer of the Perfection woven wire dynamo brush, has appointed Mr. Ernest W. Cooke as his agent for the sale of these brushes throughout the West. Mr. Cooke represents some six Eastern manufacturers in Chicago and is a well-known and popular salesman. The peculiarity of the Perfection wire brush is in the winding of the cloth, which binds the wires at the end and this makes a brush that requires no solder or stitching on the body or on the portion that comes in contact with the commutator.

SAMUEL W. RUSHMORE, 126 Liberty street, New York, has secured a contract from the Gettysburg Electric Railway Company, whose handsome power house was lately destroyed by fire, to rebuild the entire electrical plant. The new plant will consist of the two 150-kw generators, two 60-light arc machines, and two 1,200-light alternators driven by three 200-hp Frick-Corliss engines. The switchboard to be built by the Rushmore Works will be of white marble, and one of the most elaborate of its kind in the country. The building is to be of brown stone, and it is intended to make the plant the finest of its size in Pennsylvania.

Business Notices.

WOVEN WIRE BRUSHES.—The Belknap Motor Company, of Portland, Me., are the patentees and manufacturers of the best woven wire commutator brush on the market.

BATTERY CUT-OUT, CHEAP. Sensitive, reliable, never requires attention. Gas lighting much improved by its use Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

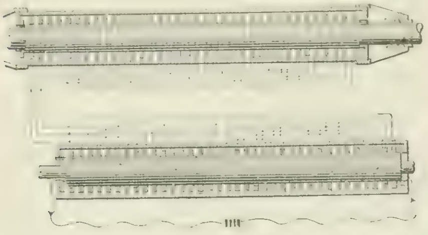
Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JANUARY 15, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

532,441. **SYSTEM OF POWER TRANSMISSION**; C. S. Bradley, Avon, N. Y. Application filed September 22, 1893. This comprises a multipolar reciprocatory generator provided with a polyphase winding on its armature and normally charged field-magnet, and a multipolar polyphase reciprocatory motor in circuit with the generator.

532,448. CONDUIT RAILWAY TROLLEY W. T Dulany, Jr., New York, N. Y. Application filed March 30, 1894. This comprises a trolley standard having plate conductors, insulators and plates inclosing them, and extending downward beyond the conductors, with a conduit cleaning brush having its back secured to the lower end of the plates between them.



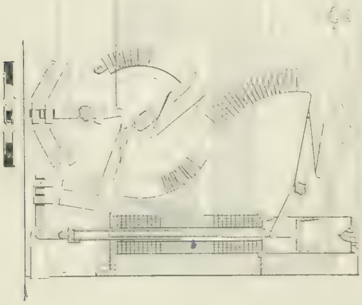
No. 532,441.—System of Power Transmission.

32,449. CONDUIT ELECTRIC RAILWAY, W. T. Dulany, Jr., New York, N. Y. Application filed August 16, 1894. An underground trolley standard having two conductors, insulating material separating and inclosing the same, front and rear bars, side plates and wearing plates secured to the bars, each conductor consisting of two upper and lower plates apart from each other, and a fuse cut off uniting the plates on a lower level than the wearing plates.

32,468. **CARBON FILAMENT AND METHOD OF MANUFACTURING SAME**: A. D. Little, Boston, Mass. Application filed June 18, 1894. A material for carbon filaments consisting of cellulose and an organic acid.

532,477. **TROLLEY CATCHER**; M. V. Nichols and J. A. Fraser, Port Arthur, Canada. Application filed May 26, 1894. This comprises a guide way on the cars, a weight sliding vertically thereon, a flexible connection between the weight and trolley pole, a detent for holding the weight elevated, having an unlocking means connected with the pole, and arranged to be operated by the upward movement of the trolley arm to release the detent from the weight.

532,514. **ELECTRIC ELEVATOR AND MOTOR CONTROLLER**; R. Wilson, Louisville, Ky. Application filed June 23, 1894. A controlling device for electric motors consisting of a solenoid having two movable cores, one acting upon the main switch to start and stop the motor, and the other operating a speed controlling device such as a retostate.



No. 532,514.—Electric Elevator and Motor Controller.

532,531. **ELECTRIC ARC LAMP**; A. Chester and J. J. Rathbone, London, England. Application filed March 26, 1984. This comprises a rocking armature with a swinging carriage, a roller pivoted to the carriage, and inclined stop fixed to the base of the lamp in the swinging path of the roller a spring attached to one end of the armature, which, in conjunction with the stop, causing the roller to move the carbons asunder.

532,537. **AUTOMATIC CIRCUIT BREAKER**; H. P. Davis, Pittsburgh, Pa. Application filed February 28, 1894. This comprises a magnetic sustainer and armature npheld thereby; in combination with a stop adapted to be swung under the armature, and to swing away therefrom when the armature is drawn fully into place by the magnet.

532,538. **CONTROLLER FOR ELECTRIC CARS**, H. P. Davis, Pittsburgh, Pa. Application filed April 14, 1894. This comprises a switch, a handle removable therefrom only when in a certain position relative to the switch, and means for preventing occurrence of the relative position of the handle and switch, save when the switch is one predetermined position.

532,549. **ALTERNATING CURRENT MOTOR**, L. Gutman, Pittsburgh, Pa. Application filed August 27, 1890. The method of reducing self induction in an armature, which consists in producing two alternating fields of the same phase, rotating an armature coil, one part under the influence of the field, and another part under the influence of the other field, so that the one part will cut a maximum number of lines of force, while the other part is cutting a minimum.

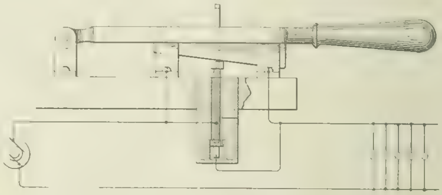
532,559. **GALVANOMETER**; A. H. Hoyt, Penacook, N. H. Application filed April 2, 1894. The combination with a solenoid of a movable armature or needle, comprising a thin plate of soft iron pivotally supported within the solenoid on an axis parallel to its own plane, and perpendicular to the axis of the solenoid.

532,560. **GALVANOMETER**; A. H. Hoyt, Penacook, N. H. Application filed April 25, 1894. This comprises an electrically moved needle, and a pivotally supported pointer or indicator, with a link connected at one end to the needle and at the other end to an arm connected to the pointer.

532,561. **GALVANOMETER**; A. H. Hoyt, Penacook, N. H. Application filed April 25, 1894. This comprises two solenoids, a common armature pivoted at right angles to the coils, the polar extremities thereof extending into the mouths of the coils respectively, and means for indicating the amount of current in either solenoid by the inductive effect thereof on the armature.

532,576. **CLOSED CONDUIT ELECTRIC RAILWAY**; G. W. McClintock, Wollaston, and D. J. McLane, Quincy, Mass. Application filed July 2, 1894. This comprises a sectional conductor rail, a feeder, a trolley rail having sections corresponding with the sections of the conductor rail, and switch levers for connecting the branches of the feeder with the sections of the conductor rail when the trolley rail is depressed.

532,590. **CLOSED CONDUIT ELECTRIC RAILWAY**; J. Schnepf, New York, N. Y. Application filed September 9, 1893. This comprises a continuous main conducor composed of interlocking links and plates upon the conduit against which the conductor is adapted to be drawn magnetically.



No. 532,594.—Non-Arcing Switch.

532,593. **CONVERTER SYSTEM FOR ELECTRIC RAILWAYS**; C. F. Scott, Pittsburgh, Pa. Application filed July 31, 1893. This comprises an alternating circuit, a working converter, a choke coil in series with the primary thereof, and a normally open short circuit around the choke coil, a bridge for closing the short circuit, and electrical means for operating the bridge in series with one of the coils of the working conductor, the choking coils being so proportioned as to be unsaturated when the secondary is open and saturated when it is closed under normal conditions.

532,594. **NON-ARCING SWITCH**; C. F. Scott and H. P. Davis, Pittsburgh, Pa., Application filed March 29, 1894. This comprises a main switch, a pair of separable shunts in contact therewith, in combination with a restricted chamber wherein one or more of the contacts is adapted to move, and a vent communicating with the interior of the chamber.

532,633. **RAILWAY BLOCK SIGNAL**; W. Berrigan and W. H. McClure, Elmira, N. Y. Application filed September 18, 1894. This comprises separate circuits for each block, pitmen connected with the semaphores, levers connected to the pitmen, track instruments actuating the levers, stops on the pitmen detents automatically engaging the stops to retain the semaphores set to danger, magnets at the semaphores, armatures drawing the detents out of engagement by energy of the magnets, and circuit closers at each semaphore in circuit with the magnets at the next semaphore at the rear, and actuated by the pitmen.

532,662. **ELECTRIC SWITCH**; W. P. Hancock, Everet, Mass. Application filed November 27, 1894. This comprises a pivoted U-shaped carrier having slots in its sides, and oppositely extending horizontal pins, a pivoted blade within the carrier provided with horizontal pins projecting through the slots of the carrier, external springs flanking the carrier and extending between the two sets of pins, pivoted contact blades, and stationary magnets engaged by the blades.

532,666. **SURGICAL INSTRUMENT**; E. E. Johnson, Denison, Tex. Application filed September, 28, 1894. This comprises a tube having guides therein and holes, and a frame consisting of two parallel members adapted to enter the tube and move between the guides, and lugs on each of the members adapted to cover and uncover the holes.

532,678. **MECHANICAL TOY**; A. Martin, London, England. Application filed October 15, 1894. In a toy, a magnetized spindle vertically mounted and provided with a fly-wheel, in combination with a quadrant rack and pinion gear for imparting motion to the spindle and fly-wheel.

532,742. **MAGNETIC SEPARATOR**; H. Arden, Seattle, Washington. Appliciaon filed August 15, 1894. The combination of a hopper, an outlet through which may fall a stream of sand, and a magnet having a trough, the magnet being alternately magnetized and demagnetized by a current of electricity passed through and shut off from the same.

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THE STREET RAILWAY INDUSTRY.

In another column we print reports from a large number of street railways relating to improvements and extensions, which give an indication of the activity in this flourishing branch of the electrical industry. Taken in connection with the extensive budget of items relating to the same subject which appears weekly in our news department, ample justification is offered for the opinion that street car traction, in this country, at least, has offered the most important field for the application of electricity, the financial returns having been much more satisfactory than in the case of electric lighting. A recent report in regard to street railways in New England shows that but few horse roads remain, and it is probably only a question of a few years when these will adopt electric traction. The same tendency is so evident throughout the country that the time is not far distant when the existence of a horse railway in a community will be a matter of reproach, and regarded as indicating a backward state of civilization.

TROLLEY GROUND CURRENTS AND UNDERGROUND PIPES.

Prof. A. J. Rowland in another column calls attention to a matter of importance in connection with the determination of data relating to the influence of trolley ground currents on underground piping. Mr. A. E. Kennelly, in the discussion of Mr. I. H. Farnham's Institute paper, referred to the same point, which is, that the difference of potential between the rails and underground piping at any place does not necessarily imply that a corresponding current flows. In our remarks to which Prof. Rowland refers, it was taken for granted that in a voltmeter survey of the road the nature of the ground between the rails and piping would be considered, as otherwise the data taken might be very misleading. Usually this point may be settled without taking any resistance measurements from knowledge of the soil in a given locality with respect to its average condition along the line, but even here an occasional check would be advisable. Where there is any marked change in the character of the soil or road-bed, or of the run of the piping with respect to the power-house, resistance measurements appear to be absolutely necessary to obtain comparative results. The advisability of depending entirely upon a well-bonded rail return is a matter to be settled by experience, but up to the present it does not seem that practice has demonstrated that this can safely be done. Where, however, the construction recommended by Prof. Rowland has been carefully followed, it would perhaps be justifiable to delay the laying of auxiliary conductors connected to the piping in the territory adjoining the power house until their necessity is indicated by the result of measurements made after the plant has been in operation.

A NEW THEORY OF ELECTROLYSIS.

In another coloumn we print a paper by Mr. Alfred H. Bucherer on a new theory of electrolysis which will repay careful study. Mr. Bucherer's explanation of the phenomena of electrolysis differs from the widely accepted one of Nernst, in that the former involves consideration of the partial pressures of the metallic vapor and the non-metallic constituents of a solution while the latter considers osmotic pressures alone. It is claimed that the theory now offered does away with many inconsistencies inherent in former theories, and when submitted to calculations agrees with experimental facts much more closely. One of the points made by Mr. Bucherer against the theory of electrolysis based upon the neutralization of static charges carried by ions, is that it involves a denial of the principle implied in the well-established laws of thermodynamics, by asserting that the neutralization occurs with an absorption of energy—work being done to deprive an ion of its charge. The basis of the theory of Mr. Bucherer is the same as that which has been so fruitful when applied to the thermodynamic treatment of chemical reactions, and in which chemical states are viewed from the dynamical standpoint. As electrolysis implies the consideration of molecular action it is necessarily a difficult subject, and its treatment one in which the speculative element must largely enter. The earlier explanations of electrolytic action had a basis but little less satisfactory than the double fluid electric current hypothesis, and the latter one of Nernst and Ostwald reposes upon a theory of osmotic pressure which seems, to be a conception in itself somewhat speculative. Should the theory of Mr. Bucherer be proved correct by experimental evidence, the new view of electrolysis which it offers may lead to very important consequences, for its basis is such as to involve a more rational and a broader view of the mechanism of the molecular phenomena involved.

PATENT LAW AND ITS INTERPRETERS.

The recent decision of Judge Grosscup invalidating the Thomson-Houston arc regulator patent is another indication of the current trend of judicial thought which of late has played such havoc with "broad" and "fundamental" patents. In the present instance the tone of the opinion resembles so closely that of other opinions rendered within the period which has witnessed what seems to be a marked tendency on the part of the courts to view electrical patents with an eye of suspicion, that one cannot but reflect on the immense influence of precedents on the judicial mind, and speculate as to the preponderating effect of that factor in reaching conclusions. Very suggestive as to the constitution of the present courts that pass on the technical questions involved in patent litigation is the confession of Judge Grosscup as to his qualifications with respect to the knowledge of electrical principles involved in the present case. Referring to the points relative to the laws of electricity brought forward by counsel and their experts the court says: "I have availed "myself as closely as I could of the excursions of counsel into these "abstruse fields, but have come back from them, I confess, more "bewildered than enlightened. So far as I have been able to ascertain, all knowledge of electricity is, so far, purely empirical; and "mere speculations, therefore, however acute and plausible as to the "ways and methods of this force, are likely to be erroneous, and "therefore valueless." In view of the fact that electrical science, instead of being "purely empirical," is one of the most firmly and exactly founded of the physical sciences, this statement is a surprising one indeed, and, coming from one who is called upon to authoritatively deal with questions within its province, displays an ignorance that, in view of its probable effect, is deplorable. Under our present system we cannot expect the judges passing on questions of patent law to be adepts in all of the various branches of science involved in the different cases brought before them, but we are scarcely prepared for the total ignorance implied in the above quotation. It may be said that the view taken by Judge Grosscup is the popular one which has been widely disseminated by so-called popular and newspaper writers, and that the contradictions of expert witnesses would naturally incline the court to form such an opinion as that expressed. We hardly expect, however, a court to be influenced by popular conceptions of science, particularly when the slightest examination would show their inaccuracy. Nor does the expression of surprise at the contradiction of experts display the knowledge of the subject of "experting" to be expected on the part of a judge. An expert witness is paid to bring out the strong points on his employer's side and evade or minimize the effect of the points brought forward by the opponent. It naturally follows that the subject being dealt with will not after this treatment present much lucidity to one who has no personal knowledge of the underlying principles. In this lies the great weakness of our present system of patent courts, for unless there is a sufficient technical knowledge to judge of the intrinsic merit of the points brought forward, the court has either to evade the issues he cannot understand and base his decision upon ulterior considerations, or form an opinion that will naturally incline toward the side whose experts have been most successful in juggling with the various technical points involved.

THE GREAT TROLLEY STRIKE.

The Brooklyn trolley strike—the most serious labor disturbance of its kind since electric railroading became a national industry—is rapidly nearing its close. It proved to be more than the proverbial nine days wonder, but now the troops called out to preserve order are disbanding and returning to their homes, and before this issue of The Electrical World reaches most of its readers this contest between street railway managers and employes will have been practically forgotten by the general public in the rush and bustle of other and more stirring events, and will have passed into history. As a rule a strike that is not won inside of thirty-six hours is a failure, and after the first day or so every one looked for the defeat of the men. One matter which many thought was likely to change the aspect of affairs was the mandamus issued by Judge Gaynor of the Supreme Court. This was looked upon at first as a great victory for the strikers, and so it doubtless would have been had a peremptory writ been granted, as probably would have been the case had the Judge not seen from the protests of the daily papers and the business community in general the danger of such a course. The alternative mandamus was believed to be a death-blow to the cause of the dissatisfied employes. Long before the time is up, enough cars will be running even if the strike should not formally be declared off, to satisfy any jury which may have to pass on the matter. The lawyer who represented the strikers in the proceedings before Judge Gaynor frankly characterizes the alternative mandamus as a failure, adding, "The learned Judge, for all the good the decision will do, might just as well have sung from the topmost peak of Mount Washington, the 'Marseillaise' hymn or 'The Star Spangled Banner.'" The result of the strike will be more far-reaching than many suppose. Its success would almost unquestionably have meant demands of a similar character upon the managers of roads in other cities. In fact, it is understood that arrangements were all perfected in a number of places to follow up any advantage which the strike brought the Brooklyn men. Even in its failure the strike will have an important bearing upon future disputes of a like nature. This being the first violent rupture between employer and employe in an industry that is daily broadening its territory and field of operation, its value as a precedent cannot be too gravely considered. As steam railroad men look back to the Missouri Pacific strike of 1886, so will trolley car managers and men regard the present tie-up. Electricity opened up possibilities and opportunities for the striking men which did not exist during the horse era. One or two striking linemen and a pair of shears did more to disarrange traffic than the slaughter of fifty horses would have done in the olden days. Although fear of violence unquestionably prevented many competent men from offering their services to take the strikers' places, even the meagre rudimentary knowledge which it is necessary to possess before one is competent to run a trolley car made considerable difference when it came to engaging new and green men. It raised the motorman to the level of a skilled workman, who could be replaced only by men possessing a like amount of skill, whereas his predecessor might have been precipitately ousted in favor of any lout who could handle a pair of reins. On the other hand trolley managers also found elements in their favor arising out of the new order of things. The rapidity with which the cars could be moved was oftentimes a determining factor in their running. Non-union men seemed to feel the indeterminate force back of them. One can face a mob with some confidence when he feels that the means of escape are at hand and lie in the simple turning of a lever. It seemed such an easy matter to run down all obstructions, or failing in that, he knows he can quickly get out of danger's way.

The New Jersey Street Railway Association.

The Street Railway Association of the State of New Jersey was permanently organized on January 17, with the following officers: President, David Young, general manager Consolidated Traction Company; vice-president, G. George Browning, treasurer Camden Horse Railroad Company; secretary and treasurer, Wm. B. Price, secretary and treasurer New Brunswick City Railway Company; executive committee, the president, vice-president and secretary, and J. A. Morrissey, treasurer Paterson Central Railway; W. H. Starr, general manager North Hudson County Railway Company, and J. Willard Morgan, president Camden, Gloucester and Woodbury Railway Company. Meetings are to be held monthly, the next one to be on February 11.

The objects of the Association, as stated in the constitution, are to facilitate the acquisition of experimental, statistical and scientific knowledge relating to the construction, equipment and operation of street railways, and the diffusion of this knowledge among the members with a view of increasing the accommodation of passengers, improving the service and reducing its cost; the establishment and maintenance of a spirit of fraternity among the members of the Association by social intercourse; the encouragement of cordial and friendly relations between the roads and the public; and to foster and protect the large investments of capital in these important enterprises. The members of the Association are to consist of street railway companies, or lessees of street railway companies operating the same, or individual owners of street railways operating the same in the State of New Jersey; but no company or individual not actually operating a street railway shall be admitted to membership in the Association, except upon a report of the executive committee that it or he is the owner of a street railway in the process of construction, which is so near completion as to assure the speedy operation thereof. The entrance fee is $50 and the dues $50 per annum.

The membership at present includes the Consolidated Traction Company, the Camden Horse Railway Company; Camden and Gloucester, and Gloucester and Woodbury Railway Companies; Newark and South Orange Railway Company, New Brunswick City Railway Company, New Jersey Electric Railway Company, Paterson Railway Company, Trenton Passenger Railway Company, and the Jersey City, Hoboken and Rutherford Railway Company.

Electrolysis by Electric Railway Return Currents.

BY ARTHUR J. ROWLAND.

The article in The Electrical World of Jan. 19, 1895, on "Electrical Wires in Brooklyn," and the editorial comments on "Trolley Return and Underground Pipes" in the same connection, have suggested to me the propriety of offering some data on the same subject.

During a number of months past I have made many measurements of difference of potential between rails and water mains on different trolley roads in this and other cities. The results I obtained have been quite similar to those already published, varying from zero reading of voltmeter up to .7 of a volt on roads installed very recently with the most modern bonds and with auxiliary return wires. Most measurements on such roads will, however, not far exceed .15 volt.

The electrolytic action in the soil, whereby the salts therein contained are dissociated to produce chemical decomposition of pipes or rails, must follow the laws of electrolysis and the amount of decomposition be proportional to the current flowing. The important thing, therefore, is to know how much current flows through the soil from rails to pipes or pipes to rails. A measurement of difference of potential between these electrodes gives no idea of this current, unless R be assumed either negligible in all cases or alike; for by Ohm's law $E = CR$ and C may be large or small according as R is large or small. And so where we have the highest differences of potential the smallest current may be flowing and least electrolytic action be taking place. Once when at the end of a suburban road furthest from the power house, where there were no systems of buried gas and water pipes, I measured a difference of potential of 10 volts between the rails and an iron post planted in the ground. Evidently this was no indication of a large current, since there was only one car within a mile, and the post could have had no part in the ground return.

Using an auxiliary conductor extended through the danger territory and connected with the rails to obviate the electrolytic action, is simply making the return path a better conductor, or making the track return of low resistance compared with the earth return. This is evidently the direction in which to work, since the current divides in an inverse proportion to the resistance of the paths it has to traverse. I believe it is unnecessary to go to the expense of these massive auxiliary conductors, except in very special cases. The 90-pound girder rails, now so generally used in street railway construction, have a cross section of 8.9 sq. in. Taking a single-track road and considering iron to have seven times the resistance of copper of the same cross section, the resistance of the track would be .0177 ohm per mile (neglecting bonds) in which, if 200 amperes flow, the drop of potential would be 3.54 volts.

The bond is the part of the return which has to have very particular consideration. I know of at least two bonds which, by ordinary fitting, will have a resistance not exceeding .00004 ohm each, and with care in bonding can be made considerably less. Allowing 176 joints per mile, this will give for two rails a resistance for joints of .00352 ohm and drop of potential through them at 200 amperes of .7 volt. The total resistance per mile will then be .02122 ohm and the drop of potential through the rail return at 200 amperes will be 4.24 volts per mile.

On the other hand, to make the ground return of as high resistance as possible, one needs to bed the ties and rails in concrete or broken stone to make a poor ground connection there, and abolish ground plates everywhere over the system.

Electric Welding of Rails.

During the past year over 40 miles of track have been electrically welded in different cities of the United States under varying local conditions. In every case the work was done with a shortage of electric current, and the Johnson company, who are alone in this field of work, and their customers looked for the results of the contraction, caused by the cold weather, with many misgivings. It is too early to speak positively as to what the year's test will show, although so far as matters have gone it looks most encouraging. Where it was fully expected that the number of welds broken by contraction would reach from 8 to 10 per cent., it is now believed it will not reach 3 per cent. Should this be ultimately substantiated, it places the practicability of electric welding of rails beyond doubt.

For the coming season extensive preparations have been made for securing ample current, and further devices have been perfected by which it is believed all internal stress can be relieved, in which event it is expected that the last of the difficulties will have been overcome. It is almost certain that by securing a full and regular product, the economy of operation will put the cost of the process beyond opposition. The following facts in regard to electric welding of rails we borrow from a circular issued by the Thomson Electric Welding Company, and written by Mr. Hermann Lemp.

The Johnson Company of Johnstown, Pa., under the able leadership of Mr. A. J. Moxham, has been indefatigable in applying the electric welding process to street railway work, and has demonstrated that a continuous rail can be made, buried in the ground, that will withstand the variations of temperature met with in this climate. The plant used by this company consists of a welding train composed of a dynamo-car, in which a continuous current of 500 volts and approximately 275 amperes is transformed into alternating currents of 300 average electromotive force and 650 amperes, which currents, after passing through an adjustable reactive coil, enter the primary of the welding transformer, suspended from a boom in the welding-car. The welder has two transformers with oil insulation and can be operated with immunity from electric shocks in pouring rain. A hydraulic jack, operated by a hand pump, furnishes the necessary pressure. The cars are equipped with electric motors for hoisting and swinging the welders, pumping water for water circulation in the jaws, grinding the surface of the rail clean, and moving the cars on the track. The rails are butted against each other, and two chucks are welded from either side across the joint. These chucks are not only welded to both of the rails, but, by the lateral pressure exerted against the heated ends of the rails, force the latter into each other.

Experience has established the following facts: A continuous 70-pound rail requires about 150,000 pounds strength to withstand the maximum strain put upon it longitudinally by the variations in temperature from coldest winter to hottest summer. An electric weld will only break at 279,000 pounds strain. Four joints can be made in an hour, under proper conditions. The electric conductivity of the joint is as great as the rail itself.

The Story of the Strike.

THE BROOKLYN STRIKE as already told in our columns was inaugurated on the morning of January 14. Forty-seven roads were affected, the two lines which made terms with the strikers and remained running being the Jay and Smith Street line and the West End and Coney Island line.

For several days the situation presented no more alarming features than an ordinary tie-up would have done, but on the night of the 18th it suddenly and unexpectedly developed very serious aspects. Early in the day the two larger companies, the Atlantic Avenue and the Brooklyn City, announced that they would force the issue. Violence all over the city was on the increase and the efforts of the Arbitration Commissioners to bring about a settlement were unsuccessful. It was at once seen that the affair was of greater importance than had at first been supposed. The railroad companies made a demand for protection by the militia, and in addition to the large police force of the city the entire Second Brigade of the State National Guard, 3,000 strong, was ordered out.

Late on Saturday night in East New York a mob attacked three companies stationed there. Major Cochran ordered a charge and many were bayoneted. Quite a number of the soldiers were injured. It was all over in a few minutes, but it was hot enough while it lasted. The strikers broke and ran in all directions, hurling a few stones by way of parting salute, and leaving four or five of their number groaning and struggling on the ground.

Meanwhile, there had been a general distribution of soldiers all over the city, all the power houses and car depots having their guard of troops. Nevertheless, the companies succeeded in opening only five of their lines, and these they ran under great difficulties for only a few hours.

The authorities realized that they were unable to handle the strike even with the assistance of the Second Brigade. Mayor Schieren telegraphed Governor Morton, who promptly ordered out the First Brigade, consisting of about 4,000 men and practically all the troops in New York city. Previous to calling for more troops Mayor Schieren had obtained the consent of the strike leaders to arbitrate, but the companies refused to consider any proposition from the men unless they applied for reinstatement as individuals. Then the Mayor read an abbreviated riot act and Brooklyn's Reign of Terror began in earnest.

Several of the wires in various parts of the city had been cut previous to Sunday, but they were repaired, and the officials of the Fulton Street line prepared to run a car in the afternoon.

The first car made the trip without other incident than that it had to pass amid a storm of jeers and yells of derision. A second car was not so fortunate. At Lewis avenue it was surrounded by a mob which began to stone it. The motorman deserted in favor of the strikers. The conductor who held out for a few minutes made his escape to an elevated railway station, chased by a crowd of more than a hundred men. Then the car was run back to the depot by the strikers, who filled it to overflowing.

When the car reached the depot the men touched their hats to the foreman and departed in great glee.

The Mayor's proclamation was placarded. Bayonets gleamed in the streets, but the military, far from awing the people, inflamed them the more. Pistol shots now began to be heard where heretofore only stones were thrown. Several policemen were wounded by bullets and many militiamen were hurt. The Seventh Regiment of New York fired into the mob at Halsey street and Broadway. Contributions of money and food to the strikers began to increase. Wires were cut and pulled down all over the city, and linemen

Some Scenes of the Strike.

were kept busy repairing these breaks. Application for a writ of mandamus was made before Justice Gaynor. The Board of Supervisors adopted resolutions favoring the strikers, and the Board of Aldermen passed an ordinance providing that no man shall run a car without taking out a license.

This was on Monday. Tuesday showed no abatement. Two men were shot down by the soldiers. Heretofore the firing had been for the purpose of intimidation. This time it was done with intent to kill. The men who were wounded were shot by sentries. One of the men was drunk, it was found afterward. This day was also notable because of collisions between cars. Inexperienced motormen have considerably lengthened the bill of repairs. The linemen also decided to join the strikers, and in anticipation of this movement, which was to take place next day, the strikers began cutting wires right and left. They were cut in Broadway, in Third avenue, in Fulton street, in Ralph avenue and in a dozen other places. It takes experienced men to repair the lines, hence it was estimated that the strike of the linemen was a large point in the strikers' favor.

Caught in the Act.

Wednesday was notable for two events, the strike of the linemen and the shooting of Thomas Carney. Carney was a roofer who was watching from a housetop the soldiers escorting a car through Hicks street. He was taken for a belligerent striker who might possibly shoot or throw stones. So the order was given to fire and Carney was shot through the body. It is claimed that the shooting was unjustifiable, and the police are investigating it. Violence was still the order of the day. It required eighty members of the Thirteenth Regiment to force a car through Hicks street, and this only under cover of a heavy fusilade. The blockade was far from lifted, and in spite of the fact that several new lines were opened, less than 300 cars were run during the day. The great fear in the minds of the poeple of Brooklyn was of what the future might bring forth. The city was unsettled. The death of two innocent spectators created a feeling of alarm and the next morning's papers were anxiously awaited.

Obstructing a Line.

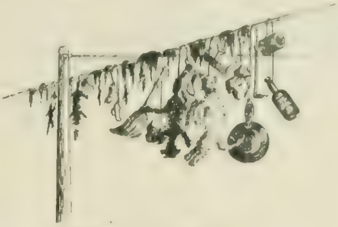
But one day brought a decided change. Slowly but surely the strike began to wane. This was not apparent at first, especially as the decision in regard to the mandamus was made known on this day. Wires were cut all over Brooklyn and strategy began to supersede brute force in the trolley war. Cars were run at night on several lines, and more cars than heretofore were run during the daytime.

On Friday the principal scene of action changed to Greenpoint, on the outskirts of Brooklyn. Some cars were wrecked there, but the outbreak was only the last throes of a rapidly dying strike.

Saturday was remarkable merely from the growing improvement in favor of the companies, and Sunday was as Sunday ordinarily is in the City of Churches—an uneventful, peaceful day.

And so it has been since. Gradually affairs in Brooklyn have adjusted themselves until at the time of going to press there can be little doubt of the ultimate ending.

We publish in this issue a number of illustrations which will give our readers some idea of the scenes during the strike. Some of these are our own made on the spot and some are reproduced from the daily papers, but they will serve a useful and historic purpose in showing just how the soldiers handled the mobs and guarded the cars, and on the other hand how the striking men found their surest method of obstruction in the pulling down of the trolley wires.



Overhead Obstructions.

SOME STATISTICS OF THE STRIKE.

The best idea of how the strike has fluctuated can be gained from the following statistics of the number of cars run during last week. Always excepting the two lines which acceded to the strikers' demands and were not molested, the number of cars run each day is as follows: Monday, 104; Tuesday, 213; Wednesday, 317; Thursday, 328; Friday, 437; Saturday, 309.

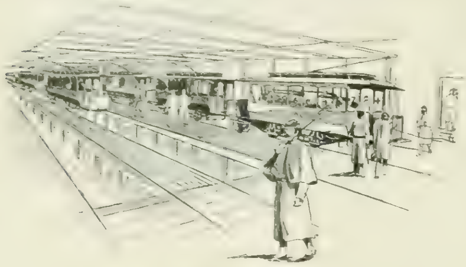
Interior of a Wrecked Car.

Saying that these cars were run is to slightly stretch the facts. They were operated but spasmodically indeed. Some of them did not go very far when their trolley poles had to be reversed, and they were run back to the depots. The number of cars usually in commission by the three companies is upward of seven hundred. The companies are gradually increasing their running force, and the limit will soon be reached.

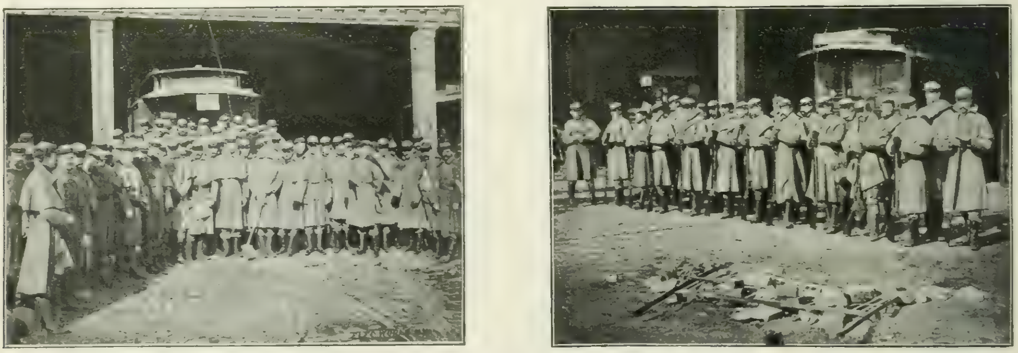
Two men have been killed in this strike and, as it happens, they were both in nowise concerned in it. The injured are many, but their number cannot be given, as the strikers, when hit, invariably slunk away without giving the soldiers the satisfaction of knowing the extent of their injuries.

Motormen were in great demand in Brooklyn last week. The companies had scouts out in all the neighboring "trolley" cities, and men came in from all directions. Some had their passage paid while others came in anticipation of a premium which they thought their services might command during the troublous times. Many deserted in favor of the strikers after the companies paid their way.

One feature of the strike was the way in which it was treated by the aldermen of Brooklyn. The board was as a unit in sympathy with the strikers. In a session which lasted four hours a resolution was passed maintaining that no motorman should have the right to operate any trolley car in the streets of Brooklyn unless he be twenty-one years of age, a resident of the State one year, of the city four months, and have obtained a license from the Mayor for such purpose, under a penalty of twenty-five dollars for each offense to be recovered from the owners of the car. Another resolution passed was to the effect that the various electric railroad companies operating lines in Brooklyn be compelled to obtain a license for every motorman employed by them, at a cost of one dollar a year for each man; that every motorman shall be a citizen of the United States and a resident of Kings County, and that the city clerk provide a badge, properly inscribed and numbered, to be furnished each motorman without any extra charge, but transferable.



Car Barracks.



Some of the Militia.

The board of aldermen of Jersey City, N. J., following the example of the Brooklyn board, introduced an ordinance at a meeting held last week providing for the licensing of motormen on the same lines as those laid down by the Brooklyn aldermen.

The workers in the various power stations in Brooklyn felt the influence of the outside makes and breaks as much as any one. They had all they could do to attend to their work of detecting the various signals of distress as they were made known to them at the switchboard. They were a very busy set of men, but there will be a technical story to tell after awhile.

The cost of this strike will be a very serious matter for the taxpayers of Brooklyn to consider in the near future. It is estimated that the pay and maintenance of the 7,000 militiamen who have been occupying Brooklyn amounted to $15,000 for every day they were there. The loss in fares to the companies, the loss in wages to the men and the cost of the big force of police will place the grand total above $1,000,000. It is estimated that the companies have been losing in receipts about $32,000 a day. The men on strike would have received $2 a day had they worked. They have therefore lost about $150,000. The retail stores and the theatres have been great sufferers. The theatres alone have lost $5,000 a night since the trolley wheels stopped running. This aggregation of cost and expense is the sweet financial pill which the people of Brooklyn have got to swallow.

Repairing a Trolley Wire.

JUDGE GAYNOR'S MANDAMUS.

The comments on the writ of mandamus in the Brooklyn strike made by the daily papers were based on partisanship. Editors saw justice or injustice each from his own standpoint. The consensus of argument does not carry conviction with any force in either direction. It might all be summed up in the platitudinal ending of an editorial which appeared in the New York *Times*. After touching on the subject at some length the *Times* concludes as follows: "These two things—the absolute need of order and its ultimately certain and complete attainment—stand out more clearly and firmly in the popular impressions at the past fortnight than all others. When everything else is forgotten or dimly remembered these will remain. The rights and wrongs of the employes of the trolley lines—and they plainly had both—the rights and wrongs of the companies—and they had both—the faults or virtues of the police administration, the conduct and efficiency of the militia, the temper and behavior of various classes in different neighborhoods—all these, eagerly or hotly discussed, as they have been, will fade out of memory, but the people of Brooklyn will not in this generation forget the injury actually suffered, the peril that seemed so imminent, and the effective and impressive demonstration of the tremendous reserve of force that a great State possesses to protect the universal indispensable right to order and the reign of law."

Harper's Weekly, however, and commercial and similar journals quite disapproved of the idea of a peremptory writ, but were relieved when an alternative writ was granted instead. It is a question how far the action of Judge Gaynor will be regarded as a precedent in similar applications in future under like circumstances.

Reports from Street Railways.

The reports which follow were received in reply to a circular letter addressed to managing officials of street railways, requesting information as to proposed extensions and improvements, with some additions from other sources. Of the numerous replies received, those are omitted that did not have a direct bearing on the points in regard to which information was asked:

Cumberland, Md.—Wm. Roberts, Jr., superintendent Cumberland Electric Railway Company: "We contemplate building about 1,100 ft. of new track in the spring."

Butte, Montana.—J. S. Wathey, superintendent Butte Consolidated Railway Company: "We will probably put new trucks under five 16-foot Stevenson cars in the spring."

Waterloo, Iowa.—J. E. Sedgwick, president Waterloo Street Railway Company: "Ours is a horse railway, and we can not hope to make any changes or extensions this year."

Natchez, Miss.—A. Moses, secretary and treasurer Natchez Street Railway Company: "We expect during 1895 to extend our lines two miles, and then equip the entire six miles of road for electric traction."

Asbury Park, N. J.—L. E. Watson, superintendent Asbury Park & Belmar Street Railway Company: "We have been operating by horses for one year past, but propose to have the trolley system in operation by May 1."

Covington, Ky.—T. M. Jenkins, superintendent South Covington & Cincinnati Street Railroad Company: "We are going to make about six miles of extensions during the year 1895, but all our supplies are contracted for."

Galveston, Texas.—Wm. H. Sinclair, president Galveston City Railway Company: "We contemplate rebuilding about five miles of track now operated by mule cars, and the purchase of fifteen or twenty motors this spring."

Elmira, N. Y.—C. H. Baldwin, treasurer and general manager Elmira & Horseheads Railway Company: "At this writing I am unable to tell what additions we shall make on our road the coming spring. Will advise you later."

Charlotte, Monroe Co., N. Y.—C. A. Derr, superintendent Rochester Electric Railway Company: "A number of additions and improvements for this line are under consideration, but it is too early to state just what will be done."

Harrisburg, Pa.—F. B. Musser, superintendent East Harrisburg Passenger Railway Company: "We do not contemplate buying any material this coming season. We may make some few changes, but have enough material on hand for that purpose."

Winona, Minn.—Andrew H. Hill, general manager Winona General Electric Company: "So far as I can see at present no improvements or extensions will be undertaken this year, business conditions not warranting any further expenditure."

Norwalk, Conn.—Wm. F. Acton, secretary and general manager the Norwalk Street Railway Company: "Our extensions depend entirely on the action of the legislature, as we have no charter rights under which we can make profitable extensions."

Terre Haute, Ind.—Russell B. Harrison, president Terre Haute Electric Railway Company: "This road contemplates extensions in 1895 aggregating ten miles and will make additions to the power and lighting plant. It is too early to give detailed information."

Warren, Pa.—D. H. Siggins, treasurer Warren Street Railway Company: "While we expect to extend our lines next season, there has been nothing settled to a certainty. We have about four miles to build, but how much will be done next season I cannot say."

Port Huron, Mich.—H. A. Dixon, superintendent City Electric Railway Company: "In the spring we contemplate a two-mile extension of single track. We will use a 7-inch T rail, and iron poles for half the distance. We have rolling stock enough to equip it."

Cottage City, Mass.—H. S. Kemp, superintendent Cottage City Street Railway Company: "We expect to extend the present road two miles to Vineyard Haven, and equip with electricity. Will use seven motor cars, and build a 150-hp station. Address H. S. Kemp, Quincy, Mass."

Gallipolis, Ohio.—H. R. Myers, superintendent the Gallipolis Street Railway Company: "We intend to extend our road half a mile and also to put down a T rail where we now use a flat rail, for three miles. We also intend to add new cars and motors. None of the above named goods are contracted for yet."

Kansas City, Mo.—W. O. Hands, superintendent and purchasing agent North East Street Railway Company: "At present we have not under consideration any extension or additions except a car barn, but have not yet decided in regard to this. We have just completed equipping our road with the latest cars, motors and trucks."

Lexington, Ky.—E. J. Richards, superintendent Passenger & Belt Railway Company: "The only extension which we expect to make this spring, will be in the way of adding eight open cars to our equipment. These are now being made by the Pullman Company. Our mileage will not be extended this season, nor will we add to our generating equipment."

Oshkosh, Wis.—Chas. E. Montgomery, superintendent Oshkosh Street Railway Company: "We cannot give you any authoritative information at present. The company intends to put in an electric line whenever the city council sees fit to give a liberal franchise, whenever that may be. At any rate, we will have to continue with a horse road for some time to come."

New Orleans, La.—Alden McLellan, president St. Charles Street Railway Company: "This company has contracted with C. E. Loss & Co., of Chicago, to rebuild its entire line for electric equipment (about 12 miles), rails and specials to be furnished by the Pennsylvania Steel Company, of Steelton, Pa. Specifications are being prepared for cars, motors, power houses and machinery.

Chicago, Ill.—W. F. Brennan, superintendent Chicago General Railway Company: "We have just completed a six mile extension and started a new power plant at Thirtieth and Kenzie streets, and are endeavoring to perfect the system which we now have in operation and at present are waiting a meeting of the Board of Directors so that we may reach a decision about future extensions."

Fort Wayne, Ind.—M. S. Robison, Jr., vice president and treasurer Fort Wayne Electric Railway Company: "The only change that this company contemplates making for this year will be the relaying of about three miles of track with new rails, which will finish up our entire system. We have not considered the matter of any extensions as yet, and could not say at present whether any will be made or not."

Steubenville, O.—J. F. Flood, superintendent the Steubenville Traction Company: "The ownership of this road is in litigation and may not be determined for some time yet. The road is now held by a local incorporation known as the Steubenville Traction Company, who will rebuild it in the spring, if they succeed in retaining their hold. In the meantime we are doing only such repairing as is absolutely necessary."

Norfolk, Va.—M. W. Mason, general manager of Port Norfolk Land Company: "The Port Norfolk Electric Railway is about to change from horse to electric power. It is likely the contract for the steam plant will be let by the time this reaches you, but we have not arranged for our motors or generators. Will want two 80-kw generators and four double car equipments; also four vestibule car bodies 16 ft., best finish."

Anniston, Ala.—Howard W. Sexton, president Oxford Lake Line: "There are no extensions, changes, or additions contemplated to the Oxford Lake Line, the only repairs being needed this winter and spring being the repair parts necessary to put each of our six motor cars in thorough repair. As the greatest care is taken, nearly everything connected with our line is in perfect running order, and there will be only such parts required as are necessary to make good the ordinary wear and tear of the year."

Merrill, Wis.—E. S. King, secretary and treasurer Merrill Railway and Lighting Company: "We do not expect to make any further additions to our railway plant this year. The only item of interest pertaining to our plant is that we have had installed, and have operated for two weeks, a 240-cell storage battery, manufactured by the Electric Storage Battery Company, Philadelphia. This is the first installation of central station battery for railway work in the United States. We intend also to use it for lighting purposes during the period of heavy load."

Beaver Falls, Pa.—Hartford P. Brown, secretary and general manager the Beaver Valley Traction Company: "This company expects to put down about two miles of heavy rail during the coming season, and some new trucks and motor equipments. Notwithstanding the hard times of 1894, this road has largely increased its net earnings as compared with 1893. The operating expenses for 1892 were 70 per cent. of gross earnings; the operating expenses for 1893 were 62 per cent. of the gross earnings, and the operating expenses or 1894 were 53 per cent. of the gross earnings."

Sandusky, O.—Thos. Wood, secretary the Sandusky, Milan and Norwalk Electric Railway Company: "The business of this road for the first year has been very satisfactory, over 500,000 passengers having been carried. Although our road is somewhat difficult to operate on account of grades, trestle work, etc., we have been fortunate enough to have not had to report the first accident to any of our passengers or employes. During the coming year possibly one single and one double equipment and one 16-foot car will cover our requirements, provided no extensions are made."

Joplin, Mo.—C. H. Belden, superintendent Joplin Electric Railway and Motor Company: "The Joplin Electric Railway & Motor Company was sold last month to the Carthage, Webb City, Joplin & Galena Electric Railway Company, and it is understood that an extension will be made this year to Galena, Kan. The surveys and all preliminarry work have already been made. This will necessitate a new power house, another engine and generator and four or five more cars. The extension will be about eight miles. Further information may be given by Carroll & Powell, 115 North Third street, St. Louis, Mo."

Corning, N. Y.—F. B. Brown, president Citizens' Electric Railway Company: "The franchise in this city has been offered to a company recently organized, viz., 'The Painted Post and Corning Street Railway Company.' The Citizens' Electric Street Railway Company did not accept the conditions. The Painted Post and Corning Company verbally accepted conditions, which were to be complied with by Jan. 21, to-day, but last week they secured a postponement of ten days. Their intentions cannot be foretold. It is safe to say that the company with which I am identified is not prepared to accept the franchise offered by the present city government."

Binghamton, N. Y.—J. P. E. Clark, general manager Binghamton Railroad Company: "A proposed extension connecting Binghamton with Union is contemplated. The construction will probably commence in the spring. It will be known as the Binghamton, Lestershire & Union Railway Company, which will be virtually the Binghamton Railway Company, and will connect with our present lines. The proposed extension will be six miles in length and will be constructed in a most thorough and complete manner. The list of officers is as follows: J. B. Landfield, president; J. M. Johnson, secretary; John B. Rogers, treasurer; J. P. E. Clark, general manager."

St. Louis, Mo.—D. G. Hamilton, president; Richard McCullough, chief engineer Citizens' Railway (cable), Northern Central Railway, Cass avenue and Fair Grounds Railway and Union Railway: "The only large work in which we are now engaged is the relaying of the track of the Citizens' Railway. This road was operated as a cable road up to the first of last December, but is now equipped with electric cars. The cars are 28 ft. long, double truck, with cross seats. The equipment is G. E. 800 motors and K. controllers. The old cable track is to be entirely relaid as soon as the weather permits. It is about ten miles of single track, and is to be laid with 85-lb Johnson girder rails on white oak ties, two feet between centres. The rails are to be furnished in lengths of 60 feet, and the joints are to be welded in some manner, either electrically or otherwise."

Grand Junction, Col.—Benton Canon, president Grand Junction Street Car Company: "The stock of the Grand Junction Street Railway Company is up in my hands as collateral security and the owners are simply holding it until times open up again when they hope to change the system from the present horse car to an electric line and are now simply holding the franchise. Our town of 4000 inhabitants is growing and has a county peculiarly adapted to fruit raising and building up suburban additions to which we hope to extend the street car service in the near future. This is a good opening for some one to come in and buy up this line, and make the necessary extensions as soon as the town starts to building again, as we have a section here that is going to grow very rapidly when the business of the country is restored to its usual conditions."

Augusta, Ga.—W. E. Moore, superintendent Augusta Railway Company and Augusta Electric Light and Motor Company: "Our plant is operated by Victor horizontal turbine water wheels taking water from the Augusta Canal and working under 32 feet head. Until the first of last year we had been greatly bothered to get a proper regulation of the speed, as the load is very variable, but have now succeeded in devising a regulator that will hold speed within 2 per cent. It is probable that we shall put in this year a 500-hp turbine water wheel with a directly connected 500-volt generator. The Augusta canal is the property of the city of Augusta, is seven miles long, having cost over $1,000,000, and has a capacity of 14,000 hp, of which 10,000 hp is in use. The city leases the power at $5.50 per hp per year, based on the maker's rating of wheel."

Gloversville, N. Y.—R. T. McKeever, general superintendent Fonda, Johnstown and Gloversville Railway Company: "The Cayadutta Electric Railway Company and the Johnstown, Gloversville and Kingsboro Horse Railroad Company, the latter now operated by electricity, represent the electric division of this railway company. We do not propose to make any extensions, and I do not know of any information that will be of value to your paper. I might add, however, that Mr. J. Ledlie Hess, of Fonda, has been made president, and myself, R. T. McKeever, secretary and treasurer of the three horse railroads now running between Herkimer and Frankfort in this State, and we propose in the early Spring to equip and connect these now separate companies with electricity. At present, however, our plans are very crude, as we have only just obtained control of this property."

Columbus, Ga.—Jno. F. Flournoy, president the Columbus Railway Company: "The Columbus Railway Company is rebuilding its entire system of horse car lines and dummy steam lines and equipping the same in a first-class manner with electricity. The Columbus Railway Company has also bought the North Highlands road, and is now operating that. We are putting quite an extensive power house in the Chattahoochee River at the City Mills Company plant here, for the purpose of generating electricity by water power with which to operate our entire system (twenty miles of road), and also for the purpose of furnishing electrical power to manufacturing plants of from one horse-power to as high as five hundred horse-power. When fully completed and ready for operation (which we hope to have done by April 1) we will have a magnificent plant. All of the material for water power, power house, equipment, etc., has been purchased, and a great portion of it is now on the ground."

Sioux City, Iowa.—I. B. Walker, superintendent Sioux City Traction Company: "At the present time we have in hand no contemplated extensions either in line constructions or power house equipments. During the past year we extended several of our lines, and built a steel span bridge across the Floyd River for the purpose of getting one of our lines into a suburb called Greenville. As you may know, there are at present time five electric street railways in Sioux City individually operated. From time to time it has been expected by the street railway property holders here that there would be a general consolidation, but as yet it seems to be as far off as ever. Our road occupies all the principal business and residence streets, while the other four are suburb lines operating from one to four cars. As far as we are able to say now, the coming year has no special features to speak of. We are simply operating as cheaply as possible, keeping our repair account at the lowest possible notch and projecting no new plans, except where it brings immediate results. Our foreign orders are very small, having to go outside of our own city for very few articles of stock used on our road."

South Pittsburg, Tenn.—J. Bright, secretary and manager Deptford and South Pittsburgh Street Railway Company: "We now have the Deptford and South Pittsburgh Street Railway (2½ miles long) running from South Pittsburgh, a city of 4,000 people, to a suburb—Deptford—which is about one-half the distance between South Pittsburgh and Bridgeport, a new town of about 2,500 people. Both South Pittsburgh and Bridgeport are live manufacturing towns with a great diversity of enterprises, consisting of three blast furnaces, two cast iron gas and water pipe works, two saw and planing mills, soil pipe (iron) works, canning factory, southern branch of the Eagle Pencil Company, two electric light plants, ice factory and other enterprises. We would like to connect these two towns by an electric line, the distance being about six miles. We now have a $12,000 line, all paid for, 2½ miles of the distance with three cars and eight miles of good track, using 30-lb T rails, which has been in operation three years. What we desire is to convert into an electric line and put our road, etc., in at a reasonable price. I can show facts and figures to any one interested enough to inquire."

Sedalia, Mo.—D. C. Metsker, secretary Electric Railway, Light and Power Company: "The Sedalia and Brown Springs Electric Railway Company has been chartered with a capital of $80,000 to operate a street railway and to establish and maintain a pleasure and health resort, and such other things as may be necessary for the profit and success of the company. It has acquired land and property valued at $60,000 and will build and equip the line from Sedalia connecting with such property, which is situated at Brown Springs, well known as a pleasure and health resort, about four miles from Sedalia. The company has issued its first mortgage bonds for the sum of $80,000, the principal and interest of which is guaranteed by the Electric Railway, Light and Power Company, a corporation now operating about 12 miles of electric railway in Sedalia and the adjoining territory and an electric light plant of 150 arcs and 1,500 incandescents. This latter company has a paid up capital of $200,000, the plant being bonded for the same sum. It has a contract to light the city of Sedalia until August, 1899, furnishing 100 or more arc lights at $76.20 per year and such incandescent lamps as may be required at $6 per annum each. After paying all expenses the company has earned over 6 per cent. on its capital stock. In consideration of the above guarantee the Sedalia and Brown Springs Electric Railway Company has entered into an agreement to lease to the Electric Railway, Light and Power Company its railway and equipment for a period of 20 years, and receives therefor a sum equal to the interest on its bonds, all taxes upon its property, and an additional sum at the end of ten years equal to 5 per cent. of its bonded indebtedness, and each additional year thereafter a like amount to be used as a sinking fund to pay off and reduce its bonded indebtedness. The bonds so secured and guaranteed are 20 year gold bonds and become due the first day of December, 1914. The Electric Railway, Light and Power Company thinks that in operating this road in connection with its own it can do so at a much less cost than if operated independently, materially increase the earnings of its own plant and receive a profit from the road after paying the rental agreed upon. There are now ready for delivery bonds to the value of $50,000, which are offered at par and accrued interest. The extension to Brown Springs is expected to be made in the early spring."

Augusta, Ga.—The North Augusta Land Company will probably lay two miles of track to develop the property of the company in North Augusta.

Brigantine Beach, N. J.—The Brigantine Transit Company contemplates an additional power house plant. Monroe B. Smith is general manager.

Meriden, Conn.—For the contemplated lines about Meriden, information could be secured of W. C. Gray, superintendent Meriden Horse Railway Company.

Yonkers, N.Y.—Some new line is to be built at Yonkers, N. Y., by the Yonkers Electric Railroad Company, of which C. H. Montague is general manager.

New Philadelphia, O.—There has been some talk here lately of an electric road to Steubenville (about 50 miles west), but as yet no definite action has been taken.

New Orleans, La.—The Orleans Railway Company, of this city, has its routes surveyed and is preparing specifications for rebuilding and re-equipping with electric power.

Flushing, L. I., N.Y.—Some extension is contemplated at Flushing, Long Island, by the Flushing and College Point Street Railway Company, of which W. G. Rock is superintendent.

Sing Sing, N.Y.—The Ossining Street Railway Company contemplates extending its line three or four miles back from the present terminus, as soon as it can do so, perhaps early next spring. Mr. Jay Champlain, Sing Sing, is superintendent of the road.

Bridgeport, Conn.—A good deal of extension is contemplated, or actually begun out from Bridgeport. Information may be obtained from Col. N. H. Heft (president Bridgeport Traction Company), Andrew Radel, superintendent, or F. E. Fischer, electrician.

South Manchester, Conn.—The Hartford, Manchester & Rockville Railway Company (Maro S. Chapman, of South Manchester, president) proposes to begin work early in the spring on the construction of a trolley line from Burnside (in East Hartford) to Rockville.

Peekskill.—The company recently formed at Peekskill, N. Y., to build and operate an electric railway has secured the franchise, and is now placing orders for engines, boilers, equipments, etc., or soon will. Mr. E. B. Gallaher, 253 Broadway, New York, is the engineer in charge.

Staten Island.—A company has been formed to build and operate several miles of electric road on Staten Island. The consent of most of the property owners has been gained, and work is to be commenced early in the spring. Cornelius G. Kolff, 32 Broadway, New York, is pushing the scheme.

Brooklyn, N. Y.—The Brooklyn Heights Railroad Company has the right of way to build about 100 miles of additional track in Brooklyn, and will probably, unless the strike changes the situation, begin construction in the spring. D. F. Lewis, president; W. A. H. Bogardus, general manager, or H. M. Brockbank, line superintendent, could give further information.

New Britain, Conn.—The Central Electric and Tramway Company, E. S. Breed, superintendent, is now before the courts for leave to build extensions through Berlin and Newington to Hartford. The lines will parallel two steam roads, the N.Y., N. H. & H. and the New York & New England, and both are opposing the extension on the ground that public necessity does not require the extensions.

Newark, N. J.—The Consolidated Traction Company is to construct many miles of new track as soon as spring opens. Mr. David Young, general manager, has lately placed an order [illegible] miles of feeder wire for this extension, so that work may not be delayed when started. Mr. Young (Prudential Building, Newark), or Mr. Charles P. Uebelacker, the electrical engineer, can give information.

Hartford, Conn.—The Hartford Street Railway Company began operating its Lafayette street and Farmington avenue lines with the trolley on December 18, 1894. When the new power house is completed, all lines in the system will be operated by electric traction, probably by March. The equipment is nearly completed. In the spring, the Main street line will be operated through to Windsor, about four miles north of Hartford.

Battle Creek, Mich.—The Citizens' Street Railway Company has just been completed, and will open for business February 1. The road, which was formerly the Battle Creek Electric Railway Company, was purchased by a new company in October last, and has been entirely rebuilt with new 60 and 45 pound T-rails, 9 St. Louis cars with two 50-hp motors under each car, 6 trailer cars, and two new generators. Everything is new throughout, and the road, which is 7¼ miles long, is pronounced to be the best road in the State.

Elyria, O.—Efforts are being made to complete an interurban line to Milan, O., to connect at the latter place with the Sandusky, Milan and Norwalk Electric Railway Company, which has been operating for more than a year with success. It is also proposed to extend the latter road from Monroeville to Norwalk, which if done will make its length 25 miles; it now operates 21 miles. There is also a plan on foot to complete a line from Wellington through Oberlin to Elyria or Lorain. Still another project is a road from Norwalk south, and still another from Fremont to Catawba Gold. It is thought that if capitalists regain confidence many of these projects will be carried out the coming season.

Newburgh, N. Y.—The Newburgh and Orange Lake Electric Railway Company secured the franchise to extend its system from Orange Lake (some four miles west of Newburgh) to Walden and Pine Bush, six or eight miles further northwest. Construction is to be begun as soon as possible after the severe winter weather is over. The company anticipate such activity in electric railway construction the coming spring that they are already placing contracts for feeder wire, line material, car equipments, etc., to avoid the delay experienced last spring while building the line from Newburgh to Orange Lake. The extension from Newburgh to Orange Lake has proved so successful that the management is quite enthusiastic over the coming extensions. One source of profit is the cross country freight now carried between Newburgh and Orange Lake.

The Eddy Street Power Station, at Providence, R. I.

BY GEO. T. HANCHETT.

This building, with its turtle back roof and plain rectangular shape, devoid of all ornament, has for the engineer a great architectural beauty. It is not one of those unfortunate power stations where the machines have been adapted to a building that was primarily erected for some other purpose, nor is it one of those that is composed of a series of patches, one patch for every increase in output that has been made.

The station has been erected with the idea of properly protecting electric power apparatus, providing means for the ready removal and repair of the machines and effecting an easy delivery of coal. There is also an ample space to increase the capacity of the plant to fully double its present output.

The boiler room or seat of power well deserves description. Steam is delivered at a pressure of 125 pounds gauge by a set of Babcock & Wilcox boilers, eight in number, used in conjunction with two Stirling boilers. Each boiler is rated at 500 hp. This gives a liberal margin of the boiler plant over the electric plant. The combination of the quick steaming Stirling boiler with the slower, but longer staying Babcock & Wilcox it would seem would make the delivery of steam at a uniform pressure much easier to the fireman. The coal consumption as given by the firemen averages 33 tons in 24 hours the year round. The water supply is very good, and scale is thereby avoided. A substantial brick stack ample for present capacity and probable increase provides a strong draught. The doors and way between the boilers freely admit of coal being brought in by the wagon load. The boilers present a fine appearance, as the fronts are built of white enameled brick and the piping around the front is of polished brass. The steam piping is exceptionally well done, the larger sizes of pipe being riveted. It is well covered and serious loss thus avoided. The boiler room is high, and there is ample room even over the high Stirling boiler. This gives abundance of fresh air, which the firemen cannot fail to appreciate. Ventilation for both boiler and engine room is provided by a series of ventilators in a row along the highest portion of the building. They are provided with vanes, and adjust themselves to the direction of the wind.

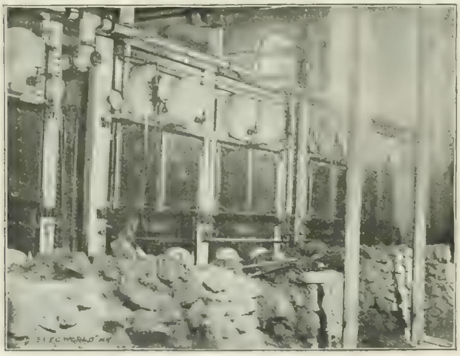
The engine room shows to the more careless observer the study in the design of the whole plant better than does the boiler room.

The engines and generators have massive brick foundations, built up from the level of the boiler room. The space under the floor of the engine room forms an ample provision for the receivers, and the Wheeler condensers with which each engine is provided. The boiler feed pumps are also located here, and from this place the feeders, rheostat wires, etc., etc., of each generator can be inspected throughout their entire length.

There are five units in the station and each has its own engine, and is complete in itself. These are driven by Greene automatic engines by a belt transmission. These engines are tandem compound, and have the following dimensions; Speed 100; stroke 4 ft.; high pressure cylinder 20 inches; low pressure 38 inches. They are directly belted on to three quadripolar General Electric generators, rated at 500 kw and revolving 350 times a minute. Each is capable of delivering 910 amperes at 550 volts, and is built to stand a heavy overload if it be required.

The remaining two units are of great interest. They are directly connected to two Greene automatic cross-compound engines and are situated directly between the high and low pressure cranks. The first of these, No. 4, is rated at 750 kw. It however carries habitually 1,400 amperes at 550 volts, and has carrried 2,500 amperes for over one hour without undue heating or sparking. The machine is at rest only a very small proportion of the twenty-four hours.

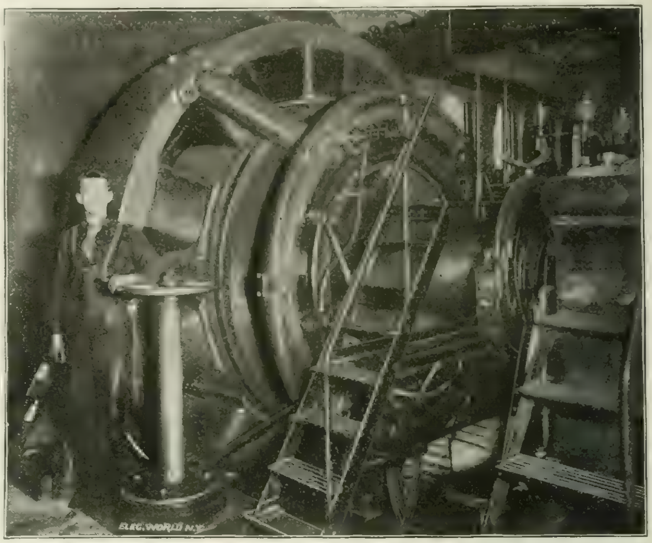
The engines of these two machines run at 100 evolutions per-minute and have a 4-foot stroke. The high pressure cylinders are 36 inches in diameter, and the low pressure 48. Each cylinder has its cut off regulated by the governor. The machine No. 5 is of historical interest, as it is the generator that supplied power for the intramural railroad at the World's Fair. It is a twin machine to No. 4, previously described. The commutator is a splendid piece of workmanship. It is composed of 36 sections of 20 bars each, making 720 bars in all. Each machine has ten poles, thus having 72 bars between 550 volts. Unfortunately the casting of the low pressure cylinder proved to be soft and cut somewhat, so that this machine has not been doing the duty that has been imposed upon its mate. It is, however, identical in construction, and will doubtless prove so in performance as soon as the defect is rectified.



The Boiler Room.

Both of these machines should appeal to the readers of the The Electrical World by their massive fly wheels. The engineer who designed them was apparently one of the few who think that in a fly wheel, as in other cases, it is a good idea to have material strong enough to resist the stresses it is called upon to bear, and as cast iron is not suited to tension and transverse stress the only prominent stresses in a fly wheel, he has used wrought iron.

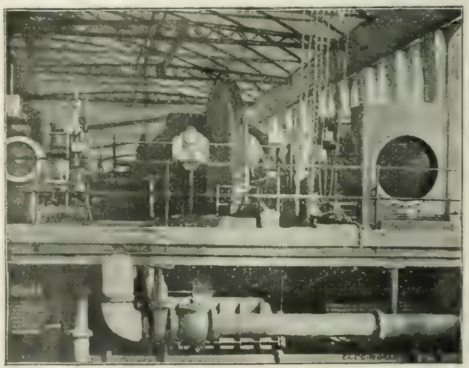
The wheels are built of twelve sections bolted by twenty-four bolts into an iron hub. On the edge of these sections are riveted the pieces of iron which form the rim. These are staggered with regard to each other, and give the wheel the appearance of a lammelar structure. The wheels are 18 feet in diameter and are fully able to stand much more than the 5,655 feet per minute that their rims are called upon to perform. How much superior this is and how much more of an engineer's job than to design a wheel of poor and unreliable material relying on the safety stop to preserve it. No one knows better than a good engineer that the best is never the cheapest in first cost.



A Historic Generator.

The station is provided with two traveling cranes which control the whole area occupied by the engines and generators, and also that provided for future addition. The convenience of this is obvious to any one who has been a station manager.

The units, it will be seen, can be readily adjusted to the following loads in kilowatts and still be fully loaded: 500, 750, 1,000, 1,250 1,500, 1,750, 2,000, 2,250, 2,500, 2,750, 3,000, stepping up in steps of 250 kw. It is not advisable to run railway generators too close, as the blowing out of one machine cut-out may bring all the others along with it if the system is tied together, for the other machines are at once overloaded. If the circuits are independent and on different generators, they may be run much closer to their rated load, but the distribution of current is more expensive in



The Engine Room.

copper, by no means as good, and beside the system is less flexible. It is probable that in this station with all the machinery running, a load of 5,000 kw. could be carried for a short time without excessive trouble. This would form quite a steeple in the station load curve, and one which at present will probably not occur. The oil used in the station is the best that Leonard & Ellis can produce, and is as clear as pure water, and of a light lemon yellow tint. The pistons are lubricated with the American Oil Company's cylinder oil. This seems to lubricate them in their 800 feet per minute travel without serious inconvenience.

The whole system is kept scrupulously clean and neat. Records are kept of voltage and current, readings being taken every 15 minutes.

Each engine is provided with an accurate reducing rig, and the indicators are frequently on the engines. It is in this way alone that economy can be obtained. It is impossible to economize till the point where the waste occurs is known. The good design of the station is well shown by the fact that it is impossible for a rival engineer to criticise. It is simplicity and utility itself.

Economic Street Railway Maintenance.—The Repair Shop.

BY KEPPELE HALL.

The growing popularity of the electric railway and its very rapid extension have given an opportunity for many engineers and managers to relate their experiences and opinions and express their views as to the most economical method of conducting a road. The majority of these discussions, or at least a goodly proportion of them, have had reference to the power station, and this is justified by the fact that it is most important. Not only does the whole traffic of the line depend upon it, but such a large amount of capital is represented by dynamos, engines, boilers and appliances that to neglect it or be careless as to its management would be suicidal to the interests of any road.

Now a street railway is not a toy. On the other hand it is a very complicated device to handle. Its branches are numerous and, as in all large undertakings, so in this, the ultimate success of the whole depends upon the perfect working of all the parts. Many roads are struggling along with indifferent success for the simple though unappreciated reason that some branch of the system is being poorly operated and acting as a drag on the whole enterprise.

The repair shop and its function in railway work is undeniably a great factor in success or failure, and it is to this department that I wish to confine this article. I have had the good fortune to have passed through the mill, not as an expert or a manager, but as a laborer working in the pit, carrying armatures, cleaning and repairing motors and controllers, and it is from this standpoint that I think I may be able to offer some practical suggestions as to the best arrangement and operation of the repair shop.

Mr. Hamill, general manager of the Brush Company, mentioned to me in a recent communication two roads that had, within a day or so of writing, failed. After going into some particulars concerning them, he sums up the matter very concisely. "My impression is that both of these roads under careful management would have no difficulty whatever in earning first-class dividends. I simply cite these two cases because they have just been brought to my attention, in order to show that the demand for good management is greater than the supply. The more actual practical experience you have in this ordinary laborers' and mechanics' work, the better foundation you will have for the future."

Where the repair shop is located in the car barn a little care in its arrangement will greatly facilitate work. It is well to have a number of tracks set apart for the crippled cars, and to use a little judgment in placing them so that the car you wish to work on can be got at, repaired, and sent out on the road without drilling nearly every car in the barn. It is always advantageous to have a number of tracks running into the barn from the street, and at least two of these kept clear all the time. Much is saved by having the transfer table operated by a motor, and a great deal is lost by having a rusty, rattling, dilapidated affair that takes all hands from their work every time a car has to be moved from one track to another. There must be one place set apart for the removal of wheels where a part of the track and beam work can be removed and the wheels dropped into the pit. A very simple and easy way to get these wheels out of the pit after they have been taken from the car is to have a pulley overhead, a snatch block on the floor, and by attaching one end of the rope to the wheels and the other to a motor car, raise them out of the pit and lower them on the track, when it will be easy to get them whenever they are wanted. A good strong chain fall and a couple of jacks will be found in almost constant use about the barn.

Instead of having a pit dug out in the dirt the width of the track, it will be found an economy to have under all the tracks an open cellar the floor of which is cemented and well drained. Brick pillars will support the track and floor beams. Keep this place fresh and clean by daily sweeping and a weekly scrubbing, having the brick and woodwork always freshly whitewashed. Have plenty of light, and it will be found that the three or four pounds of coal consumed per hour at the power station for every ten lamps burning will be more than paid for by the amount of work and the superiority of its character that can be gotten from the men. This is a view of economy that is too often overlooked by our managers, who are apt to consider only the interest on investment, depreciation of stock, and output in wages in gauging the expense of maintenance. It is no unpractical theory, but solid truth and fact, that a man who has good tools to work with and a comfortable place to work in will be kept in a contented frame of mind and do nearly twice as much work as one whose time is taken up grumbling because his wrench has spread and every now and then slips and takes the skin off his knuckles, or because he is so cramped for space that he can't draw his hammer back to strike a blow, or because he can't find his tools, and every move he makes he bumps his head and loses his temper. A man, even an ordinary laborer, has some mental sensations that affect his working efficiency to a startling extent. If any one has doubts on this subject let him put on a pair of overalls and get down into the pit and see how he feels after a hard day's work under such conditions, especially if it is winter and there is not sufficient steam heat to keep him warm nor thaw the snow and ice off the trucks and motors.

It will be found greatly to facilitate the working to have cars or trucks in the pit into which the armatures that are to go to the machine shop can be lowered. They can then be wheeled to a trap in the machine shop floor near the lathe and be raised by a chain fall that is always suspended there for that purpose, then lowered directly into the lathe, or transferred by another car, arranged as a winding stand, to the armature winder's corner, as occasion may require. This will prevent a needless waste of time and strength carrying the armatures or rolling them along the floor to the shop, which does not improve them in any event.

The machine shop should be located near the pit in order to permit of this arrangement. As to the equipment of this shop, a large and small lathe, a large and small drill press, shaper, emery wheel, grindstone, and a good assortment of tools, including a set of taps and dies and a blower for cleaning armatures, will be found sufficient. Let the armature winder have a corner and provide him with the necessary appliances, among them a good magneto. Not only will this shop be all that is necessary for repairs, but it will permit of the manufacture of numerous little articles that are always being wanted around the barn and on the line. A carpenter shop, a blacksmith shop, an oil house, and a stock room will complete this department. The carpenter shop should have a full line of the usual tools and a buzz saw. The saw and all the machinery in the machine shop can be run by one or more motors attached to the power circuit. The oil house should be isolated and contain all the oil and grease barrels. It should always be kept locked and the key hung in a convenient place inside the shop. The stock room should be supplied with brushes, brush holders, commutator segments, heads, rims and mica; contact segments and fingers, if these are used; bolts and nuts of usable sizes; cotter keys, screws, nails, cord, tape, wire, lamps, switches, sockets, shades and shade holders; glass panes, waste and articles in the line of tools and others that will be found necessary from experience. When anything is taken from this room a memorandum should be made on a slate with the number of the car on which it is used. This, entered in a book kept for the purpose, together with the hours of labor, taken from the workmen's time slips, will preserve a record of the cost of each car, and will always be valuable data to have at hand.

System is everything. Every man and every gang of men must have some definite work each day. Always have a complete set of tools for each such gang. Let this include wrenches to fit all the nuts on the motors and trucks, hammers, cold chisels, bars, etc., and insist that they be returned to their proper place when not being used, and under no circumstances allow them to be employed by other than the persons for whose use they are intended. With such an understanding, there will not be the continual hunting around for some misplaced article, and things will run smoothly.

It is almost impossible to say exactly how many men are necessary in the repair shop. The wear on the machinery is dependent to such a large extent upon the system in use, kind of track and road bed, grades and curves, that the amount of repair will vary greatly, even for roads maintaining the same mileage of track and number of cars. A few general hints may be of some value however. In the first place, I consider it unwise to have the night gang do repair work when it can possibly be avoided. Let their work be confined to tightening up loose bolts and carefully oiling and greasing motors, trucks, and trolleys. If necessary increase the gang of men on day turn. A road with which I was connected one summer, operating thirty-five cars on eleven miles of double track, kept all in good running order with a machinist and helper, carpenter, blacksmith and helper, armature winder, and three men on repairs of trucks and motors, on day turn; while at night there were four men to do the work mentioned above. The carpenter and machinist were often called out of the shop to do work on the line, and sometimes all of the men, when there was too much for the linemen to attend to, or a car jumped the track or broke down on the road. About three-fourths of the cars were equipped with Short motors two years old, and the balance with new G. E. equipment. Almost nine-tenths of the work was on the old motors, and I feel certain that with a complete installation of new motors and controllers, possessing, as they do, such great advantages over the old in every respect, the force of men could be cut down considerably. Old wheels and axles were sent to the factory, but all other work was done in the shop. The axles were numbered, and a record kept in connection with other repairs, so that the life and mileage of the wheels could be told. In removing armatures, cleaning motors inspecting bearings, etc., two men can work together in the pit to advantage, a third man being useful to operate the chain fall, but otherwise in the way. Small repairs could of course be attended to by one man. When new cars were to be equipped, an extra machinist, carpenter, and a couple of laborers were employed, until the cars were wired, the trucks assembled, and motors mounted.

On very large roads operating hundreds of cars, or on very small ones operating only five or ten, these suggestions must be modified to suit circumstances. There may have to be a number of repair shops and car barns, and these may be separated from each other. The amount of work done may make it advisable to own and operate machinery that in smaller roads would not pay. Again, it may not be economy to have as extensive a repair shop as has been described here, or any at all. But on the average road I feel sure, from my own experience, that by following out the ideas enumerated herein, street railway managers will find something to be gained.

It is impossible to go into the minutiæ of repair shop practice, as it would cover pages and be tiresome reading. A bright engineer can always see a way to meet circumstances as they arise, and work new ideas into a well planned system.

I have not mentioned track and line repairs, the management of the station, inspection of cars, nor the drill and discipline of motormen. All of these are very important, the last more so than is usually appreciated, but they were not intended for discussion under this subject, and any one of them is worthy of an article by itself.

Street Railway Overhead Appliances.

BY A. G. ENEAS.

In looking over the literature on line appliances there appears to exist no definite information of the strains to which such pieces are subjected in actual service. When we consider the important part these devices are of every street railway equipment, and the quantity of literature on details of less moment, it is a somewhat remarkable fact that this feature of strength should not have attracted more attention. Moreover, it will be found, owing to the recent introduction of many new ideas, that the literature of yesterday is no longer applicable to the devices of to-day. At the present time engineers and managers require more efficient designs, better finished, and lower prices than formerly.

With the aid of past experience and special machinery many manufacturers have met this demand fairly well; but it should not be overlooked that competition has flooded the market with much spurious material, faulty in design and deficient in strength. It frequently happens that this material finds its way into new roads by being submitted for approval along with goods of a higher price but better quality. If now the manager or engineer desires to test the various devices, it is necessary that some determinative standard of excellence be adopted in order that his decision may be of value to his employer or client. The fact is at once obvious that the manufacturer must look to the constructing engineer for a fair trial, and if the latter is unable to make one he certainly is unfit for the position he occupies.

If the trade could be made to understand the importance of a fair trial or test at the outset for their overhead appliances, both they and street railway companies would be greatly benefited, and much needless expense and trouble be saved. Yet how different is the manner in which goods are bought and sold to-day. It seems to be taken for granted that the appliances are sufficiently strong, and they are installed in the line as they come from the manufacturer without knowing whether the pieces have a factor of safety of three, two, or barely one, which is frequently the case. Except in a few instances, no tests are made beforehand; in fact, none are thought necessary beyond submitting the insulators to a preliminary trial. Why should it not be as essential to test the line apparatus as the steam plant, especially as the former frequently exceeds the latter in value, and the public safety is more or less at stake?

If the material should prove to be weak the engineer adopting it renders his company liable for damages, besides increasing the cost of repairs. If, on the other hand, the material is unnecessarily strong, the engineer accepting it puts his company to an equally unnecessary expense, both as regards first cost and future maintenance. That more overhead devices have not failed in the past is due partly to the high standard set by the larger and earlier railroads in this field, and partly to good fortune, rather than to the result of individual good judgment.

It having devolved on the writer to supervise the manufacture of a large quantity of line apparatus as well as to test the same, the following suggestions are submitted with the hope that they may prove of value to many managers and engineers in draughting up specifications for this work or submitting the same to trial.

Common Ear.

The common ear should not exceed 15½ inches or be less than 14 inches in length. The groove should be smooth and straight, well tinned, with thin or knife edges, so ground as to conform exactly to the shape of the trolley wire. This latter feature is important, as it will be found that many ears as now made do not permit the trolley wire to bottom through the narrowness of the groove. Such ears will not solder well or hold well when in place. The depth of the groove should be not more than ¼ inch or less than 7-32 inch. A deep grooved ear prevents the trolley wire from falling in the street in case the solder loosens. It is always required by our better managed and larger street railways. The clips at the end should not exceed 11-32 inch in depth, as they will otherwise cause the trolley wheel to spark in its passage under. The rib should not be less than 1-10 inch in thickness, and should have large fillets where it joins the body of the ear, and particularly the boss. Where this latter condition is fulfilled, no difficulties will be experienced from weak bosses twisting away from the ear proper.

The boss should be proportioned to bear a twisting moment of 1,800 inch-pounds and a direct tension of 400 pounds without breaking. The ear should be capable of bending sideways through an angle of 90 degrees without fracture, the bend being made about a ½-inch rod. The material of which the ears are made should stand a tensile strength, before breaking, of 30,000 pounds per square inch. Ears designed according to these conditions will have a factor of safety of three and give good satisfaction. Many ears on the market have lead in their composition besides iron and other impurities. One per cent. of lead has been known to reduce the strength of a bronze fully one-half, and the presence of .003 of iron, arsenic, or antimony is especially injurious in making the mixture hard and cold-short or brittle. Where larger quantities of material are bought it should be analyzed as well as tested, which can be done at a small expense, thus greatly assisting the engineer in forming an opinion of its value.

Strain Ears.

All that has been said relative to common ears applies equally to strain ears. There is no advantage to be gained in making the length of this ear more than 15 inches, provided the groove is of a proper shape. To make it longer or to have the distance between the eyes more than five inches is only to add to the leverage of the forces that tend to destroy it, and consequently necessitate the ear being made just so much heavier. The distance from the eye to the centre of trolley wire should be sufficient to prevent the flange of the trolley wheel clearing the anchor wire by ¼ inch. If the distance is greater, an extra bending strain is brought on the insulating bolt. The stresses this ear has to bear are similar to those already mentioned, with the additional tensile stress of 1,200 pounds from the anchor wire. The piece, as a whole, should have a factor of safety of three and be capable of bending sidewise, without fracture, through 90 degrees about a rod one inch in diameter.

Splicing Ears.

These ears have to stand the direct tension of the trolley wire and should be made with a factor of safety of not less than three and one half. The tension in the trolley wire usually amounts to 1,000 pounds, though it may double this amount at times, as on very cold nights. The holes through which the ends of the trolley wire pass should be carefully inspected previous to placing the piece in the line, as it occasionally happens that small cracks form at these points in tinning the ear. I have known cases where such ears have been installed resulting in the rupture of the piece and the pulling down of several brackets and fixtures besides delaying the work. The tendency of the wire to break at the bend in these ears, as in most line insulators, has led many roads to dispense with them and adopt splicing sleeves. The splicing sleeves as now made are more easily applied, and have to bear only the tensile stress above mentioned.

Feeder Ear.

These ears should be designed for the same strains as common ears. They are, however, giving place to the bell hanger fitted with bronze bolts in place of insulators, in which form they answer the purpose exceedingly well.

Feeder Bolts.

Only the best bronze, made of pure metals, should be used for feeder bolts; otherwise trouble is likely to occur in their breaking off where threaded, and thus allowing the line to come down. It costs little more to use pure metals than common stock, while both the conductivity and strength are greatly reduced if there are even small amounts of lead, iron, bismuth, antimony or arsenic present, all of which can be found at times in ordinary bronze. A good mixture can be made of lake copper fluxed with silicon or alloyed with 5 per cent. of tin. The stud should be ⅝ inch in diameter, and the ear tapped to fit the same.

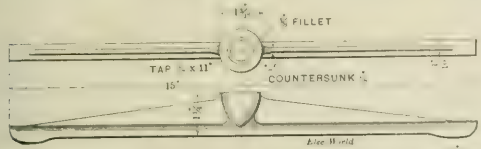


Fig. 1.—Ear in Plan and Section.

Double Curve Pull Off.

I have been requested at times by various manufacturers to test samples of their double curve pull off, and only in one instance did I find a hanger that had a factor of safety as high as three. Some of them broke as low as 700 pounds direct tension, while the average broke about 2,000 pounds, but in every case the turns pulled out of shape long before these figures were reached. Comparing the distances between the holes in arms while testing the pieces at the Massachusetts Institute of Technology, with the distance from centre to centre of arms of various hangers in the line, I find that as high a stress as 1,800 pounds frequently comes on these hangers, and should advise that they be designed accordingly and the load be considered a live one.

There will be times when this load will be greatly exceeded, as on very cold nights, or when other parts of the construction break, so that no hanger should be installed in a first-class equipment with a less factor of safety than three.

Material.

As to the material of which these hangers are made, good brass is unfit for the purpose owing to its ductility, for unless the arms be made very heavy and deep they will invariably pull out of shape at strains varying from 700 pounds to 1,400 pounds. It should also be remembered that whereas good bronze (91 copper and 9 tin) is very stiff and has a tensile strength of 36,000 pounds, brass, as ordinarily made (supposed to have 75 copper and 25 zinc), will not bear more than 20,000 pounds, owing to the impurities in the mixture and method of casting. This applies equally well to so-called aluminium bronze, for I have found from repeated tests that unless pure metals are used still poorer results are obtained. It will in any case be found to flow under stress, and it is only a matter of time with hangers made of this material before their arms pull out of shape. While the stresses given above may seem large to those who have not investigated this subject, it should not be forgotten that such pieces as double curve hangers and anchor ears have frequently to bear a transverse strain coupled with a tensile strain, that greatly increases the tendency to break the piece. The stresses, moreover, are the greatest that will likely come on the different devices, figured in direct tension only, and as such are the only ones the engineer has to consider in making his design.

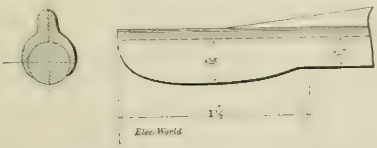
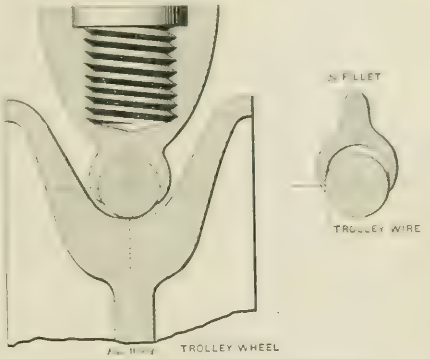


Fig. 2.—Enlarged View of End of Ear in Fig. 1.



Figs. 3 and 4.—Forms of Grooves.

Referring to the illustrations, Fig. 1 represents an ear of one manufacture in plan and elevation, and Fig. 2 shows an enlarged view of the end, giving depths of clips and groove. Fig. 3 illustrates the bad effect of a narrow groove or one that does not conform to the shape of the wire. Fig. 4 represents a section through the boss, trolley wire and a portion of a trolley wheel. This view clearly demonstrates that where the edges of the groove are properly ground they will not interfere with the trolley wheel or cause it to spark in its passage, provided the depth of the groove does not exceed ¼ inch. Fig. 5 illustrates a bending test for ears to determine the ductility of the metal and the freedom from lead in bronze compositions. Fig. 6 shows a double curve hanger of the usual type to be met with in practice, and the effect on the same of strains of different intensity. The arms can be stiffened approximately 100 per cent. by making their section similar to an I beam, as shown, instead of the present inverted T form. This is not necessary in the ordinary style of malleable iron double curve hangers, as that metal does not flow like brass and composition when strained.

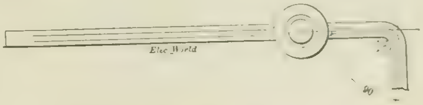


Fig. 5.—Bending Test for Ear.

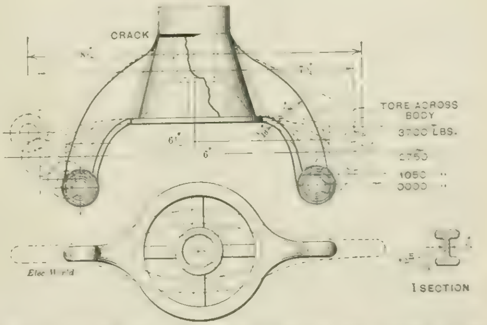


Fig. 6.—Effects of Different Strains on Double Curve Hangers.

A Theory of Electrolysis.

BY ALFRED H. BUCHERER.

In the introduction to his large work on Electrochemistry, Ostwald remarks that to a philosophic mind nothing is more interesting and fruitful than the historical study of a science. This statement is strikingly true of the science of electrolysis, to whose development Ostwald has contributed so much. For surveying the course this science has followed from its beginning to this day, we trace with wondering eye the most multifarious agencies at work continually modifying and progressively building up a theory which, according to the opinion of many physicists, represents the solution of an hundred-year-old problem. In such a survey the question obtrudes itself, what principles have been most instrumental in moulding and maturing the modern theory of electrolysis? We perceive at once that the first and second laws of thermodynamics have done most in clarifying our views and in paving the way for new discoveries. But, strange to say, powerful as the influence of these laws has been, such is the inertia of the human mind, such the "vicious circle" of preconceived ideas, that there are not a few features of the modern hypothesis that distinctly show that they are relics of a time which we may fitly call the prethermodynamic period. These features which stand in the way of an harmonious generalization of known experimental facts I have endeavored to remove, believing that such removal will not only satisfy our philosophic demand for a coherent systematizing of the data of experience, but will also give a fresh incentive to further investigations. Let us briefly recall to our minds the views which are at present held. An electrolytic solution—let it be dilute and let the electrolyte be binary—is imagined to consist of an equal number of positively and negatively charged ions diffused through the solution. In spite of the enormous charges of these ions the solution is considered to be in stable equilibrium as long as external forces are not acting. This equilibrium is disturbed by the insertion of two electrodes, the terminals of some electric generator. The positive electrode, by virtue of its static attraction for the negative ions, attracts these, and likewise the negative electrode simultaneously attracts the positive ions. If the potential difference is sufficiently great, discharge, *i. e.* neutralization, occurs and the ions become atoms, which are supposed to be free from charges. In degree as the anions and kathions are thus removed a migration of fresh ions takes place towards the electrodes actuated by the static attractions. The velocity of the ions has been calculated by Kohlrausch from concentration differences at the electrodes and from conductivity measurements. Let us picture before our mental eye these ions with charges that are simply tremendous as compared with the static charges we are familiar with in static electricity, and let us remember that the ions of electrolytic solutions, since they follow the laws of gases, must be imagined to be constantly colliding with their immense charges. The enormity of this conception is only equalled by the implied violation of the first law of thermodynamics, namely, by considering the process of neutralization of the charges as one by which energy is being absorbed. Evidently, an atom of metallic zinc by the process of being transformed into an ion can do work. In the modern hypothesis of electrolysis one should expect the ion by virtue of its charge to be capable of doing work; but here, on the contrary, work must be done upon it to deprive it of its charge. If all metals were constituted like silver and copper, which actually have more energy as ions than as metallic atoms, such a view would be somewhat more excusable.

This brief exposition of the chief inconsistencies of the modern theory will suffice to show that any hypothesis which can explain the known experimental data of electrochemistry without embodying such incoherencies as I have commented upon will be an improvement. The basis for the new hypothesis which I shall proceed to explain is the mass law which in the thermodynamic treatment of chemical reactions has played so important a part. From the standpoint of the mass law chemical equilibria are viewed as dynamical equilibria. If, for instance, we find that at a certain temperature and pressure HCl, NH_3 and NH_4Cl are in equilibrium in such a manner that the partial pressure of NH_4Cl is three times as great as that of HCl and NH_3 singly, then we explain this equilibrium by saying that the velocity with which NH_3 and HCl form NH_4Cl is three times as great as the velocity with which NH_4Cl dissociates into NH_3 and HCl. We imagine these two opposite reactions to occur continually, so that under the conditions characterizing the equilibrium the mixture of the gases never varies in composition. Now it can be shown that the maximum amount of work we can derive from such an action as: $NH_3 + HCl = NH_4Cl$, depends on the partial pressures with which the three different gases participate in the equilibrium. If we have the gases in unit concentration, namely, one grammolecule per litre, this maximum work will be

$$W = R\ T\ log_e \frac{P_1}{P_2 P_3}$$

where P_1, P_2, P_3 are the partial pressures of resp. NH_4Cl, NH_3 and HCl. The maximum amount of work is not dependent on the manner in which we obtain it, provided the manner is a reversible one. If we could utilize the above reaction in an electrochemical system the E. M. F. derivable must be proportional to the value,

$$R\ T\ log_e \frac{P_1}{P_2 P_3},$$

and if one electrochemical equivalent was involved in the action, the value

$$R\ T\ log_e \frac{P_1}{P_2 P_3}$$

would if expressed in units of electrical energy be numerically equal to the electromotive force.

The fact that the E. M. F. is simply proportional to the logarithm of the dissociation constant is of great importance and will lead to interesting results if applied to electrolytic solutions. We know from an overwhelming number of experimental data that dissolved substances behave exactly like gases. We are, therefore, perfectly justified in treating the solvent as a medium like a vacuum or ether. It differs in so far as the dissolved substances undergo dissociation into ions. These ions I do not consider as being charged. For simplicity I will, in the following explanations, only consider dilute solutions in which the salts are perfectly dissociated into ions. According to my hypothesis, then, a hydrochloric acid solution consists of uncharged chlorine ions, chlorine atoms, uncharged hydrogen ions and hydrogen molecules. The presence of uncombined hydrogen and chlorine atoms we are forced to admit. For, if we accept the identity of gases and dissolved substances, we can arrange to let the reaction occur in water, and if then there were no dissociation the energy of such a chemical action would assume an infinite value, for, in the term

$$R\ T\ log_e \frac{p_1^2\ p_2^2}{p_3^2}$$

p_3^2 would be equal to zero. We will now consider a reaction in which a metal takes part, say the reaction $2K + Cl_2 = 2KCl$. We know that a metal has its own vapor tension. That is to say, every metal emits vapor with a force which is a function of temperature. It is, therefore, legitimate to consider a reaction between potassium and chlorine, as occurring between potassium vapor and chlorine gas. If we allow this reaction to occur in the solvent we can express it thus: $2K_a + Cl_m = 2K_i + 2Cl_i$, where the indices a, m, i, mean, atomic, molecular, ionic. The energy derivable from such a reaction is again a definite amount if we succeed in having it take place in a reversible manner, and we know that metallic potassium vapor must be present. Now it is experimentally established that the E. M. F. which can be obtained from the combination of a metal, say zinc with chlorine, is an additive quality. This means that the energy which is due to the zinc is independent of the element or radical with which it is combined, and we conclude that in the formula $E = R\ T\ log_e\ K$
there is contained some value

$$E_{Zn} = R\ T\ log \frac{v_a}{v}$$

where E_{Zn} means the E. M. F. due to the zinc and $\frac{v_a}{v_i}$ the ratio of the velocity with which the atomic zinc passes into the ionic condition to the velocity with which the ionic zinc passes into the atomic condition; similarly with the chlorine. As, however, we are dealing with equivalent quantities, the number of zinc ions present is equivalent to the number of chlorine ions which are in combination; and it follows that a mean equilibrium must obtain as a resultant of the two equilibria between the chlorine ions and molecules, on the one hand, and zinc ions and zinc atoms on the other. We can calculate this equilibrium in the following manner: E_{Zn}, the potential difference between zinc and a solution of zinc salt of definite concentration can be measured; we can likewise find the value E_{cl}. Consequently, the total E. M. F. is

$$E = E_{Zn} + E_{cl}$$

$$E = \frac{RT}{2}\ log_e \frac{p_1\ p}{p_2^{22\cdot35}}$$

$$\text{and } E_{cl} = \frac{R\ T}{2}\ log_e \frac{p_3^2}{p_4}$$

where p is the sublimation pressure of zinc in water, p_1 the partial pressure of zinc ions, p_2 of the zinc atoms, p_3 of chlorine ions and p_4 of the chlorine molecules:

$$\text{Then } E = R\ T\ log_e \frac{p_1\ p_3^2\ p}{p_2\ p_4}$$

Then if x is the fraction of the uncombined zinc atoms of a dilute solution whose total osmotic pressure is P, we have

$$E = \frac{RT}{2}\ log_e \frac{P^4\ (1 - x)^3\ p}{0.0819T\ (3 - x)\ x};$$

x can be found from this equation if p is known.

It should be noticed that according to my views the potential difference between a metal and ts solution (for instance, in a Daniell cell) is directly due to the relation of the partial pressure of the metallic vapor with which it participates in the equilibrium and the sublimation pressure of the immersed metal. According to the modern hypothesis, however, this E. M. F. is due to the so-called solution tension of the metal, which is defined as the pressure with which the metal tends to pass into the condition of an ion when placed into the solution of one of its salts. According to my opinion the E. M. F. of a concentration chain should be explained primarily by the fact that the same sublimation pressures of the two immersed metal pieces is opposed by two unequal partial pressures of the atomic vapor which result from the difference of concentration. Since in the expression for the E. M. F. derivable from such chain, the ratio of the pressures of ions occurs, and not their absolute values; and since in some cases the dynamical equilibrium does not change with concentration, no great discrepancies between experimental results and the modern hypothesis were discovered. It is clear that a substitution of the ratio of osmotic pressures for the partial pressures of the uncombined constituents is justifiable in these cases. In other cases such substitution will undoubtedly lead to wrong results. With some metals like copper, mercury and silver, the partial pressure ot the metallic vapor, if considered independent of the non-metallic element or radical, would be greater than the sublimation pressure. The equilibrium of a metal and its solution we understand then to be such that the sublimation pressure of the metal is equal to the partial pressure with which it participates in its equilibrium with the ions.

The modern view of electrolysis as represented by Nernst's theory of a solution tension, while it can make certain phenomena plausible yet leads to conclusions which it is difficult to accept. For instance, Ostwald, by considering a Daniell cell whose sulphate solutions at the two electrodes have the same osmotic pressure, calculates that the solution tension of zinc is $10^{36.5}$ times as great as that of copper. Now, according to my theory a dilute copper sulphate solution of the same osmotic pressure as a zinc solution has not the same partial pressures of the metallic vapors; from which it follows that we need not assume such an enormous difference between the sublimation pressures of copper and zinc. We can draw the conclusion that the E. M. F. of a metal considered as an additive quality is a function of its vapor pressure. And there is an important relation between the change of vapor tension with temperature, the heat of formation and the temperature-coefficient, which can be experimentally established.

It devolves upon us now to describe the mechanism of electrolytic action. The atomic respectively molecular dissociation gases of a solution are, according to my view, primarily concerned in the transformation of electrical into chemical energy. Equivalent quantities at the cathode and anode require equal electrical quantities for transformation. The action of the current is such that, for instance, at the cathode the dissociated vapor is retained and prevented from its play of continuous vaporization and condensation; the vapor is thus condensed; a similar process occurs at the anode. A beautiful demonstration of this action of a current or, better, charge, is afforded by the phenomena of electro capillarity. Placing a drop of mercury into a dilute sulphuric acid solution and connecting it with the negative terminal of an electric source of energy, we shall perceive a peculiar motion of this drop as soon as the positive pole in the form of a wire is approached. This motion, as will at once be evident, shows that the surface tension of the drop has been increased; the surface showing a tendency to contract. The only conclusion we must draw is that the vapor pressure has simultaneously been reduced; that means the negative charge condensed, *i. e.*, retains the atoms and thus performs work.

The capillary electrometer, though a different theory has been given of it by Helmholtz and Lippmann, is based on the phenomenon just described. Helmholtz advanced his theory of electric double layers to explain similar phenomena and utilized the modern theory of charged ions. That negative electricity has this power is in accordance with my hypothesis, because metals are precipitated, *i. e.*, condensed, at the negative electrode. Returning to the mechanism of electrolytic action we will examine how the removal of the liberated metallic and non-metallic elements will affect the equilibrium of the solution. To simplify the process we will add fresh salt in degree as the current removes it. Evidently the vapor removed at the cathode will disturb the dynamical equilibrium near the electrode; ions will pass into the form of atoms and the result will be that, in accordance with the laws of gases, diffusion will take place to equalize the pressure of the gases throughout the solution. Since now the different ions follow with different velocities, concentration differences will result. We see, then, that the same phenomena which have been explained by the modern theory as being due to static attractions can be more simply explained by the ordinary laws of diffusion of gases. That the velocity of diffusion is different in a medium like water from what it is in the ether of a vacuum is to be expected.

We will now inquire how the chief methods of producing electrolytic E. M. F. have to be interpreted on the basis of my hypothesis. The origin of the E. M. F. of concentration chains has already been discussed. A little reflection will prove that such electromotive forces as arise from the contact of two differently concentrated solutions of the same electrolyte can be similarly explained.

The reasoning is quite analogous to that which is followed by Ostwald in his large work on "Chemical Energy," where he deduces the mathematical formula for such chains. The difference is that I deal with the partial pressures of the metallic vapor and the molecular non-metallic constituents of a solution, where Ostwald and Nernst consider the osmotic pressures. Now there would be no difference whatever between calculated and observed values if it were not for the fact that by the difference of concentration the equilibrium constant is often changed, due to the splitting of molecular elements into ions. With $K\,Cl$, for instance, according to my theory, the molecular chlorine is in equilibrium with ionic chlorine, which latter is univalent. Equivalent quantities of chlorine ions and chlorine atoms will therefore exert different pressures, and, consequently, the equilibrium changes by pressure, in such a way that with a more concentrated solution the partial pressure of the uncombined elements is proportionally smaller than in a more dilute one. Hence in the formula:

$$E = \frac{u - v}{u + v}\ RT\ log_e\ \frac{p_1}{p_2}$$

there should be a proportionally smaller value for p_1. Consequently the experimental results should be smaller than those calculated by the modern theory of electrolysis. This is actually the case. For Nernst, without being able to account for the discrepancy, found the observed values to be about 12 to 15 per cent., some 20 per cent. larger than those calculated from the osmotic pressures. For certain concentration chains similar considerations are in place. That with copper sulphate solutions the experimental results should agree with theoretical values is natural. It is interesting that Nernst when he found the experimental investigation of concentration chains—binary chlorides were chosen as electrolytes—to yield too small E. M. F., corrected his values from conductivity measurements and found that after performing this correction they agreed with his theory. At first blush such a fact seems to be a strong confirmation of the modern hypothesis. But we must remember that according to my own hypothesis with a potassium chloride solution the dilution produces a larger proportion of potassium atoms, while the number of ions decreases. With an increase of the uncombined elements, however, the supply at the cathode and anode is proportionally increased, and as the conductivity depends on the rapidity with which the uncombined potassium atoms and chlorine molecules are supplied, it follows that although the number of ions decreases by dilution, yet the molecular conductivity, or, what is equivalent to conductivity, increases. Of course the absolute conductivity of a solution generally decreases by dilution.

It is peculiar that the two theories should in this case lead to the same results in spite of the fact that according to one of them the number of ions increases by dilution, and in the other it decreases. I am reasonably sure that the discrepancy between many conductivity measurements and the lowering of the freezing point of dilute solutions—a problem which at present is the point of contention among many physicists—can be successfully removed by the application of the views set forth in this paper. All the brilliant conductivity measurements of Kohlrausch should be interpreted in the light of my hypothesis. Otherwise they would be difficult to explain. In conclusion I wish to say that I have intentionally chosen simple illustrations for the explanation of my hypothesis, reserving for the future the investigation of cases which are complicated by such conditions as great concentration, the participation of the medium in the electrolytic equilibrium, etc.

Electrical Power Transmission.—XI.

BY LOUIS BELL, PH. D.

Aside from the distribution of power for railway purposes, by far the most interesting method of power transmission by continuous currents is that in which a special combination of two series machines is employed, giving a self-regulating system comprising a motor unit and a generator unit. This plan has been widely and successfully used abroad, but has not been employed in American engineering practice except in an experimental and tentative way, owing largely to the difficulties that have been encountered in the production of large direct-current generators for high voltage.

While it is not a very difficult matter to produce a machine giving five or six thousand volts with a relatively small current, such as is used in arc lighting, the troubles at the commutator have proved decidedly forbidding when any attempt was made to use currents large enough to obtain units of any considerable size. The whole subject of power transmission has been but recently taken up seriously in this country, all the energy of the electrical art being concentrated in lighting and railway work, and so far as the development has taken place now, it has been almost wholly in the line of alternating current work. It is quite obvious that the system of power transmission such as has been described possesses very great convenience where single units are to be operated over relatively long distances. In the first place, the inductive difficulties familiar with alternating currents are avoided. In the second place the motors are self starting under load, a condition that has not been true of alternating machinery until the introduction of the polyphase system. Through the energy of several foreign engineers, notably Mr. C. E. L. Brown, a good deal was done in power transmission by this method long before alternating current apparatus had been suitably developed. The same difficulties were encountered abroad as here. It proved to be very difficult to build machines of sufficient voltage and any considerable output. In this connection it is noteworthy that nearly all the plants of this character on the continent have been installed at relatively low voltages, most of them less than 1,000, corresponding in general character to the American plants over similar distances worked at constant potential. In the very few instances where long distances have been effected, the usual method has been to employ generators and motors permanently connected together in series, on account of the impracticability of getting sufficient power in one unit at a very high voltage. This proceeding complicates the system somewhat. In addition, the generators and motors have to be especially designed for each other in order to secure regulation, which, of itself, is a considerable disadvantage. This last difficulty may be in part avoided by the use of a shunt around the field coils of the generator, thereby changing its regulation under variations of current. A similar device is widely used in this country in connection with compound wound generators, where a shunt applied across the terminals of the series coils is used to regulate the compounding. In either case, the obvious result of such a shunt is to diminish the change in the field produced by a given increase in current. In this way the necessity for special machines can be partially obviated. The plants installed on this peculiar series plan have been uniformly successful, and permit of the convenient transmission of moderate amounts of power over considerable distances. Such plants have even been employed in connection with motor-generators to supply a general distribution system, though evidently at a high cost for apparatus.

In order to distribute low tension currents from such a transmission system, it is necessary to employ either a motor, coupled to a dynamo, or a composite machine with a double winding, combining both functions already described. Either alternative involves the loss of energy substantially equivalent to that in two dynamo electric machines of the capacities concerned. These losses are necessarily much more serious than those in an alternating current transformer. They are likely to amount to from 15 to 20 per cent., so that quite aside from the efficiency of the generating dynamo and of the line, the price paid for the privilege of obtaining a low tension current amounts to nearly a fifth of the total energy transmitted. It is not only enormously greater than the loss in a transformer, but at least double that involved in obtaining a low tension direct current from an alternating current.

For the delivery of power alone, where moters in series coupled to appropriate generators can be used, the method is well fitted for use under certain circumstances, and is closely approximate in efficiency to that which would be obtained by an alternating current transmission over the same distance. It is interesting to know that the longest line over which electrical power to any considerable amount is transmitted is operated on this series direct current system. Several longer alternating transmissions are under construction, but at the date of writing the record is held by the direct current.

The plant in question is that which is used in operating the Biberest Paper Mills, near Soluere, Switzerland. The power is derived from the River Suze, near Bienne, and the distance of transmission is a little less than twenty miles. At the generating station the available head of water is about forty-five feet, and the quantity is sufficient to generate about 400 hp. The power station contains a 400-hp turbine running at 120 revs. per minute, of which the vertical shaft is connected by means of beveled gear to two 130-kw dynamos. They are six pole machines, Gramme wound, and give at 275 revs. per minute about 40 amperes at 3,300 volts. The two machines are connected in series giving a working potential of 6,600 volts on the line. It should be noted that great care is taken in insulating them, the bed plates being carried on porcelain insulators. Carbon brushes are employed. The line is a bare copper wire, 7 millimetres in diameter, about No. 1 B. & S. gauge. The line runs through a mountainous country, and is liberally provided with lightning arresters at various points. The two motors at the mills are duplicates of the generators, the only modifications being such as to insure their self regulation. They run at 200 revs. per minute on 6,000 volts delivered, and give about 155 hp each. The commercial efficiency of this interesting system is somewhat in excess of 75 per cent. at full load. Fig. 26 shows one of the motors on its foundation. This plant is the best example of long distance transmission by series wound generators and motors extant, and probably exhibits the system at its best.

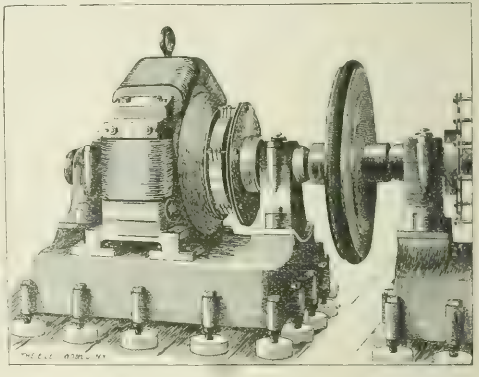


FIG. 26.—MOTOR AT BIBEREST.

In this country the above system has not been used in anything more than an experimental way, owing principally to two reasons; first, that for moderate distances, involving not more than 1,000 to 1,500 volts, shunt wound generators and motors work on either the two wire or three wire systems, and afford better opportunity for distribution, inasmuch as their use is not limited to single mechanical units; second, no serious demand for long distance transmission arose in America prior to the development of the alternating system to the point where alternating motors became thoroughly practicable. It has been characteristic of American electrical engineering that it has occupied itself with one thing at a time. The development of the electric light was followed by a concentration of energy on the electric railroad, and this has only recently been succeeded by extensive power transmission enterprises, often in themselves involving railway work. Such a mental habit, if one may so call it, is not conducive to an even development, but probably accomplishes quite as much as a more symmetrical advance.

Shunt or compound wound generators used in connection with shunt wound motors have found very extensive use in this country over moderate distances. The very obvious advantage of such a system is that it permits the ready distribution of power as well as its easy transmission. If it becomes necessary to transmit power from one point to another, the chances are much more even that at the distributing end of the line it will be desirable to utilize the power in a number of units of varying size. Such an arrangement bars out transmission from series dynamos as a practical method on account of the difficulties of regulation, whereas with shunt wound apparatus the problem is easy. It often happens, as previously mentioned, that at the receiving end both series and shunt motors are used, the former for hoisting and similar work, the latter for operation at constant speed.

The enormous development of the electric railway has encouraged the establishment of such plants, and their number is very considerable, scattered over all parts of the Union, not a few of them being in the mining regions of the Rocky Mountains and the Pacific Coast, as well as in various isolated plants through the rest of the country. In most of them, the distances being moderate, an initial voltage of from 500 to 600 has been employed; more rarely, voltages ranging from 1,000 to 1,800. Such plants have been uniformly successful and have done sterling service for some years past. The efficiency of this method of transmission is about the same as that of the series method, just described, but with the advantage that the shunt motor supplied at constant potential can advantageously be distributed wherever the work is to be done, while with series units any distribution of power has to be accomplished by means of shafting and belting or its equivalent. The net efficiency from generator to driven machine is therefore likely to be rather better with the transmission at constant potential. The generators and motors are of nearly the same efficiency; the line at ordinary distances is customarily worked at about the same pressure in both methods, but distribution by shafting is far less efficient than distribution of electric power by wire. The loss from the centre of distribution to individual motors will very seldom exceed 5 per cent., while the loss in equivalent shafting will seldom be less than 10 per cent., and more often 15 or more; in fact, it generally turns out upon investigation that so far as efficiency is concerned there is a noticeable saving in transmitting power electrically, even within the limits of a mill or large factory, over the result which can be obtained by the use of transmission by shafts and belts. In a large building where the power is to be widely distributed, it seldom happens that the loss in the shafting is less than 25 per cent. Anything in excess of this figure represents remarkably good practice. With motors, 80 per cent. efficiency, if the units are of tolerable size, can be reached without much difficulty, and there are comparatively few cases where the efficiency would fall as low as 75. In such a distribution plant, recently installed in a Belgium gun factory, employing a single 300-hp dynamo, driving thirteen motors, carrying from 16 to 37 hp in various parts of the building, the guaranteed efficiency was 76.6 per cent. As the efficiency of the dynamo was reckoned at but 90 per cent., the total efficiency would in practice be raised without difficulty to 78 or 79 per cent. at full load.

As regards efficiency in general, aside from the disadvantages previously mentioned in changing the voltage of direct current circuits, the efficiency of transmission by such currents is in itself as high as has ever been reached by other means. There is no material difference between the efficiency of direct and alternating current generators, nor between the efficiency of direct current motors and the polyphase motors, at least, of alternating motors. In these particulars, the direct current is able to hold its own against all comers.

As regards transmission of power over considerable distances, a case has already been mentioned in which the result is as good as can reasonably be expected. Direct current, however, continually runs into the limitation of available voltage as soon as distribution is to be attempted. Where single motor units are to be used, consisting of either single machines or groups operated as a unit, the efficiency of the system is likely to be as high as that obtained from units of similar magnitude on alternating current systems. The only disadvantage of the direct current in point of efficiency in this particular case is that if the amount of power to be transmitted be large, it is almost necessary to use generators and motors coupled in series, while if alternating currents were used, one would have the advantage of employing a single machine of equivalent capacity. Aside from efficiency, the principal disadvantage in direct current machinery is the commutator, which at high voltages is sooner or later the source of considerable trouble. Careful mechanical and electrical construction may materially reduce this difficulty, but it always remains to be faced, and is liable at any time to become troublesome. (To be continued.)

Practical Notes on Dynamo Calculation.—XXV.

BY ALFRED E. WIENER.

Chapter 43. Magnet Cores.

(a) Material.

The field cores should preferably be of *wrought iron*, or of *cast steel*, in order to economize in magnet wire, for the use of *cast iron*, on account of its low permeability, would require cores of at least $1\frac{2}{3}$, *i. e.*, almost twice the cross-section, and therefore a much greater length of wire to obtain the necessary magnetizing force. With the smaller wrought-iron cores the leakage would also be less.

In spite of this decided advantage of wrought-iron cores *cast-iron* field magnets are very common, since the temptation to use castings instead of forgings is very great. Where weight and bulk are of no consequence, a cast-iron field magnet may prove nearly as economical as one of wrought iron costing considerably more, but the former requires from $\frac{1}{3}$ to $\frac{1}{2}$ times more wire to encircle it than a wrought-iron one of similar magnetic density, in case of circular cross-section, and it is evident that this, by introducing additional electrical resistance, will prove a constant source of unnecessary running expense.

As to the use of *steel* in dynamos, H. F. Parshall, in a paper delivered before the Franklin Institute[1], states that magnet-frames made of cast steel are 25 per cent. cheaper than those of cast iron, but possess the disadvantage of being not as uniform in magnetic qualities as cast iron. He further asserts that good cast steel should not have greater percentages of impurities than .25 per cent. of carbon, .6 per cent. of manganese, .2 per cent. of silicon, .08 per cent. of phosphorus, and .05 per cent. of sulphur. The effect of carbon is to lessen the magnetic continuity and to greatly reduce the permeability; carbon, therefore, is the most objectionable impurity, and if possible, should be restricted to smaller amounts than the maximum above quoted. Manganese, in quantities larger than stated, seriously reduces the magnetic susceptibility of the steel, a 12 per cent. mixture having scarcely greater susceptibility than air. Silicon is objectionable through facilitating the formation of blow holes, and from its hardening effect.

E. Schulz[2], in comparing two dynamos differing only in the material of the field frame and in the magnet-winding, finds that the weight of a cast-steel magnet-frame is about one-half of that of cast iron, and that the weight of the copper for the magnets, on account of the smaller cross-section and the greater permeability of the cast steel, is reduced to somewhat less than one-half. The price of the frame will accordingly be about $1\frac{1}{4}$ times that of the cast-iron one, but, on account of the reduction of the copper-weight, the cost of the whole machine will be less for a cast-steel than for a cast-iron frame, the total weight being less than one-half in the former case.

According to Prof. Ewing[3], the permeability of good cast steel at low magnetic forces is less than that of wrought iron, but the reverse is the case with high forces. In a specially good sample tested by G. Kapp and Prof. Ewing, a magnetic density of 18,000 lines per square centimetre (= 116,000 lines per square inch) was reached with but little more than one-half the magnetizing force as is necessary for the same induction in ordinary wrought iron.

(b) Form of Cross-Section.

The best form of cross-section for a magnet-core is undoubtedly that which possesses the smallest circumference for a given area, and this most economical section is the *circle*. It is, however, often preferable on account of reducing the dimension of the machine perpendicular to the armature-shaft, to use cores of other than circular section; in this case either rectangular, elliptical, or oval cores are employed, or several round cores are placed side by side and connected in parallel to each other, magnetically. The latter method, however, is not recommendable for the reason that the magnetizing effects of the neighboring coils partly neutralize each other, because of the currents of equal polarity flowing in opposite lateral directions in the parts of the coils facing each other, as indicated by arrows in

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[1] Electrical World, Vol. XXIII., p. 214 (Feb. 17, 1894.)

[2] Electrisches Echo, Aug. 11, 1894
Electrical World, Vol. XXIV., p. 238 (Sept. 8, 1894.)

[3] Electrical Engineer (London), Oct. 5, 1894.
Electrical World, Vol. XXIV., p. 446 (Oct. 27, 1894.)

Fig. 105. There is, consequently, a double loss connected with this arrangement, a larger expenditure of copper, connected wit higher magnet-resistance, and decrease of the magnetizing effects by mutual influence of the coils.

Besides the forms mentioned, also square cores and hollow magnets of ring-section are frequently used.

An idea of the economy of the form of cross-section to be chosen can be formed by means of the following Table LIII., which gives the circumferences for unit area of the various forms of cross-sections employed in modern machines, and compares the same with the circumference of the most economical form, the circle. In the case of *rectangular* and *elliptical* cores four forms each are considered, the lengths being, respectively, 2, 3, 4 and 8 times the width of the sections. For *oval* cores three sections are examined, the semicircular end portions being attached to a center portion formed of 1, 2, and 4 adjacent squares, respectively. Next come four sections consisting of *several round cores in parallel*, namely 2, 3, 4 and 8 *separate circles*. Of *hollow* cores, finally, five cases are considered, the internal diameter being, respectively, of 1, 2, 3, 4 and 8 times the radial thickness of the cross-section.

Fig. 105.

Hollow Magnets are used in some special types, such as shown in Figs. 84, 94, 95, 96 and 100, where large circumferences of the cores are required but not the total area enclosed by these circumferences, and where the armature or its shaft has to pass through the centre of the magnet.

As to the use of *hollow* magnets in place of *solid* ones, Prof. Grotrian[4] states that with weak magnetizing forces only the outer layers of the iron, next to the winding, are magnetized. E. Schulz[5]; however, showed by practical experiments that the magnetization is exactly proportional to the area of the core-section, even at the low induction due to the remanent magnetism; from this can be concluded that Prof. Grotrian's results do not apply to the case of dynamo-magnets under practical conditions. A. Föppl[6] claims that the theory of Prof. Grotrian is correct, *i. e.*, fhat the flux gradually penetrates the magnet from its circumference, and that under certain circumstances, it may not reach the center of the core, but he admits that this theory has no practical bearing upon such magnets as are now used in practical dynamo-design.

(*c*) *Ratio of Core-area to Cross-section of Armature.*

The relation between the cross-section of iron in the magnet-cores to that of the armature core is a very important one, as on its proper adjustment depends the attainment of maximum output per pound of wire with minimum of iron.

According to tests made at the Cornell University, under the direction of Prof. Dugald C. Jackson[7], the best area of cross-section of the magnet cores for drum machines is 1⅓ times that of least cross-section of armature, if the cores are of good *wrought iron*, or about 2½ times the minimum armature section if *cast iron* cores are used.

According to Table XVII., Chapter 12, the maximum core-density in ring-armatures is from 1⅓ to 1⅔ times that of drum armatures; for equal amounts of active wire, therefore, the former require 1⅓ to 1⅔ times as great a magnetic flux as the latter, and the cross-sections of the magnet-cross, consequently, have to be taken correspondingly greater in case of Ring-machines, namely, 1¾ to 2¼ times the minimum armature-section in case of *wrought iron* cores, and 3 to 4 times the armature-section for *cast iron* field magnets.

Prof. S. P. Thompson, in his Manual on Dynamo-Electric Machinery[8], gives 1.25 for wronght iron and 2.3 for cast iron as the usual ratio in drum-machines, and 1.66 and 3, respectively, in ring-armature dynamos.

In the experiments conducted by Prof. Jackson, ten different armatures, all of same length and same external diameter, but of different bores were used in the same field, thus including a range of from .5 to 1.4 for the ratio of least armature section to core area. The curves obtained show that the total induction through the armature increased quite rapidly when the armature was increased in area from .5 of that of the magnets to about .75 of the core area. From .75 to .9 there is still an increase of induction with increase of armature section, though comparatively small, and beyond .9 the increase is of no practical importance.

TABLE LIII.—CIRCUMFERENCE OF VARIOUS FORMS OF CROSS-SECTIONS OF EQUAL AREA.

Form of Cross-Section	Description	Circumference for Unit Area	Relative Circumference (Circle = 1)
	Circle	3 545	1
	Square	4 000	1.13
	Rectangle, 1 2	4 243	1.20
	1 3	4 62	1.305
	1 4	5 00	1 41
	1 8	6 364	1 80
	Ellipse, 1:2	3 87	1.09
	1.3	4 35	1.23
	1 4	4.84	1.37
	" 1.8	6 53	1.84
	Oval 1 square 2 Semi-circles	3.85	1.085
	" 2 " 2 "	4 28	1.21
	" 4 " 2 "	5 09	1.44
	2 Circles	5.01	1.41
	3 "	6.14	1.73
	4 "	7.09	2 00
	8 "	10.03	2.83
	Ring, 1:1	3 85	1.085
	" 1.2	4 09	1.155
	" 1.3	4 43	1.25
	" 1:4	4.76	1.34
	" 1:8	5.91	1.67

Elec. World

(To be Continued.)

The National Electric Light Association.

In addition to the list already printed in our columns of papers to be read at the Cleveland meeting of the National Electric Light Association, which will be held February 19, 20 and 21, there will be one by Mr. Nelson W. Perry, entitled "The Storage of Energy Essential to Central Stations; How It May Be Accomplished and the Economies Resulting." Professor Langley of the Case School of Science, and Professor Stine of Armour Institute, Chicago, will take part in the discussion. The topic, "How to Light Large Cities," will be discussed by Frederic Nicholls, Charles R. Huntley, Frank H. Clark, J. Frank Morrison, T. Carpenter Smith, George A. Redman, E. F. Peck, and others.

Waddell-Entz Battery in Germany.

The electric street lines of Westphalia, with the first storage battery equipment in Germany, were opened on Jan. 7 with great success. The Accumulatoren Fabrik Muller & Einbach, the German manufacturers of the Waddell-Entz battery, have received a contract for the installment of a storage battery system in connection with a steam road in Vienna, the storage battery cars to run between the times of steam trains.

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[4] Electrotechn Zeitschr. Vol XV. p 36 (Jan 18 1894.)
Electrical World, Vol. XXIII., p. 216 (Feb. 17, 1894.)

[5] Electrotechn. Zeitschr. Vol. XV., p. 50 (Feb. 8, 1894.)
Electrical World, Vol. XXIII., p. 337 (March 10, 1894.)

[6] ElectrotechnZeitschr. Vol. XV., p. 206 (April 12, 1894.)
Electrical World, Vol. XXIII., p. 680 (May 19, 1894.)

[7] Transactions, Am. Inst. of El. Eng., Vol., IV. (May 18, 1887); El. Engineer, Vol. III., p. 221 (June 1887.)

[8] S. P. Thompson, Dynamo-Electric Machinery, 4th edition, p. 4.

Electrodynamic Machinery—XXIV.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

116. There is only one method in practice of connecting the separate coils of a Gramme-ring bipolar armature; namely, their continuous looping around the ring in a closed coil, as shown in Fig. 97.

Suppose that it is desired to utilize the generated E. M. Fs. for the purpose of supplying a current to an external circuit; it is then only necessary to apply suitable brushes, or conductors, at *B* and *B′*, so as to rub continually against the external surface of the turns as they revolve, making the brushes sufficiently wide to maintain continuous contact. Under these circumstances, during the rotation of the armature, a steady current will flow through the circuit maintained externally between *B* and *B′*, *B*, being the positive pole of the machine and *B′*, the negative pole. Reversing the direction of the armature rotation will, of course, reverse the polarity of the brushes, as will also the reversal of the direction of the magnetic flux. If, therefore, it be required to change the polarity of the brushes without changing the direction of rotation, it is only necessary to reverse the magnetic flux through the armature. Fig. 99 shows a Gramme ring sextipolar generator with the commutating brushes bearing directly on the metallic surface of the turns of conductor on the surface of the armature. This method, however, of commuting the current from a Gramme ring armature is not the one in most frequent use, for not only are the conductors upon the surface of the armature usually too small to bear brush friction without destructive wear, but also the relative amount of friction offered by brushes placed upon so large a diameter is considerable, except in the case of very large machines. In order to avoid this and other objections, it is usual to employ a special form of commutator, as represented diagrammatically in Fig. 100, where each turn is connected by a special conductor to a separately insulated segment of a commutator. This commutator, therefore, contains as many separate segments as there are turns on the armature. Usually, however, there are many turns of wire on the armature to each segment of the commutator.

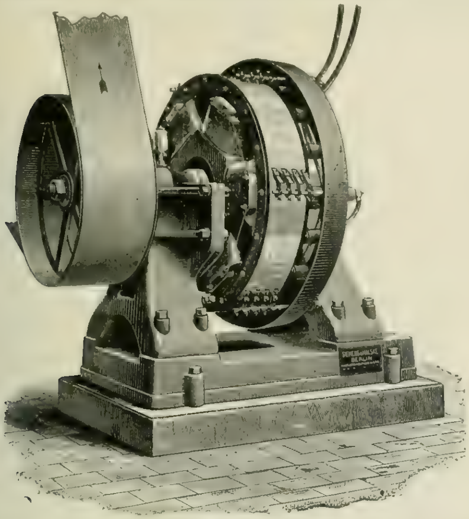
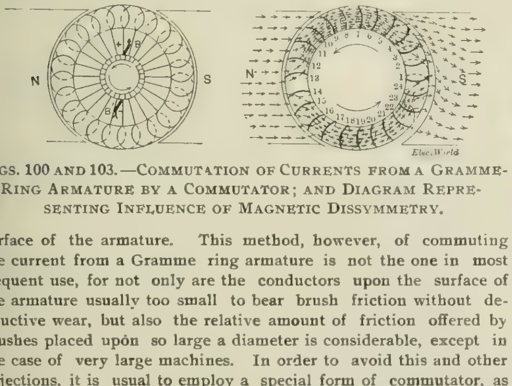


FIG. 99.—GRAMME-RING SEXTIPOLAR GENERATOR WITH BRUSHES COMMUTATING ON SURFACE OF ARMATURE.



FIGS. 100 AND 103.—COMMUTATION OF CURRENTS FROM A GRAMME-RING ARMATURE BY A COMMUTATOR; AND DIAGRAM REPRESENTING INFLUENCE OF MAGNETIC DISSYMMETRY.

It is customary in practice to give a considerable length of free surface to the commutator bars, so as to increase the surface of contact diminishing the pressure that has to be applied. Fig. 101 shows two forms of such commutator. The separate segments are insulated from each other by mica strips. In order to provide for the connection of the wires from the armature to the separate commutator segments or bars *B*, metal projections or lugs, *L*, attached to the bars, are provided. The bars after being assembled are held rigidly in place by the nut *N*.

Various forms of brushes are provided to maintain contact with the commutator bars. One form, consisting of wires and strips in alternate layers, is shown in Fig. 102.

In the armature so far considered, it has been supposed that the condition as regards distribution of flux and the consequent generation of E. M. F. is symmetrical. It is possible, however, that in the construction of the machine this symmetry may not be secured. For example, in Fig. 103, the pole piece S is represented as being considerably further from the armature at its lower than at its upper edge, thereby increasing the reluctance of the air gap at the lower edge, and producing magnetic dissymmetry, as represented by the flux arrows. It will be found, however, on examination, that despite this magnetic dissymmetry, the average E. M. F. produced in the coils will remain the same, although the distribution of this E. M. F. among the different turns necessarily varies. Thus if Φ, being as before the total flux through the armature, the lower half of the armature may take a certain fraction $n\Phi$, where n is less than 0.5, while the upper turn takes the balance $(1-n)\Phi$. The total change in flux linkage in passing from the position 7, to the position 19, will be $n\Phi-(1-n)\Phi=\Phi$, as before, so that the average E. M. F. will not be altered by the dissymmetry. It might be supposed that since the total flux passing through the armature remains the same, that no loss exists in an armature whose air-gap is thus widened, but a little consideration will show that the increased reluctance in the magnetic circuit necessitates a greater M. M. F. to drive the same amount of flux through the circuit, and consequently, if the M. M. F. in the magnetic circuit remains the same the total E. M. F. of the armature will be diminished. In addition to magnetic dissymmetry, a dissymmetry of winding may exist, such as shown in Fig. 104, where the right hand half of the armature is seen to be wound with six coils while the opposite half is wound with five. In this case, supposing the armature to be rotated, there will be, at the moment represented, a greater E. M. F. in the right hand half than in the left hand half of the winding, and a current will therefore tend to flow through the armature under the influence of the resulting E. M. F., even when no external circuit is provided. When the armature has made half a revolution from the position shown, the left hand half will be generating a greater E. M. F., thus tending to force the current backward. Under these circumstances there will be produced in the armature an oscillating E. M. F., the number of oscillations in a given time being the same as the number of poles passed by any part of the armature in that time. That is to say, in a bipolar machine the frequency of the double oscillations will be equal to the number of revolutions of the armature per second. In a quadripolar machine it would be equal to twice the number of revolutions, and so on. These oscillations heat the armature winding and waste energy in it, so that although symmetry is very desirable, symmetry of winding is,

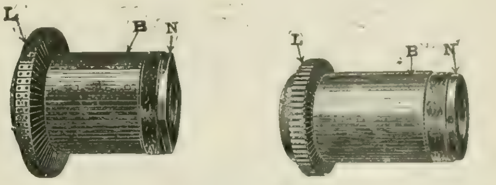


FIG. 101.—FORMS OF COMMUTATORS.

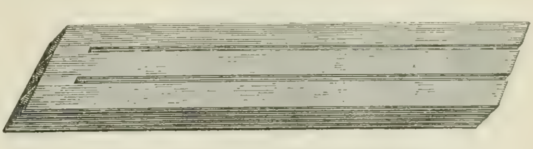


FIG. 102.—FORM OF GENERATOR BRUSH.

therefore, of greater importance than symmetry of magnetic flux distribution.

117. The armatures represented above are shown diagrammatically as rings; of circular cross-section. In practice, however, Gramme ring armatures always have a practically rectangular cross-section, as represented in Fig. 105. We have seen that the E. M. F. of a Gramme armature depends upon the number of turns of wire wound upon its surface, the flux passing through, it and the number of revolutions per second. The electrical capability of a machine is expressed by $\frac{e^2}{R}$ (Sec. 6), that is to say, its capability increases directly with the square of the E. M. F. and inversely with the resistance. For a given E. M. F. of the armature it is, therefore, desirable to reduce the resistance as far as possible, in order to increase the electrical capability of the machine. The shorter the length of the winding, *i. e.*, the shorter each turn, and the greater the cross section of the wire, the less the resistance of the armature. If R ohms be the resistance of all the wire on the armature as measured in one length, then the resistance of the armature will be $\frac{R}{4}$ ohms, since the two halves of the winding are in parallel; consequently the resistance of the armature will depend upon the shape of its cross section, since on this depends the length of each turn of conductor. A B C, Fig? represent the cross section of three different armature cores and have the same area. Calling the length of one turn around A unity, the length of a turn around B will be 7 per cent. greater, and around C 40 per cent. greater, consequently, two armatures having respectively the cross-sections of A and C, and wound with the same size and number of turns of conductor, would have the same E. M. F., if driven at the same speed, when traversed by the same flux, but the armature C would have 40 per cent. more resistance than the armature A, and its electrical capability would be about 30 per cent. less $\left(\frac{1}{1.4}\right)$. It is, therefore, desirable in designing a Gramme ring armature to retain a nearly square cross section. On the other hand, the section shown at C offers for a given polar arc a larger surface, and, consequently, a lower reluctance to the passage of the flux in the air gap or entrefer, than in the case of the armature A, so that it may be sometimes desirable to employ an armature of the type B, in order to reduce the air gap reluctance, and, at the same time, not greatly to increase the length of winding.

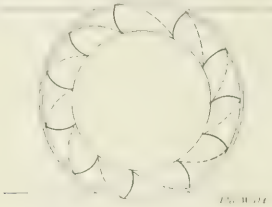


FIG. 104.—DIAGRAM REPRESENTING DISSYMMETRY OF WINDING.

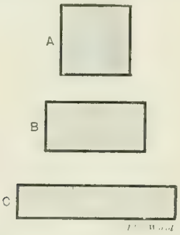


FIG. 105.—CROSS SECTIONS OF GRAMME RING ARMATURES.

Laboratory of Houston and Kennelly, Philadelphia.

(To be continued.)

Electrical Difference of Potential.

To the Editor of The Electrical World:

Sir:—In the article by Prof. Stine in the issue of THE ELECTRICAL WORLD of Jan. 12, a statement occurs which, if I understand it aright, does not conform with my idea of the actual fact.

The statement is as follows: "When a dynamo is started on open circuit it is generally regarded that it absorbs no power, except for mechanical reasons, until the circuit is closed. It really absorbs power to establish an E. M. F. When this reaches its maximum no further transfer of energy occurs until the circuit is closed."

It appears to be implied, that although power is required to *establish* an E. M. F. no power is needed to *maintain* it. The following is a concrete example of what is involved in this statement. If a straight wire cut one hundred million lines of force in one second, there will be established between its ends *one volt* difference of potential, the *establishment* of which difference of potential will require the expenditure of energy, but if, for an hour subsequently, the wire continues to cut lines of force at the same rate, no more work will be required. I can scarcely conceive the possibility of such a phenomenon. I think that work is required to maintain the difference of potential, because there is always the tendency for the potential to be equalized throughout the conductor.

It is certain that the wire must continue to cut the lines of force at the rate of one hundred millions per second, in order to keep up the E. M. F. of one volt. I see no reason to consider the first second as different in any respect from the remainder of the hour. Indeed, if a million lines of force are cut in one hundredth of a second, one volt E. M. F. will be established, and if no work is required to *maintain* a difference of potential, I think a plain course of argument goes to show that neither during the first second, nor during the first hundredth of a second, but merely during the first infinitesimal portion of time, must work be supplied; for if one line of force is cut in a hundredth-millionth of a second, the assumed electromotive force will be established.

If I am wrong about the electrical facts, the analogy in my article in THE ELECTRICAL WORLD of December 8 is to a certain extent imperfect, for when air is compressed towards one end of a box, and rarefied at the other by the motion of paddles, there is no doubt that work is necessary to maintain the difference of pressure, for the air tends to flow back past the paddles, and this back flow must be prevented by the *motion* of the paddles. Work must be done equivalent to the heat produced by the motion of the paddles agitating the air, in keeping it from flowing back.

The only case in which no work would be done would be if there were some suitable arrangement of air tight valves used in connection with the paddles, but in that case, so soon as the paddles had established the given difference of pressure, it would be a matter of no importance whether they continued in motion or came to rest. This case is not analagous to that of a wire cutting lines of force, but more like that of a statical machine of which the two conductors are charged, one positively, the other negatively. The construction of this machine is such that when its motion stops the conductors remain with their relative charges, or in other words, at their respective potential. A voltaic cell is in this respect, I think, similar to a statical machine, for there is no tendency for the ions to travel from copper to zinc, and there seems to be no doubt that transfer of energy in a cell cannot take place without a motion of the ions.

JOHN WADDELL,

Royal Military College of Canada, Kingston, Ont.

Static Electricity and Printing.

To the Editor of The Electrical World:

Sir:—Having tried numerous contrivances to get rid of static electricity in paper without success I had concluded to give it up, when some time ago I saw two presses running side by side on the same class of work, with the same grade of paper, except that one was glazed or finished and the other was not, and noted that the finished paper contained static electricity and the other had none. I immediately began to investigate and found that the higher and also the unfinished grades of paper have no static electricity, the finished and occasionally the "hard pan" grades being alone in this respect. The reason seems to be that the latter are finished, cut in sheets, dropped in a box one after the other in rapid succession, done up in reams in a manilla wrapper, and stored for shipment—all so rapidly that the static electrcity created by the finishing has not time to get away, which it would otherwise do. Whether this be the cause or not, the remedy is very simple, and consists in oiling the blanket of the press, thus obviating trouble in the second handling, even though the room be cold and the ink stiff; the latter condition, it may be remarked, plays quite a prominent part in the generation of static electricity in printing. In my opinion the manufacturer could do much to relieve the paper of its static electricity by having two paper covered rolls, oiled as the pressman oils his blanket, for the paper to run through just before it is cut, which expedient besides would not be very expensive.

G. DONALD.

ERIE, Pa.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors or publishers are solicited, and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 922 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Coupling of Alternators.—In the "Rev. de L'Elec." for December Mr. Chavannes discusses the question apart from any theories and endeavors to find the chief factors to be considered. He discusses the ability or inability of a number of prominent machines to be coupled in parallel and finds that by dividing them into two classes, first those which can and those which cannot be so connected, that in either case they may have iron in the armature or not, they may have large or small air gaps, that the self-inductions may be great or small, that the magnetic intensities may vary from zero to the strongest used in practice, that the armature coils may be surrounded by, or may surround iron; but there is one feature that is found in only one class, which is the resultant of the reaction of the armature, the distance of the magnet poles (between each other?) relatively to the air gap, and the magnetic intensity which can be called the "distinctness" of the magnetic field or its resistance to deformation; it may therefore be concluded that the property which characterizes the machine which may be coupled is this distinctness of the magnetic zones. He states that a sufficiently high induction does not operate in an active manner in facilitating coupling, but in a passive manner in protecting the machines; in ordinary cases it is not worth while to give an alternator a strong self-induction in order to protect it; it may be well, however, to do it in stations where there is fear of lightning or when an alternator is to be coupled with another of very different construction; many constructors consider it important to have a strong magnetic field, but too much importance should not be given this as Mr. Mordey has been able to add the currents of two alternators of his type when one was not excited.

Alternating Current Motor.—A new system patented by the Schuckert Company is described and illustrated in the "Elek. Anz.," Jan. 10. The principle is as follows: if an alternating current electromagnet is placed opposite two iron cores one of which is covered with a short-circuited winding, it will have a stronger attraction for the one that has no winding, or in other words the effect will be somewhat analogous to having a magnetic insulator over the short circuited one; by means of sliding contacts containing insulating and conducting segments, a motor can be so arranged that a continuous attraction may be produced; in the drawing, a 4-pole magnet rotates and is surrounded by a fixed frame containing 12 coils whose terminals are so connected to the segments over which brushes slide, that the proper coils are short-circuited in turn; they should remain short-circuited until they are in a neutral position in which they may be cut out without sparking.

The First Polyphase Motor.—In the Lond. "Elec.," Jan. 11, Prof. S. P. Thompson gives an illustrated description of the motor constructed and described by Walter Baily, and exhibited at the Physical Society June 28, 1879. It was intended to produce Arago's rotations; instead of rotating a magnet he constructed four parallel magnets and by means of a commutator he sent currents through the alternate pairs in such a way as to produce a rotating magnet field; the four magnets were vertical and over their ends was suspended a disc of copper; a part of the original description is reproduced.

Large Alternator.—According to the Lond. "Elec.," Jan. 11, Mr. Ferranti is about to build a 1,000 kw alternator of 11,000 volts, 100 amperes, at 156 revolutions, frequency 83, which is to be installed at the Deptford station; the electrical efficiency is to be 97 per cent.

Parker's Dynamo.—The English journals, Jan. 11, give illustrated descriptions of this dynamo, the chief feature of which is that the upper parts of the pole pieces are hinged so that they may turn back to allow the armature to be examined or removed, or to allow the field coils to be lifted off.

Small Motors and Dynamos.—Some illustrations are given in the Lond. "Elec.," Jan. 11.

LIGHTS AND LIGHTING.

Arc.—The copy of the paper of Prof. Ayrton on "Variation of Potential Differences of the Electric Arc with Current, Size of Carbon, and Distance Apart," which he read at the Chicago Congress, having been destroyed by fire, the Lond. "Elec.," Jan. 11, announces that he has prepared an abstract of the original, which will be published in that journal beginning with the next issue.

Optical Efficiencies.—The Lond. "Elec. Plant" for January gives the following optical efficiencies "according to the latest determinations" (but without giving the authorities): oil lamp 0.073 per cent., ordinary gas flame 0.033 per cent., incandescent electric light 1.0 per cent., arc lamp 3.875 per cent., magnesium light 15 per cent., sunlight about 31 per cent. and the Geissler tube light 32.7 per cent.

POWER AND HEAT.

Diphase Transmission Plant.—A paper by Mr. Boucherot (see Digest, Jan. 5,) is published with numerous, although not well executed illustrations, in the "Bul. Soc. Int. Elec.," for December. (References to English abstracts were given in the Digest last week.) He gives a description of a plant at the works of Weyher et Richemond, which is intended chiefly for distribution of power throughout the factory, and also for lighting; he gives the reasons why diphase currents were preferred to single-phase and three-phase, most of them being the same as those which decided the same question for the Niagara Falls plan; the generators and motors have a higher efficiency than those for single phase, the flux in the armature being constant in the former while it is periodic in the latter which tends to heat the iron; the motors may be started like those for continuous currents and they do not get out of step when overloaded; by the use of resistances in the armature circuit the speed may be varied, which cannot be done with the single-phase motors; they were preferred to triphase motors because the system is better adapted for lighting; for a complete load on one of the circuits and a half load on the other the difference in voltage is only 2 to 3 per cent.; both the generators and motors are also more simple in construction. He describes the installation in detail, part of which has been running for several months; there is one small triphase dynamo and motor and three large diphase alternators of 130 hp each at 110 volts 400 amperes per phase and 40 periods; he gives the results of tests made by himself in which the efficiency was measured like in continuous current dynamos, by finding the excitation, the resistance of the armature, and measuring the friction and other similar losses by running the machine excited but with no load, by means of a small dynamo whose efficiency was known; the results are given in detail in a table, the efficiency being 91.3 per cent. for full load, 87.2 per cent. for half load, and 60.3 per cent. for 1-10 load. To start the motors he uses a choking coil having sections in multiple arc, which are inserted one after the other; with the normal current a starting couple equal to about twice that at full charge is obtained; for a variable speed motor he prefers a triphase system in which resistances can be inserted in the armature circuit; this is used for large motors which are required to start heavy transmission shafting; he gives a table of the power and efficiency of each of the 17 motors used for different purposes, amounting altogether to 257.7 hp, the average commercial efficiency of all the motors being 90 per cent. and that between the pulley of the generators and that of the motors is 78.5 per cent. at full load. Regarding the supposed difference between the light efficiency of continuous and alternating current arc lights, he states that this is still to be proved, but assuming it to be equal, there is a saving in this installation of 20 to 25 hp during the lighting hours by the use of self-induction coils in series with the lamps instead of dead resistances.

Elastic Couplings for Gas Engines.—The mathematical discussion by Mr. Guillaume which was mentioned in the Digest Dec. 22 is published in full in the "Bul. Soc. Int. Elec." for December. (See also Digest, Jan. 19.)

Operating Ships' Turrets.—In the continuation of this article in Lond. "Engineering," Jan. 11, large working drawings are given.

Electric Elevator Service.—A paper by Mr. Harding read at the annual convention (1894) of the American Institute of Architects has been received in pamphlet form. He discusses the subject in general and gives a detailed description, without illustrations, of the plant in the Postal Telegraph Building, New York (of which an illustrated description was published in THE ELECTRICAL WORLD, April 21, 1894, page 529). If a car has a maximum speed of 250 feet a minute there is no necessity of being able to run it at variable speeds and it can readily be stopped, but for speeds from 300 to 600 feet per minute it becomes vital to have absolute control of the speed of the car by the motor, independently of the brake and it should be able to run at variable speeds; he believes that the hydraulic elevator has met its rival, and that the electric elevator will prove to be as much of an advance over the hydraulic as the latter was over the steam machine; the hydraulic elevator uses the same volume of water under the same pressure whatever the load, and this amount and pressure are those required when the maximum work is being performed; in the electric elevator, however, the current required is almost directly proportional to the live load, after allowing for that required to move the empty car; the coal consumption for the electric elevator is certainly not over one-half and he believes even less; if in the one case the current is used directly and in the other through the medium of an electrical pump operating a hydraulic elevator, there would be a difference in the electric energy of not less than 2 to 5 in favor of the electric elevator; in a plant of considerable size the water evaporation for the electric elevator, and consequently the coal consumption, will not exceed 35 to 40 per cent. of that for a hydraulic plant. He gives some detailed data about this building among which is the following: the cars are making 2,200 round trips a day; the voltage is 230; 25 readings from single machines gave an average of 87.3 amperes for one machine at an average speed of 390 feet; adding about 35 amperes for starting, for the controller and field excitation, the cost of a mile of travel at 5c per hp is 20.3c; 150 readings at five-second intervals were taken on the whole battery of elevators giving a cost of 19.25c per mile; the meter records are in accord with this result; 250 pounds of water are required per car mile of travel, which would be considerably less than one-half that required if this service were hydraulic.

Niagara Falls Plant.—"Elec. Power" for January contains an illustrated description by Mr. Foster. It is written in the style of a magazine article.

Government of Turbine Driving Railway Generators.—In the "St. Ry. Rev." for January Mr. Replogle discusses the subject and gives some of his observations.

TRACTION.

Sectional Surface Conductor Systems.—A long and full description with numerous illustrations of the Claret-Vuilleumier system which has been in use in Lyons, is published in the "Bul. Soc. Int. Elec." for December; the system was briefly described in the Digest Oct. 13-27. In the present article a detailed table of costs is given for this as also for the overhead trolley system, that of the former amounting to about $3.80 per metre while that of the latter is $4.30; the cost of operation is also given.

Electric Railways in Europe.—According to the "Elek. Anz.," Jan. 10, there were on Jan. 1, 1894, 43 electric railways in Europe having a total length of 174 miles, with a total power of 10,650 kw; there were 538 motor cars; the number of miles in each country were as follows: Germany 60, England 42, France 24, Austria and Hungary 18, Switzerland 12, Spain 7.8, Italy 6.6, Russia and Belgium each 1.8.

Electric Traction.—In a continuation of Mr. Dawson's article in Lond. "Engineering," Jan. 11, he gives tables of estimates of costs, comparisons, etc.

Mountain Railway.—The Lond. "Elec. Eng.," Jan. 11, abstracts a paper by Mr. Berg on the St. Gothard and Stanzerhorn Railways; it deals chiefly with the civil engineering features.

Daily Mileage for a Car.—The question of the proper daily mileage is briefly discussed in the "St. Ry. Rev." for January. It has a very important bearing on the earning power of a road; the speed, which averages more than double that of the horse cars, enables the car and a given number of train men to do twice as much work in a day; the cost of power is a small item in the operating expense; on some suburban roads cars are making up to 300 miles per day, and there are few that do not make 110 even in crowded cities; a high mileage should not be gained at the expense of too quick starts, it is better to have the motors built for a high maximum speed and they will then not need to be crowded on the start; attention is called to the importance of the assignment of train crews; there should be more than one crew to a car if it is to earn what it ought to.

Conduit vs. Trolley.—A paper by Mr. Sachs on this subject is begun in "Elec. Power" for January. He gives a history with illustrations of the development of the electric railway. Referring to the conduit system he states that it is an absolute necessity where it is impossible to use the overhead wire; there have been over 1,600 patents issued for inventions regarding electrical railways, of which over one-half are for conduit methods; he believes that the problem has not been properly attacked; a conduit system must not necessarily compete in price with the overhead trolley, for where it is wanted a cheap trolley system would not answer. He divides the systems into six different classes which he intends to discuss. He discusses in a general way some of the requirements for a successful conduit road, giving, however, nothing new; he states that a large cost is permissible as long as it competes with the cable.

Love Conduit Road in Washington.—The "St. Ry. Rev." for January gives briefly the results of investigations which it has made, which show that this road is neither a remarkable success nor a flat failure; during the past year there have been 6 stops due to trouble in the conduit; in 1893 the insulators were changed to those made of molded mica; the greatest source of trouble has been the expansion and contraction of the trolley wires, which shows the wisdom of the proposed use of channel irons on the New York line; there has been little trouble from moisture, the main difficulties being mechanical; it is encouraging to note the absence of electrical troubles, which tends to show that 500 volts may possibly be used with safety; "the general adoption of a conduit electric system is still in the far distant future."

Washington Conduit Road.—The "St. Ry. Rev." for January contains a brief description, with good illustrations, of the system devised by Mr. Connett, which it has been decided to use on 8 miles of road in that city. The construction is similar to that of a cable conduit; the insulators are of porcelain and the conductors are hung over the roof of the conduit; a manhole is placed above each insulator, 13.5 feet apart; a sliding contact will be used, rubbing on the vertical faces of the steel conductor; the contact devised will be slung under the truck; a complete metallic circuit will be used; the voltage will be 450 to 500, which will be increased to 550 if experience warrants it.

Three Wire Trolley System at St. Louis.—The "St. Ry. Rev." for January contains an illustrated article describing the system and a number of the details, which has been installed on one of the lines in St. Louis; it appears to be very successful and is applied to a down town portion nearly two miles from the station where the traffic is heaviest and where it is most difficult to operate the three wire system; it has been in continual use about seven weeks; the balance is obtained partly by making one pair of track positive and the other negative and also by dividing the line into short sections, alternately positive and negative; there should then be a double throw three pole switch to each generator and another to each feeder at the feeder board; at night when one generator would suffice, all the sections can be switched on to one side of the circuit.

Waterloo Underground Road.—The cross section of the tunnel of this electric line is given in the "St. Ry. Rev." for January.

Chicago Street Railway.—The annual report of the North Chicago Street Railway Co. is reprinted in the "St. Ry. Gaz.," Jan. 19.

Electric Traction in England.—Mr. Smith's article mentioned in the Digest last week is reprinted in the "St. Ry. Gaz.," Jan. 19.

Suburban Railways and Their Possibilities.—An article on this subject by Mr. Swift is published in the "St. Ry. Rev." for January.

Steep Grade Traction.—An abstract of Mr. Preller's paper (see Digest, Dec. 15) is published in the "St. Ry. Rev." for January.

Truck.—"Eng. News," Jan. 24, gives an illustrated description of the maximum traction truck (see Digest, Jan. 19) and editorially considers this arrangement one of the most satisfactory solutions of the problem.

Street Car Ambulance.—An illustrated description of one used in St. Louis is given in the "St. Ry. Rev." for January.

Horse Power for Car Propulsion.—A further correction of the simple rules mentioned in the Digest, Jan. 19 (see also Jan. 26), is published in "Eng. News," Jan. 24.

Specifications.—"Eng. News," Jan. 24, reprints the specifications for the Waukesha Beach Electric Railway, Wis.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

High Voltage Lamps for Central Stations.—The Lond "Elec. Rev.," Jan. 11, contains an article by Mr. Addenbrooke; he discusses the bearing which the voltage of the lamps has on central station distribution. The chief difficulty in the way has been in meeting the demand for an 8-cp lamp; 16-cp lamps can readily be made by mounting two 8-cp filaments in series in the same bulb; theoretically the advantages of high voltage may be said to increase as the cube of the voltage up to about 200 volts; in practice nine or ten times the area could be better supplied on the three-wire system from a central station at 200 volts than now at 100 volts; distributing mains might then be carried three times the distance and the loss in houses would be merely nominal, the number of feeding points in a given area would be greatly reduced. He gives a table showing the variations in candle power for slight variations in the voltage and finds that for 4 per cent. variation on each side of the normal every 1 per cent. makes 5 to 6 per cent. variation in the light, and as it is the light which the consumer buys a slight variation in the voltage, which makes but little difference in the current registered by the meter, makes a difference of 10 to 15 per cent. in the light; this is a serious matter, especially as the mains are gradually filling up. He speaks very favorably of the incandescent gas light, which he says has come to stay, and the light is decidedly superior to the incandescent electric light if the latter is worked below pressure; it also costs only about one-half as much.

Electric Light on Board Vessels.—Some alterations and amendments to the regulations of the Lloyd Register are published in the Lond. "Elec," Jan. 11.

Yarmouth.—A long, illustrated description is published in the Lond. "Elec. Eng.," Jan. 11; the system used is the alternating with transformer stations and direct current series machines for street arc lights.

Meter vs. Contract System of Charging.—A short paper by Mr. Cole read at the meeting of the Northwestern Electrical Association is published in the "West. El.," Jan. 26. He gives the results of his own experience with a plant in Beloit where both systems were in use; he charges meter rental, which he says pays a good percentage, and he finds that there is an additional profit in the meter system over the contract system, of which he gives several illustrations; another advantage is that he can use smaller transformers; the income from the investment in the meter has been very satisfactory; on the contract plan over one-half the number of wired lamps were being used, while on the meter plan this is reduced to one-third; there is another advantage in the profit in wiring residences as customers will put in more lights on the meter system.

WIRES, WIRING AND CONDUITS.

Regulations for Conductors on Public Roads in France.—A translation of a summary of the rules recently published in "L'Energie Elec." is published in the "Elec. Rev.," Jan. 11.

Explosions.—The Board of Trade inquiry of the Euston Road explosion is published in the Lond. "Elec.," Jan. 11.

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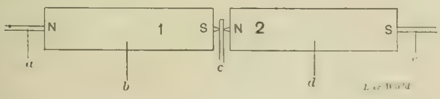
Paper Insulation.—"Elec. Power" for January contains an article by Mr. Bishop on paper insulated telephone cables. Although paper was used in England and France at least 25 years ago, and has been abandoned since, it has been resurrected in America and is now doing most excellent work, the conduits of one company in Brooklyn containing nearly 70 miles of this cable amounting to nearly 8,000 miles of wire; in New York one company has 30,000 miles in use while other large cities use proportionate amounts. He mentions the advantages of paper and states that pure fibre paper is as indestructible as carbon; the first paper cables laid 6 years ago are in better working condition to-day than when they first left the factory; he believes that the subterranean telephone cable of the future, except under some peculiar and exceptional circumstances, will be exclusively of paper; there are no foundation patents on paper insulation. He gives the specifications of the "Conference Standard," which corresponds to those for the larger part of the cables laid in New York and elsewhere; the conductors are number 19 B. & S. guage, after insulation with paper they are twined with a three inch twist, 50 pairs are then cabled in reversed layers; the insulation resistance must be at least 500 megohms per mile and the capacity must not exceed 0.080 microfarads per mile; such a cable weighs about 4 lbs. per foot. He describes briefly a plant installed by himself for turning out 3,500 feet of this cable per day which requires one-third the number of hands formerly necessary for an output of 3 feet of old fashioned cable. According to Dr. Perrine the lowest possible theoretical capacity would be 0.0386; with paper, the object is to use as little paper and as much air space as possible. The bunched wires are covered with jute and then with lead containing 3 per cent. of tin; if properly handled the utmost confidence may be placed in hot lead process at 500 to 700 tons pressure to prevent the existence of even the slightest pin-hole; one may almost conclude that the practical limit of a low capacity has been reached.

ELECTRO-PHYSICS AND MAGNETISM.

Unipolar Induction.—A paper by Prof. Lecher read at the Imperial Academy of Science in October is reprinted in the "Zeit. f. Elek.," Jan. 1. Faraday stated that the rotating magnet does not carry its field with it and that the lines of force remain fixed; in many text books, however, the contrary is claimed; in the present paper he discusses this question and describes a number of experiments. If a point of light is moved the rays follow it only in a figurative sense, news rays start out from each successive position while the old ones cease. If the field does not rotate with the magnet then the views of Preston ("Phil. Mag.," 1885, page 131,) who was probably the first to differ with Faraday, are not correct; W. Weber and Lord Rayleigh agree with Preston. The present writer thinks that the statements of Preston do not decide the question; Faraday could find no experimental proof for his opinion; a conclusive proof is not possible with a simple galvanometer and a single rotating magnet; this is explained in some detail; he concludes that the results obtained by a number of physicists, which he cites, can be explained equally well by both theories. He describes the following tests: In the adjoining figure let 1 and 2 be two electromagnets mounted as shown so that they can be revolved independently of each other, the two adjacent poles being unlike, and there being 5 contacts, *a*, *b*, *c*, *d*, *e*, the one at *c* being in connection through the pivots; the coils of the magnets revolved with them. When *c* and *d* were connected with a galvanometer, magnet 1 being at rest and 2 rotating once per second, a deflection of 38 was obtained; with *d* and *e* the deflection was 39, in both cases the current flowed from the equator to the axis; according to Faraday the seat of the E. M. F. in both cases is in the equatorial radius; the results were not changed when the magnet 1 was also rotated either in the same or in the opposite direction; when either magnet was at rest and the other rotated and when *b* and *d* were connected with the galvanometer the deflection was about the same, but if they were rotated simultaneously in opposite directions the deflection was practically equal to their sum, which is easily explained according to Faraday but not according to the views of Preston. In another experiment he mounted the near ends of the magnets on insulated pivots and soldered copper discs to those ends of the magnet, the edges of which dipped into mercury cups forming the contact *c*. *a* and *b* gave a deflection of 40 whether magnet 2 rotated or not; *c* and *b* gave a deflection of 7 in the opposite direction whether the other magnet rotated or not; *a* and *c* gave the difference between the two; with *a* and *c*, magnet 1 rotating alone, it was 33, while with 2 rotating alone and in the opposite direction it was 33.5, the deflection being in the same direction; when both magnets were rotated in opposite directions the deflection was equal to the sum of the above, while if they were rotated in the same direction there was no deflection. He concludes from this, that Faraday's views are correct, in that the field of a rotating magnet remains at rest. Applying this to the earth there should be positive electricity at the north pole and negative at the equator. (Could this question not be solved in a very simple way by revolving a circular electromagnet on its axis and holding a copper disc in front of one of the poles? if the copper disc does not tend to revolve with the magnet then Faraday and Lecher are right in stating that the lines of force remain fixed, but if it does tend to revolve, then Lord Rayleigh and the many others who believe as he does, are right; the magnet must be truly cylindrical and the disc must be symmetrically placed and be protected from air currents by a sheet of paper. If Lecher is right a bar magnet should heat if it is revolved rapidly on its axis.)



Magnetic Quality of Iron.—The Lond. "Elec.," Jan. 11, contains an interesting paper by Prof. Ewing on "Is the Magnetic Quality of Iron Affected by Often Repeated Reversals?" Referring to the recent observations of Mr. Partridge (see Digest, Dec. 29, Jan. 5-12,) he describes some experiments made by himself to investigate this phenomenon; in these, small iron rings were exposed to a long continued series of reversals, but without having their temperature raised by more than a very trifling amount; the section of the rings was somewhat less than 1 sq. cm.; the magnetic quality was carefully examined, to begin with, by a graded series of cycles, the curve being plotted for each; the induction ranged from 9,000 to 11,000 and the frequency was 80; the rings remained under this action continuously for 11 days, after which they were removed and at once tested in the same way as before; he gives the results in a table and a curve; the curves showing the cyclic processes before and after are also given and show that no change was brought about in the general character of this cycle; the areas are given and the curve of hysteresis losses is plotted; the results show that the effect described by Mr. Partridge was not due to molecular fatigue induced by reversals of magnetism, the induction was much higher than would be found in a transformer. He adds that it would be interesting to make a further comparison before and after prolonged baking.

Manganese Steel.—According to Lond. "Ind. and Iron," Jan. 11, Mr. Hadfield states that this metal, which is practically non-magnetic, can be made magnetic by submitting it to a prolonged action of a temperature between 500 and 600 degrees for two hours.

Resistances of Poor Conductors.—A paper by Mr. Peirce from the "Proceedings of the American Academy" is reprinted in full in the Lond. "Elec. Rev.," Jan. 11. He gives the results of experiments chiefly with wood, marble, ebonite, etc., as used for switchboards; the results, however, are mostly of relative value only, as they refer to the distance between two mercury cups drilled into the materials. Among other things he refers to the resistance of white marble which at first is a fairly good conductor, but two weeks drying in the sun sometimes increases the resistance 10,000-fold. Immersion in hot paraffine is recommended for porous bodies, specially if done under the receiver of an air pump; a coat of shellac when not thoroughly dry often lowers the insulation very much.

Electrical Energy.—In the Lond. "Elec. Eng.," Jan. 11, Dr. Shuttle offers a theory regarding the nature of electrical energy; it appears that he believes an electrical current to be an effort to establish equilibrium of ether stress.

Work of an Electrical Current.—The fourth, fifth and sixth Christmas lectures by Prof. Fleming on this subject are abstracted in the Lond. "Elec. Eng.," Jan. 11.

The Work of Hertz.—Extracts from an address by Mr. Loewy, the President of the Academy of Sciences, Paris, are reprinted in "L'Elec.," Jan. 12.

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Distribution of Energy in the Spectrum of the Glow Lamp.—A paper of some length by Dr. Nichols is published in the "Phys. Rev." January-February. He summarizes the researches of others which show that the amount of light for the energy expended is much greater in incandescent lamps with filaments having a bright, silver-gray surface than with those having a dull surface having the appearance of lampblack, showing the advantages of the former kind of filaments. He describes a long series of experiments made by himself to study the laws of radiation of these two widely different carbon surfaces; he subjected the filaments to very wide ranges of temperature and measured the distribution of energy in the spectrum; the results of the tests are given in curves and tables; the areas of the portions of the curves lying within the range of the luminous rays is larger in the case of bright filaments, which explain their superiority.

Influence of Electric Current on Young's Modulus.—The "Phys. Rev." January-February, publishes a paper of considerable length by Mary Noyes on "Influence of Heat and the Electric Current upon Young's Modulus for a Piano Wire." The object of the investigation was to see if there is any indication of a maximum value for the modulus between 100 degrees and 200 degrees; the results were negative; temperatures were obtained by means of an electric current. The results as far as they refer to the influence of the electric current, show that it perceptibly modifies the elasticity and that the effect varies with the conditions; the results are not sufficiently numerous to deduce the laws; the results show that longitudinal magnetization has no appreciable effect upon the elasticity.

A Theory of Electrical Vision.—An abstract of a paper by Dr. Turner read before the Edinburgh Medico Chirurgical Society, with this title, is published in the "Elec. Rev.," Jan. 16. He mentions that electromagnetic waves differ from light and heat waves merely in the wave length and describes the detector for the former kind of waves, made of a tube of iron filings as suggested by Hertz and his followers. He gives Prof. Lodge's suggested electrical theory of vision and suggests that selenium affords a better analogy.

Secular Magnetic Changes.—The "Pop. Sc. Mo." for January gives a very brief account of Prof. Ruecker's recent observations (see reference in Digest, Sept. 1). The earth is not a simple magnet and each hemisphere contains a pole and two foci of maximum intensity, which latter are in motion producing the secular change; the changes suggest that they are due to waxing and waning of forces apparently exerted by secondary lines or points of attraction or repulsion.

Magnetic Potential.—The "Phys. Rev.," January-February, contains a short paper by Dr. Bedell. He considers the effect of permeability on the magnetic potential, and shows its bearing in the discussion (to which he gives many references) regarding the dimensions of the magnetic pole in the electrostatic system. He discusses the dimensions of magnetic potential and shows that in a uniform medium the magnetic potential due to a current is independent of the permeability.

Pre-Scientific Electricity.—An article of some length by Mr. Hayden from the "New Science Review" is reprinted in "El'ty, Jan. 25.

Electrochemical Actinometer.—An abstract of some length, with illustrations, of the recent paper of Mr. Marechal (see Digest, Dec. 15-29) is published in the "Elec. Rev.," Jan. 16.

ELECTRO-CHEMISTRY AND BATTERIES.

Electricity Direct from Coal.—The Lond. "Elec." Jan. 11, contains a brief communication from Mr. Mond which he states throws a strange light upon the source of electricity in Dr. Borcher's cell (see Digest, Nov. 10, Dec. 8-15-29). He gives a table of the following combinations: when the annode was carbon and the cathode copper the voltage obtained was as follows: in 25 per cent. HCl 0.6006, cupric chloride in the HCl 0.4655, cuprous chloride in HCl 0.3774, carbon in copper oxychloride in HCl and copper in cuprous chloride in HCl 0.4315, carbon in copper oxychloride in HCl and copper in carbonic oxide chloride in HCl 0.4407; when both the anode and the cathode were of carbon the results were as follows: carbon in cuprous chloride in HCl and air the other carbon being in cuprous chloride in HCl and carbonic-oxide (carbon monoxide?) 0.0015 carbon in cuprous chloride in HCl and air, while the other carbon was in cuprous chloride in HCl and coal gas 0.0050. Editorially it is stated that the obvious deduction is that the production of a current in Dr. Borcher's cell was due to the corrosion of the copper electrode and not to the oxidation of the gas (see also an article by Mr. Reed in THE ELECTRICAL WORLD, Dec. 22, p. 637).

Gas Battery.—The Lond. "Elec. Eng.," Jan. 11, gives an abstract from the "Jour. of the Chem. Soc." of a paper by Mr. Smale, which appeared in the "Zeit. Phys. Chem." (no dates are given). The E. M. F. was determined in a large number of gas batteries the electrode being usually platinum strips coated with platinum black and immersed partly in the gas and partly in the electrolyte; the nature of the plates had no effect, similar results being obtained with gold, platinum and palladium; the E. M. F. appeared to be independent of the electrolyte and its concentration; abnormal values were obtained with the halogen acids and many salts, which he believes were due to secondary actions; the means of the results are: hydrogen, oxygen, 1.044 volts; hydrogen, chlorine, 1.532 volts; hydrogen, bromine, 1.111; hydrogen, iodene, 0.530; in the oxygen-hydrogen cell the E. M. F. falls regularly as the temperature increases.

Electrochemical Processes.—In the Lond. "Elec. Rev.," Jan. 11, Mr. Swinburne gives a brief review of what has been done during the past year. As many of the processes are kept secret it is not possible to publish accounts of them; the greatest development has been in copper refining; chlorate of potash is now being made largely by simple process; caustic soda and bleaching powder are also being made, but there is less chance for a large profit, and the anode difficulty stands where it did, the only promising solution being a cheap form of carbon which is easily replaced; it will take many thousand hp to make any appreciable portion of the chemicals now used; important results have been obtained by Siemens and Halske and by Andreoli in the generation of ozone; Vautin's process for separating silver from gold by using gold as an anode and fused chloride of silver as electrolyte, deserves mention as a simple way of conducting an otherwise troublesome process; several other processes are referred to very briefly; regarding the stripping of tin he states that the problem now is to find sufficient scrap tin to strip. There are hardly any master patents to be gotten for electrolytic processes and there is therefore less incentive for the formation of companies; companies who pay little and who go to work with energy and good management would do splendidly by manufacturing such chemicals as pay best without being tied down to any patented processes.

Extracting Gold.—According to the Lond. "Ind. and Iron," Jan. 11, Mr. Lorsen, a German, electrolyzes a solution of potassium bromide and obtains an alkaline solution of hypobromide and bromate which is capable of dissolving gold; the ore is treated with an excess of this solution in rotating cylinders after which it is filtered and the gold precipitated by iron and coal, and the solution which then contains chiefly potassium bromide is used over again after being electrolyzed.

Bleaching.—The Kellner process is described and illustrated in "L'Eclairage Elec.," Dec. 22-29; he uses an electrode of copper or of phosphor bronze, one side of which is platinum plated while the other is amalgamated; the current passes through successive plates in series forming an approximation to a number of cells, the fabric to be bleached passing between these plates.

Primary Batteries.—Mr. Paine in the Lond. "Elec. Rev.," Jan. 11, states that the current and constancy of a battery are increased by placing the carbons perpendicularly to the zinc instead of parallel, the reason for which, he believes, is due to the doubling of the active surface.

Batteries in Multiple Arc.—A paper by Mr. Peirce from the "Proceedings of the American Academy" is reprinted in the Lond. "Elec. Rev.," Jan. 11; he gives a mathematical discussion of the conditions when cells of different electromotive forces and resistances are connected in multiple arc.

Faure Patent.—The British Faure Patent expired Jan. 10; the Lond. "Elec.," Jan. 11, gives an abstract of the patent with one of the figures.

Local Action in Accumulators.—A translation of the article of Mr. Darrieus (see Digest Dec. 15, which should read "L'Elec." Nov. 17 instead of Lond. "Elec." Nov. 17) is published in the Lond. "Elec. Rev.," Jan. 11.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Testing and Inspection of Electric Light Cables.—An anonymous article is begun in the Lond. "Elec. Rev.," Jan. 11, in which it is intended to give a few hints. It is regretted that so much importance is attached to the resistance per mile while the electrical stress which it will stand is generally neglected completely; it is quite possible to have the former high and the latter low, and the reverse; it is often forgotten that it takes much longer to recover from an electric stress than is usually supposed. Regarding the usual method of testing the insulation by comparison with a known resistance he gives a few hints; if the deflection is not quite steady, then if the unsteadiness is always positive the cable is probably faulty, while if it is sometimes positive and sometimes negative it is probably good and the unsteadiness is caused by a bad contact in the battery even though the "constant" deflection was perfectly steady. To clean the end of a cable it should be stripped for 6 inches, rubbed with a rag, soaked in naphtha, scraped with a knife and then dried with a flame; to test a cable by pouring water over the drum is quite useless and very misleading as it may appear to be quite faulty, although under water it would be quite satisfactory, which is probably due to the fact that the cable never gets properly electrified; an immersion of less than 24 hours should never be used.

Voltmeter.—Nalder's permanent magnet voltmeter is described and illustrated in the Lond. "Elec.," Jan. 11; it resembles the Weston instrument in principle, the chief difference being that the contacts between the coil and the terminals are made by means of platinum-iridium pivots and springs resting against them; this obviates the use of spring or flexible connections exerting a controlling force; the controlling force is obtained by a small magnet attached to the coil and it thus varies with any change which may take place in the permanent magnet; the instrument is dead-beat and takes about 2 watts for 100 volts.

Determining the Efficiencies of Dynamos and Motors.—In the serial by Mr. Ashworth in the Lond. "Elec. Plant" for January he describes and illustrates a number of dynamometers.

Pupillometry and Photometry.—Mr. Henry's article is continued in "L'Eclairage Elec.," Dec. 22-29.

Measuring Small Resistances and Insulation Resistances.—In an article by Mr. Fuchs in the "St. Ry. Rev." for January he describes in a simple manner a practical way of making such measurements on street car motors and apparatus, with the aid of a voltmeter and an ammeter. For the resistance measurements a millivoltmeter reading from 0.02 to 3 volts is used for measuring the differences of potential when a known current is flowing through the resistance; for insulation measurements a high resistance voltmeter of about 80,000 ohms is used; a ground reading and the full voltage are measured, from which the insulation resistance is calculated, knowing the resistance of the voltmeter; up to 39 megohms can thus be measured with a 600 volt Weston instrument; the methods have been in daily use for three years.

Electrical Terms.—In a short article on this subject by Mr. Hachenberg in the "Elec. Rev.," Jan. 16, he argues in favor of the use of scientific descriptive terms and against the present use of proper names.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Microphone.—In "L'Eclairage Elec.," Dec. 22-29, Mr. Anizan describes and illustrates a microphone devised by himself and Mr. Mercadier. He states that microphones made of grains give good results in the beginning but are apt to settle, while those made of rods do not give as good results in the beginning but are more constant. The present one is made of carbon rods, slightly inclined, the bottoms resting on metallic pivots while the upper parts rest against a V-shaped groove in a block of carbon on the diaphragm; one instrument contains eight of these arranged two in parallel and four in series, there being thus 16 contacts; the resistance is 7 to 8 ohms and the current required about 0.3 ampere; they can be regulated by adjusting the inclination; at the minimum inclination conversation is practicable with an artificial line of 240 miles of iron wire or 10,800 miles of copper wire.

Telephonic Efficiency.—In a paper by Mr. Picard in the "Bull. l'Ass. Ing. El. Montefiore," Dec. 15, he discusses the telephonic efficiency of the Van Rysselberghe transmitter and the loss of energy in the derived circuits to a strong self-induction. He concludes that systems in which transformers are used are inferior as far as the utilization of energy is concerned, in comparison with those in which the telephone is in derivation to a resistance having a great impedance.

Telephone Switchboard.—The Pozdena system is described and illustrated in the "Zeit. f. Elek.," Jan. 1.

Magnetic Call.—An electromagnetic telephone call devised by Roulez is described and illustrated in "L'Elec.," Jan. 12.

Cable Signaling.—Mr. Delany's recent paper (see Digest, Dec. 22, Jan. 5), is referred to briefly in the Lond "Elec. Rev.," Jan. 11, and it is stated that the experiments are interesting chiefly from a scientific point of view as the chief want at present is to increase the working capacity by means of automatic transmission and not to go back to the sounder; doubt is also expressed whether it would be advantageous to connect land lines with the cables as the former can be worked more rapidly.

Muirhead vs. Commercial Cable Co.—In an editorial in the Lond. "Elec. Rev.," Jan. 11, that journal expresses a difference in its views with those expressed in a recent number of "Engineering" (see Digest, Jan. 19), regarding this important litigation.

Telegraph Poles.—According to the "Elec. Tech.," Dec. 31, telegraph poles in Norway have a hole bored into them several feet above the earth, about 1 inch in diameter reaching to the middle of the pole, into which is introduced about 150 grammes of pulverized sulphate of copper after which the hole is plugged with a wooden stopper; it is renewed every three or four months.

Multiple Telegraph.—A continuation of Mr. Baudot's article (the first part of which was mentioned in the Digest, April 14,) is published at some length in the "Bul. Soc. Int. Elec.," for December.

Telegraph System in London.—An address by Mr. Eaton is reprinted in the Lond. "Elec. Rev.," Jan. 11.

Recent Storms and Telegraphs.—A short article referring to the English lines is contained in the Lond. "Elec. Rev.," Jan. 11.

Telegraphs.—"Elec. Power" for January contains an article by Mr. Haskins, in which he gives a brief history of the early American, English and Scotch systems, the latter being that of Bain.

Magneto Telephone.—In "El'ty," Jan. 23, Mr. Perry describes how to construct a cheap and serviceable instrument for domestic and office purposes.

Peculiar Telephone Troubles.—The article of Mr. Mix abstracted in the Digest, Jan. 19, is reprinted in full in the "Elec. Rev.," Jan. 16.

MISCELLANEOUS.

Sterilizing Milk.—According to the "Elek. Anz.," Jan. 10, a process has been invented in Holland which, according to the patent, consists simply in subjecting the milk for some time to the "double action" of an electric current, whereby all the microbes are destroyed.

Electric Logs.—Several forms of logs for recording the speed of vessels are described and illustrated in "L'Elec.," Jan. 12.

Treatment in Case of Accidents.—The instructions prepared by a committee of the French Academy of Medicine consisting of Bourchard d'Arsonval, Laborde and Gariel for the municipal departments in Paris, are reprinted in "L'Elec.," Jan. 12; they appear to differ but little from those now well known.

Ozone.—"La Nature," Jan 12, gives an illustrated description of the establishment of St. Raphael where ozone is issued for curative purposes.

Electric Light as a Therapeutic and Diagnostic Agent.—A paper on this subject by Dr. Cleaves read at the American Electro-Therapeutic Association is reprinted in the Lond. "Elec. Rev.," Jan. 11.

Mattei's Remedy.—The leading article of the Lond. "Elec. Rev.," Jan. 11, discusses "Matteism on Its Defence."

Educational.—An anonymous correspondent to the Lond "Elec.," Jan. 11, discusses the subject of "labor saving" apparatus as an instrument of education (see Digest, Jan. 12 and 26). The basis of his argument is well expressed in one of the opening sentences in which he says: "I believe that the put-a-penny-in-the-slot-and-turn-the-handle system of teaching practical physics is subversive of all true education, especially with junior students, and I think it has the additional effect of completely spoiling the teachers."

Training of the Electrical Engineer.—The "Elec. Power" for January contains the first part of an article by Mr. Cahoon in which he intends to point out the necessity for supplementing a technical education with a practical course of training and to give the changes which have occurred in the course of training as given to students by one of the large electrical companies; he took charge of the "Expert" department of the course which was started at the works of the Thomson-Houston Co.; the present portion consists chiefly of a large number of illustrations of the old and the new apparatus made by that company, including an illustration of a large 1,000 kw transformer.

Meeting of the Northwestern Electrical Association.—The greater portion of the "West. El.," Jan. 26, is devoted to a report of this meeting, including a large number of illustrations of the exhibits.

Moonlight Tables for March, 1895.

Herewith we give Mr. H. W. Frund's table of lighting hours for the month of March, under his modified form of moonlight schedule:

TABLE NO. 1,
Standard Moonlight
System.

Date.	Light.	Date.	Exting.
1	10.10 P. M.	2	5.30 A. M.
2	11.10 "	3	5.30 "
3	.....	3	....
4	12.25 A. M.	4	5 30 A. M.
5	1.30 "	5	5 30 "
6	2.30 "	6	5.30 "
7	3 20 "	7	5.30 "
8	4 00 "	8	5.30 "
9	No light.	9	No light.
10	"	10	"
11	"	11	"
12	6.30 P. M.	12	9.20 P. M.
13	6.30 "	13	10.30 "
14	6 30 "	14	11.50 "
15	6 30 "	16	1.00 A. M.
16	6 30 "	17	2.00 "
17	6.40 "	18	3.00 "
18	6 40 "	19	4.00 "
19	6.40 "	20	4.30 "
20	6.40 "	21	5.00 "
21	6.40 "	22	5.00 "
22	6 40 "	23	5.00 "
23	6 40 "	24	5.00 "
24	6 40 "	25	5.00 "
25	6.40 "	26	5.00 "
26	6 40 "	27	5.00 "
27	6.50 "	28	5.00 "
28	8 00 "	29	5.00 "
29	9 00 "	30	4.50 "
30	10 00 "	31	4.50 "
31	11.00 "	1	4 50 "

TABLE NO. 2,
Frund's New Moonlight
System.

Date.	Light.	Date.	Exting.
1	6.20 P. M.	2	5.30 A. M.
2	" "	3	5.30 "
3	" "	3	12.00 M.
4	12.25 A. M.	4	5.30 A. M.
4	6.20 P. M.	4	12.00 M.
5	1.30 A. M.	5	5.30 A M.
5	6.20 P. M.	5	12.00 M.
6	2.30 A. M.	6	5.30 A. M.
6	6.20 P. M.	6	12.00 M.
7	6 20 "	7	12.00 "
8	6.30 "	8	12.00 "
9	6.30 "	9	12.00 "
10	6.30 "	10	12.00 "
11	6 30 "	11	12.00 "
12	6.30 "	12	12.00 "
13	6.30 "	13	12.00 "
14	6.30 "	14	12.00 "
15	6.30 "	16	1.00 A. M
16	6.30 "	17	2.00 "
17	6.40 "	18	3.00 "
18	6.40 "	19	4.00 "
19	6.40 "	20	4 30 "
20	6.40 "	21	5.00 "
21	6.40 "	22	5.00 "
22	6.40 "	23	5.00 "
23	6.40 "	24	5.00 "
24	6.40 "	25	5.00 "
25	6.40 "	26	5.00 "
26	6.50 "	27	5.00 "
27	6.50 "	28	5.00 "
28	6.50 "	29	5.00 "
29	6.50 "	30	4 50 "
30	6.50 "	31	4.50 "
31	6.50 "	1	4.50 "

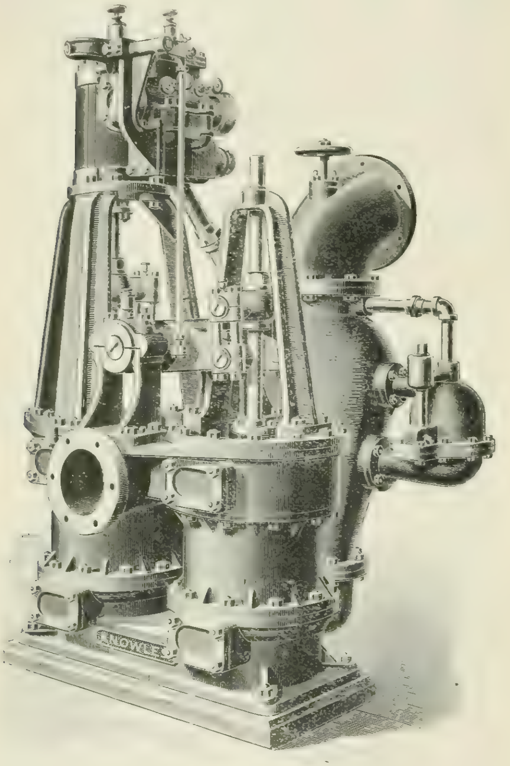
NOTE.—These schedules are made up on sun time. Where standard time is used and it varies considerably from sun time, the proper deduction or addition must be made to all the times here given.

Static Electricity and Printing.

For years printers, and others handling textile and other kinds of fibrous materials, have been troubled during cool or windy weather with static electricity, at times the electricity being so troublesome as to make it necessary to stop the machinery many times a day. In printing it often happens that two feeders are required to get the paper down to the grippers. Even then the trouble is only begun, for at times the paper will cling so tightly to the cylinder that it has to be torn off, or, if successful, in leaving the cylinder, it may cling to the fly and cause another stoppage of the press and a loss of time. At the fly table the paper is delivered in such an irregular and uneven manner that much time, patience and labor are required to straighten it out to be worked, cut or folded. At other times it clings so tenaciously to the other sheets that the ink is transferred. The trouble is not in any particular kind of paper, although some kinds become more readily electrified than others. Among electricians who have made this a matter of study is Mr. L. E. Bathrick, 29 West Thirteenth street, New York, who was called upon in the winter of 1883 by the president of one of the largest printing houses in New York and asked to devise something to aid them in getting rid of the electricity which causes so much trouble. After experimenting 18 months, a means for dissipating static electricity, not only in the pressroom, but elsewhere, was discovered, and since then this method has never failed to accomplish its object. The invention consists in the employment of a fibrous material charged with a fluid whose nature is not divulged by the inventor. These are placed in the path of the sheets or material in which the electricity is present in such a manner that it is dissipated, thus obviating the trouble that would otherwise result.

Knowles Air Pump and Jet Condenser.

The style of vertical single acting air pumps, in combination with a jet condenser, illustrated, manufactured by the Knowles Steam Pump Works, 95 Liberty street, New York, is applicable to all kinds of condensing engines, in connection with electrical and other power plants. It has shown high efficiency under all kinds of service, due, partly, to the vertical single acting air cylinder, which produces a continuous flow of the condensing water and vapors in one direction, doing away with the intermittent action produced in a double acting pump, and partly to the perfection of the valve gear, which controls the pump when running at any speed. The motion of the valve, which is adjustable, even while the pump is in operation, is taken from the beam connecting the two air buckets through the medium of crossheads and links, and is transmitted by means of a connection and bell crank to a small *D* slide valve. On the rod of this valve are placed two adjustable collars, which can be adjusted to shorten or legthen the stroke of the pump at pleasure. This valve controls an auxiliary steam piston which, in its turn, moves another ordinary *D* slide valve, distributing steam to the main steam cylinder. The valves in the buckets and valve plates are not of the old-fashioned beam engine type, but consist of a large number of small disc valves that are more efficient, and whose aggregate area is greater than a single one. The condenser has an attachment that is almost indispensable, and consists of an automatic device for preventing the condensing water from rising above a certain height in the condenser, and so obviating any possibility of serious damage through flooding the cylinders of the main engines with water. Without the condenser this air pump is also very effective for marine engines, in which capacity it has already done excellent service.

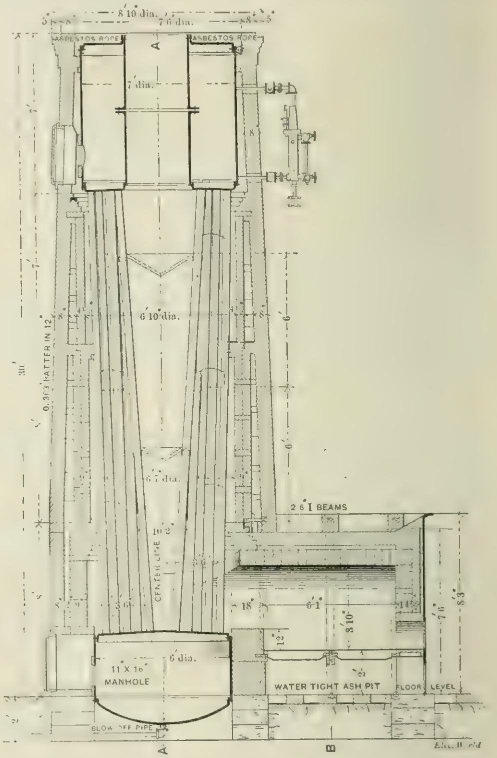


Air Pump and Jet Condenser.

The Cahall Vertical Boiler.

The vertical water tube boiler we illustrate is manufactured by the Aultman & Taylor Machinery Company, of Mansfield, O., for which H. E. Collins & Company, Bank of Commerce Building, Pittsburgh, Pa., are sole agents in the United States. As will be seen it consists of two drums arranged one above the other and connected with four-inch vertical tubes which are expanded in the drums at each end. The upper or steam drum has an opening through its centre for the exit of gases; as the water line is only about a foot above the bottom of the drum, this leaves five feet of vertical heating surface above which slightly superheats the steam, thereby precluding any possibility of priming.

A feature of the boiler is the external circulating pipe which leaves the upper drum below the water level and is carried down outside the brick work to a point just below the tube sheet of the lower drum, where it enters. The circulation in this pipe is very rapid and positive in one direction; the water in the pipes connecting the drum ascends to the steam drum, delivering there a mixture of water and steam, the former of which then enters the circulating pipe, is carried down to the mud drum, and then again arises with its mixture of steam. As this mixture of steam and water coming from the upper ends of the tubes in the boiler is in the proportion of about half steam and half water, the water in the boiler consequently circulates 218 times through the course described before finally becoming steam. This steady and rapid circulation insures a uniform temperature of water in all the tubes, thus relieving the boiler from the possibility of destructive strains from unequal expansions.



The Cahall Vertical Boiler.

The boiler rests upon four iron brackets riveted to the lower or mud drum, supported upon four piers of the foundation, the entire structure standing without contact with the brickwork, and thus allowing the freest expansion.

The gases escape through a central opening in the upper drum, the upper tube sheet having a circular opening in its centre, which leaves a central open space between the tubes which gradually narrows to the bottom of the tube sheet. In this space, which is in the form of an inverted cone, deflected plates are introduced which cause the gas to be alternately thrown out and in throughout the whole heating space, giving them a sweep at nearly right angles to the tubes and thereby extracting the heat from the gases until they become very nearly of the temperature of the water contained in the boiler.

The external combustion chamber is roofed over with a heavy fire-brick arch which becomes incandescent shortly after the boiler is fired and radiates directly on top of the green coal, its intense heat thus enabling the Caball boiler to be operated, it is claimed, with less smoke than other boilers. The space occupied by these boilers is very small, that for a 250-hp boiler being 9 feet front by 17 feet long.

A Model Isolated Plant.

The new building of the Philadelphia *Inquirer*, as a part of its modern equipment, contains a very complete lighting and power plant, designed and installed by W. C. McIntire & Company, Philadelphia, and for which the Eddy Electric Manufacturing Company, Windsor, Conn., supplied the dynamos and motors.

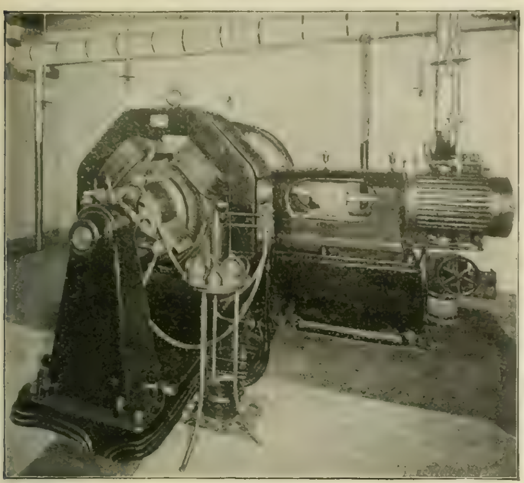


Fig. 1.—One of the Generators.

The generating plant consists of two 40-kw lighting generators and one 90-kw 220-volt power generator. Each machine is directly connected to a McEwen engine running at a speed of 300 revolutions per minute. The connection between the engine and dynamo shaft is by means of a rigid flanged coupling securely fastened by bolts, no bearing being used between the armature of the dynamo and the engine box. An outboard bearing is provided, however, at the commutator end of the machine, which is supported by a pillow block made adjustable to the engine bearings by means of wedges. The bearing sleeve itself is of the spherical self-aligning type, and self-oiling from a reservoir in the box.

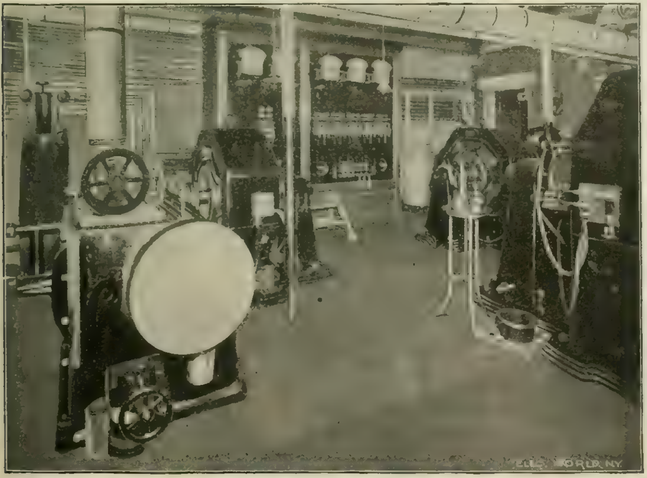


Fig. 2.—Dynamo Room.

The armatures are of the iron-clad type, with conductors consisting of copper bars of rectangular section embedded in slots cut in the core. These bars are connected at the ends by copper strips, bent spirally and so arranged as to prevent any crossing of conductors, and the bars are placed in micanite tubes before inserting into the slots, the slots and core being also thoroughly insulated by micanite. The whole armature and commutator are thoroughly ventilated by apertures and ducts for the free passage of the air. The field coils are wound on metal spools, the series and shunt coils occupying separate compartments.

The machines are all highly finished and present an appearance in accord with the attractive engine room in which they are placed. Their behavior, too, is fully on a par with their appearance, and they handle their full loads and often large overloads without the least sparking or undue heating. The whole combination of engines and dynamos makes so little noise and vibration as to be hardly noticeable in the adjoining rooms.

Directly belted to each printing press is a slow speed motor, that on the largest press being of 40-hp at 475 revolutions, and those on each of the smaller presses of 25-hp at 52 revolutions. These motors are of the multipolar consequent pole type, with steel frames and ironclad armatures. Their construction is such as to insure, as far as possible, against danger from accident, either mechanical or electrical.

The type-setting machines are run by one 10-hp motor, and the stereotyping room has also a 10-hp motor. The high speed plate-lift connecting the stereotyping and pressrooms is operated by a 5-hp motor. The photographers' room and pneumatic tube system each employ a 2-hp motor, and a ½-hp motor operates the lift from the basement to the first floor; this latter is a link-belt device, and carries papers from the pressroom to the delivery room.

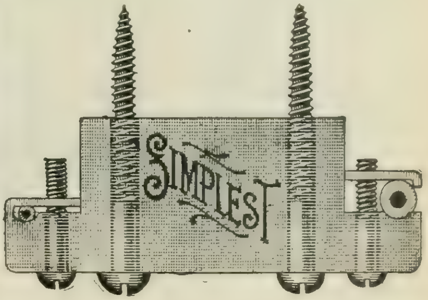
While the 2 kw lighting machines have had ample opportunity for showing their excellent qualities under severe circumstances, frequently carrying large overloads for several days, in the shape of current for displaying lighting, it remained for the 90 kw machine to prove the worth of its design. This machine furnished current for the motors in the building, including those running the presses. It is a frequent occurrence for the full load to be thrown on and off several times a minute, and at no time during its run does it have a steady load, a condition peculiar to large press work, the sharpness and frequency of the variations exceeding those of the well-known trolley load. Under these trying conditions, these machines behaved admirably, sparking at the commutator being imperceptible; their behavior was the wonder and admiration of all the visitors present at the recent formal opening of the new building. The regulation also came in for a generous share of well deserved praise.

The switchboard in the engine room was furnished by W. C. McIntire & Company, and is composed of two panels of slate: one for the generators and feeders of the lighting system and the other for the power system. These panels contain Weston illuminated dial switchboard instruments, switches for dynamos and feeders, ground detector, fuses, etc. The wiring of the building is done on the three-wire convertible system with a switch so arranged on the switchboard that the load may be thrown on the regular three-wire system of the Edison Illuminating Company or on either one or both of the lighting generators. When the system is operated from the lighting dynamos it becomes virtually a two-wire system at 110 volts. There are altogether 1,200 lights installed throughout the building.

In like manner the panel for the power system has a double-throw switch so arranged as to permit the motors throughout the building being thrown on the street circuit should the power dynamos be disabled by any cause.

A New Cleat.

A new cleat, which we illustrate herewith, is being placed on the market under the name of the "Simplest" by the Electric Heat Alarm Company, 145 High St., Boston, Mass. The claims made for the cleat are its simplicity on account of comprising only one piece; it anchors the wire without cutting or bending it, and there is no breakage; it can be put up independently of the wire and can be used for nearly all sizes of wires, and two different sizes may be used with the same cleat. It is also claimed that by actual test it proved to be a better insulator than the usual two-piece cleats.

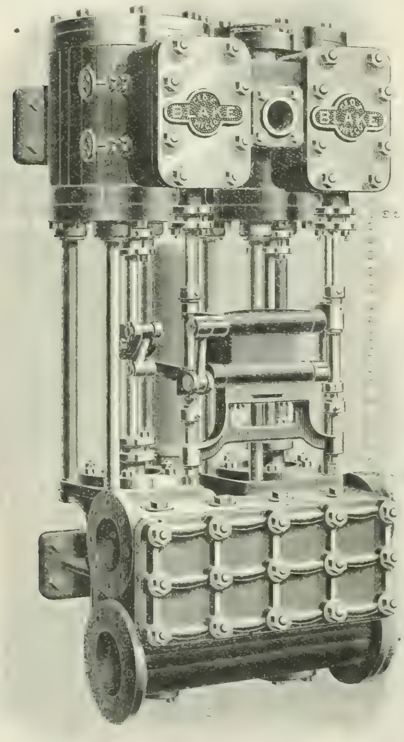


New Single Cleat

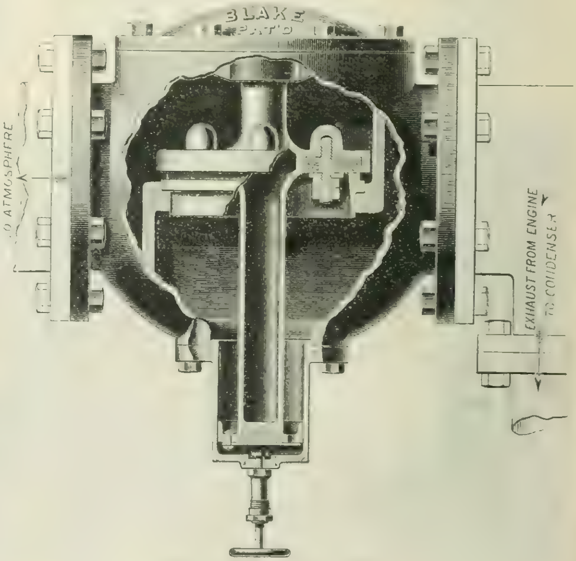
Vertical Duplex Boiler Feed Pump and Automatic Exhaust Relief Valve.

In our last issue we published a description of the Blake vertical twin air pump and jet condenser, manufactured by the Geo. F. Blake Manufacturing Company, 95 Liberty street, New York, as applied to the four 1,000 hp engines at the West End electric power station in Chicago. The accompanying engraving represents the Blake vertical duplex boiler feed pumps that are used so satisfactorily in the same plant. This is the same type of pump that has been adopted by the United States Navy in all the later large naval vessels, where they have made a good record on account of their efficiency, compactness and minimum weight. The valve is of the regular standard Blake construction, arranged with adjustable collars on the valve rods, which can be set to regulate the length of the stroke of the pump, even when running. The area through the water valves is unusually large, thus permitting a high rate of speed, an important advantage in case of fire or other emergencies. The removal of the bonnet shown on the front of the water cylinder gives ready access to all the valves, the latter being held in position by a special form of valve bolt, which is designed to also hold the seats in place and prevent any possibility of their coming loose. The water cylinders are supplied with adjustable packing, which can be replaced by removing the follower plate from the upper side of the water piston.

In addition to the outfit of air and boiler feed pumps at the Chicago station, the Blake automatic exhaust relief valve is used on the generating engines. As its name implies, it is an automatic device for relieving the back pressure in the low pressure cylinders of the main engines, in case of the failure of the vacuum due to air leaks, cessation of the injection water, or accident to the air pumps. Its use and operation is so clearly shown in the cut that a brief description only is necessary. As soon as the pressure of the accumulated steam in the exhaust pipe reaches the pressure of the atmosphere, the valve rises quickly, allowing the steam to escape and the engine to run non-condensing. As soon as the vacuum is again obtained, the pressure on the top of the valve tends to close it. Instead, however, of suddenly dropping to its seat, as an ordinary check valve would do, and pound itself to pieces, the valve gently seats itself, through the compression of the condensed steam beneath the dash pot piston. This water slowly escapes through the annular space provided by a loose fit between the piston and the dash pot, and cushions the valve before it seats itself. The valve face is made of a material that is not affected by heat, and does not adhere to the seat and cause the valve to stick when the relief is needed. The valve was originally designed to only go with the Blake condenser, but as it has proven so successful for other purposes the above company has placed it on the market for general application.



VERTICAL FEED PUMP.



AUTOMATIC EXHAUST VALVE.

Electric Heating.

Among the other modern conveniences that will be employed on the Metropolitan Elevated Electric Railway, of Chicago, are electric heaters, for which the contract has been awarded to the Central Electric Heating Company, 26 Cortlandt St., New York. The form of the heater is shown in Fig. 1, and the method of wiring in Figs. 2 and 3, the former being for motor cars and the latter for trailer cars. The first cars to be heated will be 55 motor and 100 trailer a cars,ll of which are 38 feet 8½ inches long, 7 feet 10 inches wide, with a centre height of 8 feet 6⅝ inches and a side height of 6 feet 7¾ inches. The capacity of the cars is 2,233 cubic feet and the total glass surface 208 square feet. As shown in Figs. 2 and 3, each car will have 12 heaters connected four in series and each of the three series of each car on an independent switch. With all the circuits on the heaters will take 144 amperes at 500 volts, or 7,000 watts. The heaters placed at the side seats are to be 34 inches long, 7 inches high and 2½ inches wide. The other four are smaller, being 21 and 7x2½ inches. Each series of the larger heaters takes 2,600 watts and the four smaller 1,800. It is estimated that with all of the heaters on the car temperature will be kept between 56 and 60 F. when the outside temperature is from zero to 10 degrees F.

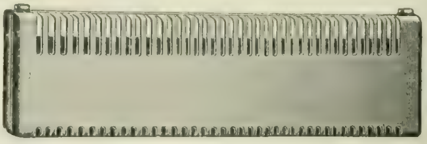
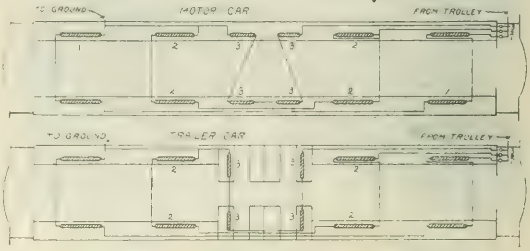


FIG. 1.—HEATER UNDER CROSS SEATS.



FIGS. 2 AND 3.—MOTOR AND TRAILER CAR WIRING.

Test of Steam Pressure Regulator on a Dynamo Engine.

The accompanying chart shows a result that will be interesting to steam users. The chart was made by two Edson recording gauges. For convenience of comparison, two lines—one indicating the initial or boiler pressure, and the other the delivery pressure—were traced on one chart. The figures at the top of the chart indicate the hour. The light parallel lines represent the scale of pressure—ten pounds to each space. The upper irregular line, varying from seventy pounds to nearly ninety pounds, indicates the boiler pressure—about forty-four pounds—as regulated by a four-inch Foster pressure regulator, supplying steam to three dynamo engines and one steam siphon. Two engines were running constantly, while one engine and the siphon were operated intermittently. This efficient regulation was obtained by the new Class "W" pressure regulator, manufactured by the Foster Engineering Company, Newark, N. J.

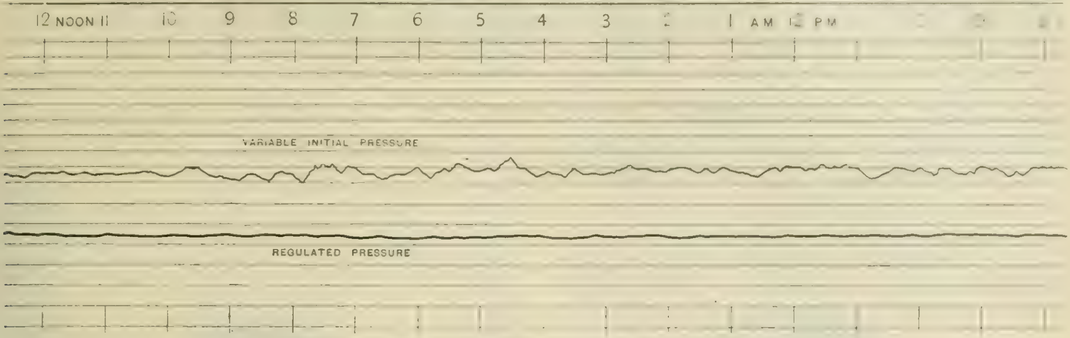
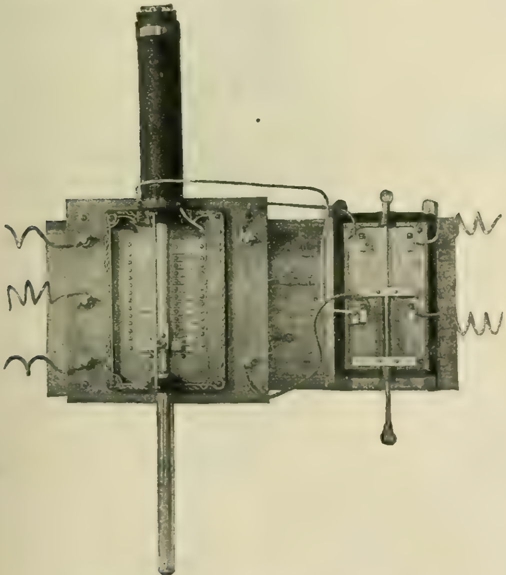


DIAGRAM SHOWING OPERATION OF PRESSURE REGULATOR.

Automatic Switching Apparatus for Electric Elevators.

The apparatus we illustrate, manufactured by the Automatic Switch Company, Equitable Building, Baltimore, Md., is intended to be used in connection with the ordinary freight elevator, driven by an electric motor, and started and stopped by the ordinary belt shifting arrangement, with the motor running continuously in one direction, whether the elevator is in operation or not.



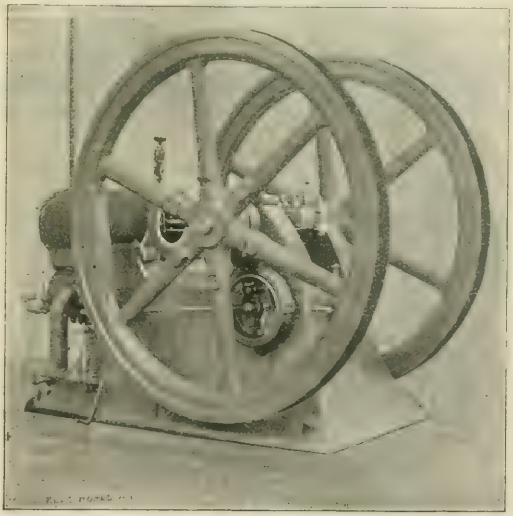
ELECTRIC ELEVATOR AUTOMATIC SWITCH.

Experience has shown that many freight elevators are in actual use only a small fraction of a working day, and that the rest of the time the motor is running idly, consuming current and wearing out bearings and commutator simply to be in readiness when needed. The automatic motor starter and knife edge switch shown is designed to obviate the useless running of the motor, by making it possible to start and stop it from any floor of the building, by simply pulling a cord connected to the knife switch. The starter, which is controlled entirely by the current, gradually cuts out the starting resistance when the current is turned on the motor, and immediately replaces the same when the current is turned off. With this arrangement it is only necessary to run the motor when the elevator is needed, and when idle all wear and tear and consumption of current are done away with. It is stated that one user of the apparatus saved on his regular meter bill for current nearly $200 in one year, and another cut his current bill down from $35 to $7.50 per month.

New Type of Gasoline Engine.

In view of the constantly increasing demand for gas and gasoline motors, the Quast Gas and Gasoline Engine Company, Bucyrus, O., has brought before the public a new type of engine of this class, which we illustrate. In this engine an explosion takes place at every other revolution, but the force of the explosion is regulated by a governor, which controls the amount of fuel entering the cylinder. The engine operates under the well-known four-cycle principle.

The novelty in this engine is that there is but one valve, which accommodates both the suction and the exhaust. It is of the rotating type, being automatically oiled and operated in such a manner that cleaning, grinding and re-grinding are not necessary.



GASOLINE ENGINE.

The ignition of the compressed charge in the cylinder, is effected by an electric spark, which, without question, is the best possible way. The Quast ignitor consists of two small electric cells, which are especially constructed for this purpose. The spark is so strong and effective that, so far, the speed of the engine has not been high enough to cause it to fail to ignite, although the engine experimented with, a 12-hp actual, was running at 950 revolutions a minute, exploding every other revolution. There is absolutely no smell to the igniting device, and the chemicals of the cells need not be replenished for two years, but the cells have to be connected to an electric circuit, either incandescent or arc, for about three hours every six months, which can easily be done, the life of the cells themselves being about six years.

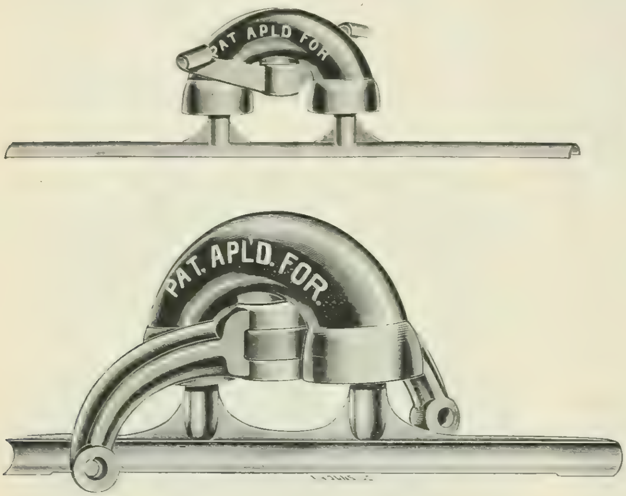
A small oil pump, worked and controlled by the governor, draws gasoline from the underground oil tank to the engine, and forces it into the air mixer, no vaporizer being used; this takes place only during the outstroke of the engine piston when it is drawing in a charge.

Owing to the valve and igniting arrangement the engine can be run with safety at a very high speed, and has given great regularity. Various tests made have given a gasoline consumption of ⅝ of a gallon per horse power per 10 hours. One of these tests lasted three days.

Efficiency, economy, quiet and smooth running, general reliability combined with simplicity and neatness of design are the chief points claimed for it. The engine is started without any delay, and the speed and the point of ignition are regulated without stopping the engine. For electric lighting this has the qualifications of steadiness and high rate of speed, which has so often been lacking in other forms of the same class.

New Trolley Wire Hanger.

A new line of overhead railway material is being placed upon the market by the Thompson-Brown Electric Co., 97 High St., Boston, Mass., of which we illustrate two forms of insulated trolley wire hangers. In these hangers the common fault of ears breaking under severe strains has been reduced to a minimum, by attaching them to the bell in two places instead of one. The bell is in the form of a bent tube with expanded ends, and the two lugs are joined together and run entirely through this tube. In manufacuring, the ear with the connecting lugs is cast first, and the bell is then cast around the arch formed by the two lugs joined together, thus obviating any possibility of the ears becoming detached from the bell by breaking of insulation or unscrewing, as is very often the case in other forms of hangers. The insulation consists of hard rubber, and is completely protected by the metal bell. It is claimed that the simplicity of the design eliminates all machine work, thus enabling this type of overhead material to be manufactured in a thoroughly first-class manner, at considerably less cost than other forms.



TROLLEY HANGERS.

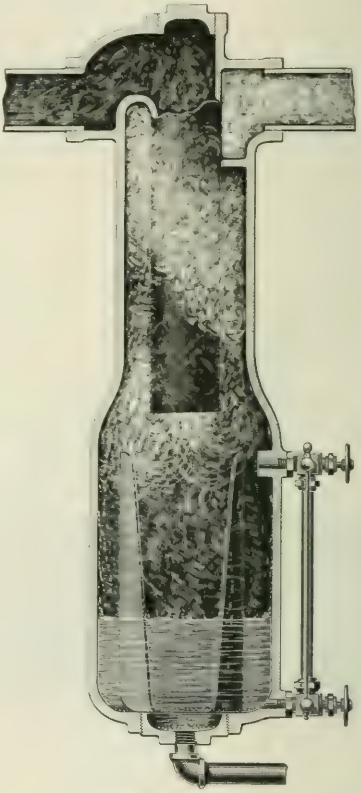
A Large Power Transmission Plant.

The Pelzer Manufacturing Company, of Pelzer, S. C., has contracted with the General Electric Company for a three-phase electric transmission plant that will be exceptionally large and interesting. At the generating station, three miles from the cotton mills owned by the company, there will be three slow speed generators of 750 kilowatts each, directly coupled to water wheels. These dynamos will generate current at a potential of 3,300 volts, and the current will be fed directly to the transmission wires at this pressure. The transmission line will consist of eighteen No. 00 wires, this size having been selected in preference to larger wire to reduce the line drop as much as possible under the existing conditions. At one mill will be located a 400 hp synchronous motor receiving current directly from the wires. There will be, in addition, more than twenty induction motors in various rooms. Of these, fourteen will be 110 hp motors, and the others will be of various sizes, from 5 to 75 hp. In a sub-station will be located nine 160 kilowatt transformers for the motors, and for 1,200 incandescent lights for the mills. Two electrically operated blowers, of three hp each, will be used for cooling the transformers.

Test of a Steam Separator.

Prof. R. C. Carpenter, of Cornell University, recently made a test of a Stratton separator and in his report states that "the results show that this apparatus is practically perfect and removes all the moisture that can be taken from steam by mechanical means." This separator, which is manufactured by the Goubert Mfg. Co., 14 Church St., New York, is of the type largely employed on United States men-of-war, and is shown in vertical section in the accompanying illustration.

In making the tests Prof. Carpenter surrounded a portion of the steam pipe leading to the separator with water, in order that as great a percentage of moisture as possible might be present in the steam. The discharge of steam from the separator was led to a surface condenser where it was condensed and carefully weighed; the drip of water discharged was led to a barrel standing on a scale and also accurately weighed. A throttling calorimeter was placed in the discharge steam pipe of the separator, and measurements showed that while the steam supplied to the separator contained from 5 to 21 per cent. of moisture that leaving it contained in every instance less than 1 per cent. The separator was worked up to its full capacity and there was no appreciable reduction of pressure.



STEAM SEPARATOR.

Night Navigation in Indian Waters.

Some interesting experiments have been lately carried out, says the *Indian Engineer*, on the s.s. "Scinde," with regard to the possibility of night running in the Sunderbunds by the aid of the electric search light. Recently a large party assembled on board to witness the trial run of the plant (which consisted of a 25,000-cp projector worked by a Marshall's vertical engine and dynamo placed on the upper deck) off Koila Ghat. The search light was thrown on different vessels down the river with the long-distance lens on, and then put on the bank with the diverging lens. The trial proved in every way satisfactory, and she left Calcutta the next morning, making a most successful run to Naraingunge, on the Brahmaputra, and back in twelve days.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Jan. 26, 1895.

GENERAL ELECTRIC continues in its undemonstrative course, though there have been developments of consequence enough to lend a deal of strength to its quotations. The management of the company has realized, at length, the necessity of checking, to some extent, the recent onslaughts made on its credit, and the directors, after a five hours' session on Wednesday in Boston, issued this manifesto: "Whereas, various printed statements (favorable and unfavorable) regarding this company and its business, have heretofore appeared, most of them in a manner calculated to give the impression that they are issued either with the sanction of this company, or from information furnished by its officers; and, whereas, In point of fact, and almost without exception, such statements, if made, are unofficial, and while often having some foundation in fact, are so inexact as to be to a great extent misleading; now, therefore, be it resolved, that the Board of Directors desires to caution the public against assuming that any casual statements, whether favorable or unfavorable, emanate from sources competent to furnish information respecting this company; and resolved, further, that this board now state for the information of stockholders that the company is entirely free from floating debt. Since the date of the last annual report the company has purchased $1,127,000 of its debenture bonds, using for this purpose the proceeds of various accounts and assets which have been liquidated since the date of the said report." Relative to the last-mentioned matter—the purchase of debenture bonds—it can be stated that $100,000 of these bonds were bought within very recent days. The company put by $40,000 in December for interest and set aside a little more for another deposit, and still has over $400,000 in bank to meet notes payable of $2,827 and endorsments of $35,000, a total of $37,827. The cash balance over this indebtedness is more any day than the bills or accounts payable in the auditor's office. Meantime, business continues to improve. Everywhere contracts are being placed. For instance, the Pittsburgh branch has just been awarded the contract to put an electric power plant in the Great Southern Hotel at Columbus, O., at its bid of $10,000. Other like important sales have also been made or are being concluded.

WESTINGHOUSE ELECTRIC issues have developed no new features of interest, although they betray no signs of weakness, by reason of the momentary wane of interest in their doings. The company secured a very important contract this week, the West End Street Railway Company of Boston placing with it an order for 269 motors. The price is said to be an extremely low one—less than $250 per motor being the figure mostly mentioned—but in such quantities and on a cash basis, that there is money in the deal for the Westinghouse Company. The 6 per cent. scrip of the company has slackened off a little; 97 is bid where a few weeks ago 98 was freely offered. Only a limited quantity, however, finds its way to market, and transactions are not very significant.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	128	130
Edison Electric Ill., New York	100	98	100
" " " Brooklyn	100	108	110
" " " Boston	100	124	128
" " " Philadelphia	100	120	125
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	35	40
General Electric	100	33⅛	34
General Electric, pref	100	67	70
Westinghouse Consolidated, com.	50	31¾	32⅛
" " pref	50	49⅛	50
BONDS.			
Edison Electric Ill., New York	1,000	108	109
Edison Electric Light of Europe	190	75	85
General Electric Co. deb. 5's	1,000	90⅛	91

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	191⅛	192
American District Telegraph	100	35	40
American Telegraph & Cable	100	92	93
Central & South American Telegraph	100	102	105
Commercial Cables	100	140	145
Erie Telephone	100	49	50
Gold & Stock Telegraph	100	106	110
Mexican Telegraph	100	180	190
Mexican Telephone	100	75	80
New England Telephone	100	67	69
New York & New Jersey Telephone	100	97	98
Postal Telegraph-Cable	100	50	55
Western Union Telegraph	100	87¼	87⅛

AMERICAN DISTRICT TELEGRAPH stock came into unusual notice this week by reason of the fight for control that developed at the annual meeting this week. It has been claimed, ever since earnings have been falling off, that there is too much Western Union in the company and that American District interests are frequently sacrificed to Western Union. The latter corporation owns but 4,000 of the 40,000 American District shares, and yet it has five of the thirteen directors and all the officers. The Western Union people say the diminution of general business is responsible for the decrease in earnings and that it is of great value to the American District to have the privilege of distributing Western Union messages for which it gets 3 cents a message. Whatever the merits of the controversy, the Western Union people won the day and re-installed practically the old Board of Directors in charge of the American District Company. The annual report shows gross earnings for the year of $538,288, a decrease of $97,698. The total net revenue was $68,411 a decrease of $31,649, as compared with 1893, making the total surplus $109,101. The dividend of 1 per cent. paid in May, 1894, called for $38,440, leaving a net surplus of $70,660 applicable on December 31, 1894, for dividend purposes. No action has as yet, however, been taken in the matter.

ERIE TELEPHONE AND TELEGRAPH stock is very quiet. Its officers, however, draw atttention to the fact that, notwithstanding the dull times, the company shows a net gain of 770 subscribers for the fiscal year ending December 31, 1894, as against 107 for 1893.

EDISON ELECTRIC ILLUMINATING of Boston continues to rule strong. It now is quoted dividend-on, the directors this week having ordered a distribution on February 1 next of 1½ per cent.

ELECTRIC TRACTION STOCK MARKET prices continue to hold firm, though there is very little open buying just at present. A good many transactions are, however, being made on the quiet, and there is a deal of gossip to lend diversion to the various sales and purchases. Long Island and Brooklyn Traction, especially the former, are still under the weather on account of the continuance of the strike on their lines, and the bonds of their various consolidated lines have weakened a little. In Boston the buying of West End common continues, and the New York traders insist that it is for New York interests who are seeking control. Among out-of-town stocks dealt in here, Worcester Traction is firm, upon the declaration of a 3 per cent. dividend, payable February 1, while Columbus Street Railway is strong on the showing made by the annual report just published. The net income during 1894 was $297,448, a gain over 1893 of $93,559, and the road, after paying a first dividend of $45,000, has a surplus of $75,800. The floating debt, amounting to $450,834 at the beginning of the year, has been entirely paid off, leaving the company free of all floating debt with a cash surplus in the treasury. A quarterly dividend of 1 per cent., available February 5, has been declared, and the road promises to pay at least 4 per cent. during the year.

PHILADELPHIA TRACTION has been conspicuous in the Quaker City trading. The strength of its quotations is attributed to the expectation that net profits during the coming year, after rental and interest, will amount to $1,500,000, or 10 per cent. on the present capital stock. This, however, is shortly to be increased to $20,000,000, the proceeds of the new $5,000,000 issue to be used for trolley improvements. Duquesne Traction (Pittsburgh) is also strong upon a report that the long expected dividends are at length to be begun at the rate, it is stated, of $1 per share or 2 per cent. It has been earned, and the money is in the road's treasury.

ELECTRIC TRACTION STOCKS.

	Bid.	Asked
Union Ry. Co. (Huckleberry)	120	130
Brooklyn Traction, pref	58	62
" " com	11	13
Long Island Traction	11⅛	12
Rochester St. Ry	36	38
Columbus St. Ry	45	50
Louisville St. Ry. pref	87	88
" " " com	37	39
Cleveland Electric Ry.	59	60
Cleveland City Ry.	68	70
North Shore Traction	23	25
New Orleans Traction	14½	16½
New Orleans Traction pref	56½	59
Worcester Traction pref	77	80
" " com.	12⅛	14
Metropolitan Traction, Philadelphia	96⅛	97
Philadelphia Traction	86½	87
People's Traction	45⅛	46
Binghamton R. R. common	100	—

BONDS.

	Bid.	Asked
*Union Ry. 1st. mtge 6s.	105	108
*Westchester Electric 1st. mtge. 5s.	98	101
Rochester St. Ry. 1st. 5s.	95	97
*Columbus St. Ry. 1st 5s.	95	97
Columbus Crosstown 1st. 5s.	95	97
*Binghamton Railroad Co. 5s	99	100

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*With accrued interest.

Electric Construction & Supply Co., com.	15	7⅛	10
" " " " pref.	15	7⅛	10
Fort Wayne Electric	100	1⅛	2

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*Ex div.

Special Correspondence.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, January 26, 1895.

WEIR & COMPANY will open a sales store at 225 Dutton street, Lowell, Mass., on February 1, 1895, and carry a supply of general electrical goods and contract for all kinds of electrical work.

THE BRADBURY-STONE ELECTRIC STORAGE COMPANY, Lowell, Mass., has elected as its president, Hon. John C. Burke, of the law firm of Marshall, Burke & Marshall.

MR. GEO. HAMILTON POOR, manager of the W. S. Hill Electric Co., Boston, and Miss Jennie Euphrasia Campbell, were united in marriage January 16, and have just returned to Boston after a brief wedding trip. Mr. Poor has gained for himself universal popularity and hosts of friends throughout the electrical fraternity, who will, with us, wish for him and his charming bride complete and uninterrupted happiness and prosperity.

MR. A. W. TOPPAN, formerly with the General Electric Co., as meter expert and salesman, is now representing in New England the Thompson and Allen Co., of Philadelphia, arc light supplies, and also the Commercial Electric Co., of Indianapolis, dynamos and motors, with office at 65 Sudbury st, Boston. Mr. Toppan is a hustler and is well acquainted with the electrical field in New England. He will also make a specialty of handling second-hand electrical apparatus of all kinds.

THE SIEMENSHALSKE ELECTRIC COMPANY Chicago, is now represented in New England at No. 31 Milk street, by Mr. Henry C. Radford and Mr. Hollis C. Spaulding, both of whom are well and favorably known. Mr. Radford was for a number of years identified with the Edison company and the General Electric Co., while Mr. Spaulding will be remembered as the first manager of the motor department of the Thomson-Houston Co., with which for a long period he was conspicuously connected.

THE THOMPSON-BROWN ELECTRIC COMPANY, Boston, is introducing a new and varied line of street railway appliances and specialties, of which they have already an abundance, and still more to come, and all of which are the inventions of Mr. Geo. Thompson, president of the company. The specialties will undoubtedly attract quick attention and recognition from the trade, combining as they do extreme cheapness and thorough efficiency, added to which the company has taken the agency of the well-Known Harthan tower wagon. The company is doing an excellent business, and with these new specialties occupies an enviable position for pushing and cultivating the trade.

MR. H. C. HAWKS, president of the Anchor Electric Company, Boston, has just returned from an extended business trip, visiting agencies of the company, establishing new agencies and looking after business generally, which he says shows a gradual and continued improvement, the outlook all around in the electrical trade arguing a brighter, steady and healthy future. The Anchor company is certainly forging ahead rapidly, and every day shows increased business. The three large front windows of the salesroom of the company have been rendered extremely attractive the past week by a conspicuous display of specialties—veritable "Hawkeye" views of the interior of the establishment.

PITTSBURGH NOTES.

Pittsburgh, Jan 26, 1895.

LAST WEEK was dividend week among the local electric railroads. The West End Passenger Railroad Company declared a semi-annual dividend of 1 per cent., the Pittsburgh, Allegheny and Manchester Traction Company 2½ per cent., the Citizens' Traction Company a semi-annual dividend of 3 per cent., and the Second Avenue Traction Company a dividend of 1 per cent.

THE STUPENDOUS CONTRACT of moving the Westinghouse electric works from their old location on Garrisson alley to the new plant at East Pittsburgh is rapidly progressing. A small army of workmen are already employed there. The electric railway motor department is now in full operation, and every day other departments are being removed from the crowded shops in Pittsburgh. About 300 feet of the upper floor of the warehouse has been converted into the general offices of the company, where all the officers and clerks will be located. This arrangement will greatly facilitate the office work, because it will place the offices and works in close proximity. The sheet-iron department, the blacksmith shop, carpenter shop, as well as the drying and dipping departments, are now being completed and it is expected that after Feb. 1 the process of removal will be conducted more rapidly than heretofore.

THE WESTINGHOUSE MACHINE COMPANY some time ago purchased a large tract of land adjoining the site where the new works of the Westinghouse Electric and Manufacturing Company are located, and the machine company is now making arrangements for the erection of a new plant. The Westinghouse machine works are at present situated on Penn avenue, in this city, and when the new plant is completed the company will make a specialty of the manufacture of high-class engines for the operation of electric generators. The new works will consist of a main building 610 feet in length, and 230 feet wide, in addition to which a blacksmith shop and power house will be constructed. The site for the new works is at East Pittsburgh on the Pennsylvania Railroad about twelve miles from this city. The Westinghouse interests are all gradually being concentrated there. With the completion of the machine works, the Westinghouse air brake shops, the Westinghouse Electric and Manufacturing Company's works, the plant of the Fuel, Gas and Manufacturing Company, all companies of which Mr. Westinghouse is president, will be located together.

THERE HAS BEEN a great deal printed in the local papers, as well as in some of the electrical journals, regarding the awarding of the electric light contract by the city of Allegheny. This matter has now been hanging fire since last August, and to-day it is just as much unsettled as ever. The facts in the case are simply these: Allegheny City advertised for bids on an addition to their arc lighting plant, and when the bids were examined it was found that the Westinghouse Electric and Manufacturing Company and the Western Electric Company were the lowest bidders, there being a difference of $1,600 between them in favor of the Chicago concern. However, when the matter was brought before Councils it was found that in the common branch of that body a majority of the members were in favor of giving the contract to the Westinghouse Company, for the reason that in view of it being a home concern, and also because they believe the Westinghouse apparatus to be superior, the local bid was cheaper, and they voted in favor of the Westinghouse bid. Select Council, on the other hand, looked at the matter differently, and they awarded the contract to the Western Electric Company. In this manner the affair stood until a conference committee was appointed, composed of members of both Councils. This committee awarded the contract to the Westinghouse Company, and as far as Councils were concerned, the affair was settled. It now remained for the Mayor of Allegheny to approve the action of Councils. But, contrary to expectations, he vetoed the ordinance giving the contract to the Westinghouse Company, and the result is that the matter stands to-day where it was six months ago. It has been an interesting contest so far. The Western Electric Company was represented by Mr. Chase, of the New York office, and the Westinghouse Company by their various local representatives.

WESTERN NOTES.

Branch Office of The Electrical World,
936 Monadnock Building, Chicago,
January 26, 1895.

THE METROPOLITAN ELECTRIC COMPANY recently received a letter from a well-pleased customer, in which he stated that for the first time in all his experience with supply houses, every article was received in splendid condition and just as ordered. Considering that the invoice of goods embraced nearly everything in the Metropolitan's catalogue, they naturally feel proud of this compliment.

THE FITZSIMMONS TELEPHONE COMPANY, of Cincinnati, has secured the order for telephones in the new Springfield (O.) exchange, taking it from seven competitors. A public exibition was given, the Fitzsimmons winning easily. It was a very decided victory.

THE DEARBORN ELECTRIC COMPANY'S little catalogue is meeting with much favor. It is handsomely gotten up, and in such shape that a man cannot help wanting to keep it close to him.

THE CHICAGO BELTING COMPANY seems to be one of the houses that has taken special pains to be ready for the expected acttivity in Spring work. It has a fine line of belting for engine room work, and is well equipped to handle it.

HENRY L. PRATHER has opened an office in the Monadnock Block, where he will make Western headquarters for the well-known Cleveland firm of Dorner & Dutton.

MR. FOREE BAIN, an electrical engineer well known in the South and West, has opened an office in the Monadnock Building, Chicago, and extends a cordial invitation to his friends to call on him. He is making a specialty of designing machinery in which electricity is applied to new uses to hasten and cheapen the process of manufacture in the industrial arts. He also devotes considerable time and is meeting with success as an expert in patent causes.

General News.

NEW INCORPORATIONS.

THE GOFFSTOWN ELECTRIC LIGHT AND POWER COMPANY, of Goffstown, N. H., has been incorporated.

THE BOUDREAUX DYNAMO BRUSH COMPANY, Chicago, Ill., has been incorporated with a capital stock of $25,000.

THE INTERSTATE TELEPHONE COMPANY, Kansas City, Mo., has been incorporated by C. B. Riley, George McLean and George J. Twiss.

THE VICKSBURG ELECTRIC LIGHT COMPANY, Vicksburg, Miss., capital stock $125 000, has been incorporated by Joseph Hirsh, Chas E. Armstrong and others.

THE ST. LOUIS TELEPHONE COMPANY, Clayton, Mo., capital stock $50,000, has been incorporated by M. B. Greensfelder, E. W. Warfield, O. H. Benois, and others.

THE DANVILLE TELEPHONE COMPANY, Danville Ill., has been incorporated by Elliott E. Boudinct, Wm. W Tobey and John White. The capital stock is $25,000.

THE E. S. KAROLY ELECTRICAL CONSTRUCTION COMPANY, Chicago, Il., capital stoc $12,000, has been incorporated by E. S. Karoly, V. Merriman and J. H. Weber.

THE MISSOURI TELEPHONE MANUFACTURING COMPANY, St. Louis, Mo., capital stock $2,000, has been incorporated by Isidor J. Kusel, Russell Parker and others.

THE CARTERSVILLE LIGHT AND POWER COMPANY, Cartersville, Ga., capital stock $100,000, has been incorporated by P. W. French, F. P. Symonds, W. E. Merrill, and others.

THE NEWMAN CANNING AND ELECTRIC LIGHT COMPANY, Newman, Ill., capital stock $14,000, has been incorporated by R. Thomas, Joseph Vandine, L. E. Root, W. J. G. Pound and J. H. Scotten.

THE YORK TELEPHONE COMPANY, York, Pa., capital stock $10,000, has been incorporated by C. A. Eisenhart and others, for the purpose of constructing, purchasing, or leasing telephone lines, etc.

THE BATSDORF CONSTRUCTION COMPANY, St. Louis, Mo., capital stock $10,000 to $50,000, has been incorporated by Harry Batsdorf, Helen E. Batsdorf, Julia E. Rood, Thos. S. Rood and Thos. C. Vance.

THE SNOQUALMIE FALLS ELECTRIC POWER COMPANY, Snoqualmie Wash., capital stock $2,000,000, has been organized to transmit electrical energy from the falls of the Snoqualmie River to Seattle and other points.

THE ASSOCIATED WATER, GAS AND ELECTRIC LIGHT COMPANY, Nevada, Mo., capital stock $25,000, has been incorporated by F. J. Tygard of Butler, as president, and C. F. Stratum as secretary and treasurer.

THE OAKLAND RAILWAY COMPANY, Royal Oak, Mich., capital stock $50,000, has been incorporated by George Hendrie and others to construct and maintain a street railway between Royal Oak and Detroit and Pontiac.

THE AMERICAN BUREAU OF ELECTRICAL ENGINEERING INFORMATION AND EMPLOYMENT, Chicago, Ill., has been incorporated by Clinton F. Woods, Francis E. Drake and P. Malden. The capital stock is $1,000,000.

THE SPIRAL WIRE COMPANY, Portland, Me., capital stock $1,000,000, has been formed to do electric lighting, and to supply electric power. Wm. C. Burnham, Jas. W. Briggs and Gorham Gray, Boston, Mass., are the promoters.

THE ELECTRIZED-AIR MEDICAL COMPANY, Milwaukee, Wis., capital stock $50,000, has been incorporated by E. J. Harrison, H. O. Brown and E. D. Valentine, all of Milwaukee, to manufacture and sell Dr. Harrison's invention of electrizing air.

THE RAWSON ELECTRIC COMPANY, Elyria, O., capital stock $50,000, has been incorporated to purchase, manufacture and sell telephones, electrical supplies; construct telephone lines, etc. H. C. McKinley, J. B. Coffinberry and T. M. Brush are the organizers.

THE NANTUCKET ELECTRIC COMPANY, Nantucket, Mass., capital stock $20,000, has been incorporated to generate and supply electricity for light, heat and power. Fred. H. Porter, president; John R. Bacon, treasurer, and W. A. Clark, Jr., are the promoters.

THE LINDNER AND REMIG MANUFACTURING COMPANY, New York, has been incorporated by Ernst Lindner, New York; Theo. H. Mulch, Mt. Vernon, and Philip W. Remig, Brooklyn, N. Y., to manufacture gas, electric, water, steam and other fittings and fixtures.

THE TRI-STATE TELEPHONE AND TELEGRAPH COMPANY, Cincinnati, O., capital stock $250,000, has been incorporated by M. S. Forbus, Chas. W. Baker and others, for the purpose of operating a telephone and telegraph business in the States of Ohio, Indiana and Kentucky.

THE MOUNTAIN STREAM WATER COMPANY, San Diego, Cal., capital stock $10,000,000, has been formed to deal in water and water rights, operate water works, and operate electric light and power plants. J. M. Howells, Chicago, Ill.; John D. Works, Lewis R. Works, San Diego, Cal., are interested.

THE WELLSTON AND JACKSON BELT RAILWAY COMPANY, Wellston, O., capital stock $500,000, has been formed to construct and operate or acquire a railroad to be operated by steam, electric, or other motive power. Harvey Wells, J. C. Clutts, Chas. L. Currier, A. D. Lutz and F. H. Alfred are the promoters.

TELEGRAPH AND TELEPHONE.

BLACK ROCK, ARK.—Address the Mayor concerning the establishment of a telephone system.

LUMBERTON, MISS.—A company has been organized to construct a telephone line to McComb City.

PETERSBURG, VA.—Address W. M. Habliston for information regarding the proposed telephone system.

DE SOTO, MO.—W. H. H. Thomas and others will establish a telephone exchange. The capital stock is $2,000.

WAUSAW, WIS.—Wausaw business men are making an effort to establish a telephone system in that city to connect it with neighboring towns.

ELECTRIC LIGHT AND POWER.

WELLS, MINN., is considering proposals for a municipal plant.

NEWBERG, ORE.—An electric light plant will probably be established.

SWEET SPRINGS, MO., is making an effort to establish an electric light plant.

DANSVILLE, N. Y.—The electric light plant has been sold for $8,000 to Chas. H. Rowe.

BILOXI, MISS.—The Biloxi Electric Light Plant has declared a dividend of 10 per cent.

BIRMINGHAM, ALA.—It is reported that a $200,000 electric light plant is to be established.

ORLANDO, FLA.—An effort is being made to secure a franchise for an electric lighting plant.

LEWISTON, ME.—Address the Mayor concerning the establishment of an electric light plant.

TOPEKA, KANS.—Address the City Clerk regarding the establishment of an electric light plant.

LENOIR CITY, TENN.—The Lenoir City Car Works has let the contract for its electric light plant.

TROY, ALA.—Address the Mayor concerning the improvement of its electric light and water works.

DALLAS, TEX.—C. Warfield and others are endeavoring to secure a franchise for an electric light plant.

MONTREAL.—There is a prospect of the Montreal Street Railway building a belt line to University street.

NEWMAN, GA.—Address the Mayor concerning the purchase of the Newman Light and Power Company's electric light plant.

NORTH TORONTO.—The Town Council is applying to the legislature for power to purchase the Metropolitan Street Railway.

LANCASTER, PA.—A company is being organized with a capital stock of $5,000, to establish an electric light and power plant.

CLEVELAND, TENN.—Address the Mayor regarding the [illegible] of bonds for an electric light plant and water works.

ROCK RAPIDS, IOWA.—It is rumored at Rock Rapids that Joel W. Hopkins, of Cranville, Ill., will build an electric light plant here.

BALTIMORE, MD.—The Mt. Washington Electric Light and Power Company has purchased a site for its proposed electric light plant.

HOWARD CITY, MICH.—The Council has appointed a committee to investigate the advisability of purchasing the electric light plant.

IVANHOE, VA.—The Blue River Mineral Company is in the market for an electric dynamo for eight arc lights, with all necessary fittings.

CLEVELAND, TENN.—The city contemplates holding an election to vote on the question of issuing bonds on electric light plant. Address the Mayor.

THE ELECTRIC RAILWAY.

KENT, O.—An electric railway is to be built.

SAVANNAH, GA.—The Electric Railway Company has appointed a temporary receiver.

ELYRIA, O.—The sum of $35,000 has been subscribed for an electric railway between Elyria and Oberlin.

FREDERICKTON, MD.—An electric railway is proposed from Frederickton to Middletown, Md.

WALFORD, ONT.—An electric railway will be constructed in the spring. Address Dr. J. A. McLeay.

GREENSBURG, PA.—The Ligonier Valley Railroad Company will substitute electricity for steam on its road.

CLEVELAND, O.—The Cuyahoga Suburban Railway Company has increased its capital stock from $10,000 to $50,000.

VENICE, ILL.—Work on the construction of a new street railway to Madison and East St. Louis is about to be begun.

APEX, N. Y.—The construction of an electric railroad from Apex to Cannonsville, Delaware County, will soon be commenced.

PITTSBURGH, PA.—An electric railway is to be built from Pittsburgh to Washington, Pa., through the Chartiers Valley.

SIOUX CITY, IA.—The South Sioux City and Covington Street Railway will extend their lines and substitute electricity as a motive power.

WILMERDING, PA.—The Wilmerding Electric Railway has secured the right of way for an electric road to Moss Side, and work is to begin at once.

NEW LONDON, CONN.—A company is being formed with a capital stock of $200,000 to construct an electric road between New London and Norwich.

INDIANAPOLIS, IND.—The county commissioners have granted a franchise to the Indianapolis, Franklin and Greenwood Electric Railway Company.

VICKSBURG, MISS.—The Interstate Transportation Company will build a trolley electric line from its gravel pits near Vicksburg to the Mississippi River.

HILTON, N. J.—The citizens of Hilton will meet to discuss electric railway franchises on Springfield avenue. The South Orange Township Committee has been invited.

ROCKY HILL, N. J.—Montgomery township and Rocky Hill borough have granted a franchise to the New York and Philadelphia Traction Company for an electric road.

BETHLEHEM, PA.—It is said that the scheme for the erection of the Bethlehem-Nazareth electric railway is being worked secretly, and by spring time all the stock will be taken.

HELENA, MONT.—The Helena Rapid Transit Line has been consolidated with the Helena Electric Railway Company and is now known as the Helena Power and Light Company.

WEEHAWKEN, N. J.—A proposition is on foot to tunnel the Palisades, so as to establish a direct communication by electric cars between North Hudson and the West Shore ferry at Weehawken.

GETTYSBURG, PA.—The Gettysburg Electric Railway Light, Power and Heating Company has been sold to J. L. Murphy, of Chicago, and John Connelly, of Philadelphia, for, it is stated, $250,000.

WESTCHESTER, PA.—S. M. Patterson, of the Pennsylvania Traction Company, proposes to take out a charter, in the near future, for a proposed electric railway from Westchester to Unionville and Kennett Square.

WALTHAM, MASS.—At a recent meeting of the Board of Aldermen a right was granted to the Newton Street Railway Company to extend its system out through Crescent Park to Forest Grove. Operations have just begun.

SPRINGFIELD, MO.—The Metropolitan Electric Railway Company has installed a power generator and metallic circuit for motors, the underwriters no longer permitting the supply of power to stationary motors from the trolley circuit.

NORTHPORT, L. I., N. Y.—The citizens of this place are agitating the question of organizing a company to operate a trolley road to the stations of the L. I. R. R., with the idea in view of eventually extending the road across Long Island.

ST. GEORGE, S. I., N.Y.—It is reported that the Staten Island Rapid Transit Company intends to extend its system through the interior of the island. Application is to be made for permission to change its motive power from steam to electricity.

BLOOMFIELD, N. J.—The receiver of the Suburban Traction Company has announced that estimates will be immediately obtained and contracts made for the change of the line of the road through East Orange and Bloomfield to the trolley system.

GENEVA, N. Y.—The Fall Brook Railway Company has refused to allow the

Geneva and Waterloo Electric line to cross its tracks; but for this objection cars could run between Geneva and Waterloo, as the poles and trolley wires have been installed.

ROCKFORD ILL.—An electric railway from Harvard to Delavan, Wis., by way of Walworth, Fontana and Geneva Lake, is contemplated by Chicago and Minneapolis capitalists. This road will connect with the Chicago Milwaukee and St Paul at Delavan.

WESTCHESTER, PA.—S. M. Paterson, of the Pennsylvania Traction Company, proposes to take out a charter in the near future for a proposed electric railway from Westchester to Unionville, thence to Kennett Square, Toughkenamon, Avondale, West Grove and Oxford.

PORTLAND, O.—The proprietors of the electric railway to Portland propose building the line through New Middletown and Petersburg to Enon Valley, Henry W. David and Zeb Currey, of Youngstown; Robt. Hilands, of Cleveland, and Surveyor Jones represent the company.

CHICAGO, ILL.—The General Electric Railway has been incorporated with a capital stock of $5,000,000. The company proposes to build and operate an extensive electric railway system, employing a new and improved underground trolley system recently invented by Henry Brandenburg.

PORTLAND, ME.—Jacob A. Winslow, A. R. Small, A. D. Boyd, and F. C. Boyd, with their associates, have formed the Portland Electric Railway Company, with authority to operate a road, beginning at the intersection of Cross and Free streets in Portland, and running to the town of Cape Elizabeth.

CHESTER, PA.—The directors of the Media, Middleton and Aston Trolley Company paid to the Chester City Council and the Supervisors of Chester County $4,100 for a right of way through the two places. It is the intention of the directors to award the contract for the construction of the road in the near future.

GREENFIELD, MASS.—A syndicate of capitalists in the eastern part of the State, headed by H. T. Prince, of Leominster, proposes building an electric road from Greenfield to Turuer's Falls, via Cheapside and Montague City, at an estimated cost of $50,000. The resident directors are F. A. Pond, F. P. Lowe, E. A. Hall and N. S. Cutler.

HACKENSACK, N. J.—The National Trolley Company has been organized with a capital of $50,000. Ex-Assemblyman Delos Culver, of Jersey City, is the president. The company will operate under the charter of the New Jersey and New York Bridge Company, and will establish electric roads between Fort Lee, Englewood and Hackensack.

FONDA, N. Y.—R. T. McKeever, superintendent of the Fonda, Johnstown and Gloversville Railroad, and Deputy State Treasurer J. Ledloe Hees, of Fonda, have purchased three horse railroads which connect the villages of Herkimer, Mohawk, Ilion and Frankfort, in Herkimer County. The roads will be consolidated and operated by electricity.

PORT BYRON, N. Y.—The people are looking forward with high hopes to the construction and equipment of an electric railroad between this place and the city of Auburn the coming season. It is understood that the rights of way have already been secured or surely will be in the near future, and that the necessary capital is backing the enterprise.

WINDHAM, N. H.—Mr. Barker, of Windham, is to introduce a bill in the New Hampshire Legislature to incorporate the Merrimac Valley and St. Lawrence Railway. This bill contemplates the construction of an electric railroad from the State line, connecting with the Lowell, Lawrence and Haverhill system, through Nashua, Manchester, and on up the Merrimac Valley.

WASHINGTON, D. C.—Mr. Turpin, of Alabama, has introduced a bill in the House to incorporate the Washington and Brighton Railway Company. The incorporators are Horatio Browning, Clarence F. Norment, Levi Woodbury, Wm. B. Webb, F. P. May and R. F. Baker. The company proposes to operate an electric railway between Washington and Chesapeake Bay.

EAST ORANGE, N. J.—At a meeting of the East Orange Township Committee Mr. Watson Whittlesey, receiver of the Suburban Traction Company, was present, and stated that he had received word that day from the Chancellor, permitting him to expend $14,000 in equipping the company's line through East Orange with electricity. The work is to be commenced at once.

PHILADELPHIA, PA.—The Board of Directors of the Philadelphia, Castle Rock and West Chester Railway Company will probably begin work on the new trolley road on the Philadelphia pike this spring. Their plan is to build a trolley road from Sixty-third street to Castle Rock, and ground has already been purchased near Llanerch station for the erection of a power house.

ATLANTIC CITY.—At a meeting of the stockholders of the Brigantine Transit Company, the old board of officers were re-elected, and it was decided to double track the line, which operates from the Atlantic City inlet to the upper end of Brigantine Beach. This is the road which follows the contour of the beach, near the ocean, and which has so frequently been damaged by high tides.

MERRIMACK, N. H.—A bill to incorporate the Merrimack Valley and St. Lawrence electric road has been presented to the New Hampshire Legislature by Representative Wilcomb, of Chester. The incorporators are Thos. Sanders, Chas. Corliss, E. B. Fuller and others. The road is the scheme of Chas. Corliss of Haverhill, and will pass through Salem, Windham Hudson and Nashua.

BROAD LAKE, PA.—A large meeting of taxpayers of Whitpain township, Montgomery County, was held for the purpose of considering the advisability of allowing the Ambler Electric Company to lay tracks along the Upper Dublin Turnpike, from Conshohocken to Ambler. After a thorough discussion the meeting favored the trolley, the only opposition relating to the route proposed.

NYACK, N. Y.—It is rumored that a new telephone company known as the Rockland County Telephone Company has been organized by a number of well-known citizens for the purpose of giving this county complete telephonic communication. It is said the certificate of incorporation has already been filed with the Secretary of State at Albany. Nyack, Haverstraw, Suffern, Hillburn, Sloatsburgh, Spring Valley and other places are to be connected.

CLEVELAND, O.—It is reported that Congressman T. L. Johnson and his brother, Albert Johnson, are to retire from the board of directors of the Cleveland Electric Street Railway Company, which, with the Cleveland City Cable Company, now controls every street car line in the city. It is believed that if the Johnsons retire the cable and electric companies will consolidate. This would result in a deal of about $20,000,000, and effect a street-car monopoly in Cleveland.

NEW BRIGHTON, S. I., N. Y.—The Staten Island Terminal Electric Company will build a surface railway for a distance of about three miles from the ferry landing at St. George, and form a loop with such spurs and branches as may be necessary, which loop shall terminate in the village of New Brighton. The capital is $50,000, and the directors are H. Bergholtz, De F. Van Vleet, F. C. Cornell, D. Thomson, and others, of Ithaca; F. Leuchter, Port Richmond, S. I., and Grant Crabtree, New Brighton, S. I.

DOYLESTOWN, PA.—A mass meeting of taxpayers was held in the Blue Bell Hotel, at Ambler, to protest against the granting of a trolley franchise over the Upper Dublin and Blue Bell turnpike, as requested by the Norristown and Ambler Electric Railway. The trolley people have secured the franchise of several streets in Ambler borough, and desire to build a connecting link to Harmonville, etc. The refusal of the supervisors to grant the right to build on the turnpike probably will cause an indefinite postponement of the line.

NEWTON, MASS.—The Newton Street Railway Company is anxious to obtain a location for a single track road from its present line on Washington street, Newton, to Watertown, thence to Bemis, and through various streets to connect with the line now operated by the company between Watertown and Waltham. It is understood that there is practically no opposition to the plan, and that it will be very generally favored at the hearing to be given by the Newton Board of Aldermen on February 18th.

KUTZTOWN, PA.—W. A. Heller and A. E. Swartz, representing the new Traction Company of Allentown, which is to conect that city with Kutztown by means of an electric road, has made application to the borough County of Kutztown for permission to lay tracks on the streets of that town. The entire right of way from Allentown to Kutztown has been secured. A car and power house will be erected in Kutztown, and it is also proposed to furnish the borough with electric lights.

DETROIT, MICH.—The Detroit Street Railway is having plans prepared under the direction of J. F. Randall, its electrical and mechanical engineer, for a power house and three large car barns. For the power house it will purchase direct-coupled generators and cross-compound Corliss engines. There will be four engines of 750 horse-power each, and two of 250 horse-power each. It is estimated that this will furnish double the power required for the entire system. For further partiulars address the engineer or H. A. Everett, general manager Detroit Railway Company, Detroit, Mich.

PALMYRA, N. Y.—The completion of the Palmyra electric light plant has been delayed by a farmer who owned both sides of the road and who refused to allow poles to be set on his property. As a consequence Senator John Raines has introduced a bill in the legislature providing that electric light and power companies may acquire land by condemnation proceedings if the price of land cannot be agreed upon by the owner and the corporation which proposes to purchase. If this bill goes through the railway company will operate with current brought from Littleville to Palmyra, a distance of five miles.

SPRINGFIELD, MO.—L. C. Hatler, of Bolivar, Mo., has organized a company for the purpose of building a telephone line between Springfield and Bolivar. This would give Springfield telephone connection with Bolivar, Fairplay, Humansville, Hermitage, Pittsburgh, Urbana, Buffalo and Conway, Mo., as there is being constructed a line from Bolivar to Fairplay and Humansville, which will connect with a line in operation from Humansville, via Hermitage, Pittsburgh, Urbana to Buffalo, in Dallas County, and Conway in Laclede County, and it is only a question of a very short time when there will be a connecting line with Lebanon, which will give communication with all north Missouri.

NEW GERMANTOWN, N. J.—The stockholders of the Rockaway Valley Railway have elected as directors J. N. Pidcock, W. N. Sutton, J. E. Melick, W. Amiz, H. M. Lovenign and others. The railroad extends from Whitehouse to the top of the hill near Peapack, and before the extensions were made to Mendham and Morristown its expenses exceeded its receipts by about $10,000 a year. The branch of the road running to Peapack may be abandoned. The company has under consideration the project of building a new line to Somerville, to connect with the Central at that place, and extend two miles further to South Somerville. Surveys have already been made and construction will probably begin at an early day.

ELKHART, IND.—The Indiana Electric Railway Company, which recently purchased the Elkhart Electric road and the tracks and franchises of the Indiana Electric Power Company, is now rebuilding the old Elkhart road, and as soon as spring opens will commence on the interurban line between Elkhart and Goshen; 60-pound T rails are being used. The road will be about 25 miles long, and one of the best in the West; it has about three miles of track now ready, and will be completed by July 1. It will be operated by steam and water. W. W. Hatch has the contract for both track and overhead work. The New Castle Car Company, of New Castle, Pa., is furnishing the cars, and the steel is being supplied by the Illinois Steel Company, and the overhead material by the Ohio Brass Company.

MISCELLANEOUS NOTES.

THE BROOKLYN ELECTRICAL SOCIETY will give a smoking concert at 315 Washington street, Brooklyn, on Thursday evening, January 31, beginning at 8 p. m. This society is composed of over 100 young men interested in various branches of the electrical trade and includes also a number of steam engineers, who are anxious to acquire a knowledge of electricity. The object of the entertainment is to provide suitable headquarters, with a library and laboratory that can be available night and day to members.

MR. A. H. BAUER, chief electrician of the Pullman Company, died in New York on the 15th inst., and was buried in Baltimore two days later. Mr. Bauer for a number of years was in the telegraph service of several different companies, and from 1882 to 1888 was engaged in the storage battery business, with the Electric Storage Battery Company of Baltimore and the Electrical Accumulator Company of New York. In the latter year he was appointed electrician of the Pullman Company, a position which he occupied at the time of his death. Mr. Bauer was well known in electrical circles, where his untimely death will be much regretted.

THE BUFFALO NIAGARA FALLS POWER GRANT.–The Buffalo Electrical Society has received the following invitation to act in conjunction with the Buffalo Street Committee and Committee of Councilmen: "Your association is herewith earnestly requested to act in conjunction with the Street Committee and the Committee of Councilmen in regard to the petition of the Niagara Falls Power Company for a grant to bring their power into this city. As this question is of extraordinary importance and proportions I shall feel obliged to you to appoint an advisory committee from your association to act with the committee having this subject under consideration and to secure a speedy solution thereof for the best interests of the city at large. The next meeting has been set down to the 24th inst., at Chamber of the Board of Councilmen at 2.30 p. m." President Frank C. Perkins appointed the Executive Committee of the society to act in this capacity, and a meeting of the committee was held to consider the invitation, which was accepted, and the Society will assist the Street Committee in every way possible.

Trade and Industrial Notes.

THE LEWIS & FOWLER MANUFACTURING COMPANY, of Brooklyn, went into the hands of a receiver on January 9, 1895.

THE PERKINS ELECTRIC SWITCH MANUFACTURING COMPANY, Hartford, Conn., reports that it is very much overrun with work and has commenced running nights in its machine shop in order to catch up with its orders.

THE PITTSBURGH WHITE METAL COMPANY, 1,739 Liberty street, Pittsburgh, Pa., makes nine grades of anti-friction metal, and has been engaged in the manufacture of this material for ten years. The metals are not given fancy names, but graded according to their quality and corresponding prices charged.

PIEPER BROTHERS, San Jose, Cal., have issued a neat catalogue containing descriptions and illustrations of the Pieper electric dental engine and motor. These apparatus are the result of many years' experience and give evidence of skillful design.

CHAS. A. SCHIEREN & COMPANY, 45 Ferry street, New York, have issued a 72-page pamphlet devoted entirely to the subject of belts. Much information relating to belt leather and the manufacture of belts is given that will interest users of belts.

J. E. HAM, general agent for Kerite wires and cables, reports having contracts for over one hundred and fifty miles of telephone cables of standard Kerite construction. One order covers an amount of cable only exceeded by the order of the N. Y. C. & H. R. R., which was for 300 miles of Kerite cable.

L. F. JORDAN, Portland, Me., has issued a sheet containing illustrations of the various forms of the Jordan mast arm. Among the claims made are that this mast arm is simple in construction, durable, neat, with a greater range of position, and enabling more lamps to be trimmed in a given time than any other arm on the market.

THE PRENTISS TOOL AND SUPPLY COMPANY reports that it has on hand at its salesrooms, 115 Liberty street, New York City, a number of rare bargains in second hand metal working machinery, all first-class, high-grade tools, many of which have never been used. All of them are as complete as when they left the factory, and many have chucks, tools and special attachments.

THE FOSTER ENGINEERING COMPANY, of Newark, N. J., has just received an order from the Anheuser-Busch Brewing Association of St. Louis, for two of the largest reducing valves it has ever made. They are of the new "Class W" construction, 18 inches and 14 inches in size, respectively. There are few, if any, pressure regulators of equal size in any service.

THE PHILLIPS ELECTRIC MOTOR COMPANY, Paterson, N. J., calls our attention to the fact that in mentioning its orgaization in our last issue, the company was erroneously styled the "Phillips Electric Water Company." The principal business of the company will be the manufacture of single phase alternating current motors.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has closed its purchasing agent's office in Philadelphia, and hereafter all purchases will be made from the office of the company at East Berlin, Conn. Mr. W. E. Stearns, who lately occupied the position of purchasing agent, has severed his connection with the company and accepted an important position with the Pennsylvania Steel Company

HUGO REISINGER, 38 Beaver St., New York, has issued a circular stating that as it has come to his knowledge that inferior qualites of arc lamp carbons are continually being offered and sold to the trade under the spurious denomination of "Electra" carbons, he calls special attention to the word "Electra" having been duly registered by him as a trademark for his high grade direct and alternating current carbons.

THE STOREY MOTOR AND TOOL COMPANY, manufacturers of the Storey motor and dynamo, whose headquarters has heretofore been located in New York City, announces that hereafter its main office will be at the factory in Philadelphia, corner of York street and Sedgeley avenue. A New York office will, however, be maintained at 120 Liberty St., with Mr. N. M. Garland in charge.

THE ONONDAGA DYNAMO COMPANY, Syracuse, N. Y., has recently completed an 82-kw generator for the Westminster Coal Company, Wilkesbarre, Pa., where it will be used to operate a mine locomotive and a drilling apparatus at that company's mines. The machine was recently started up at the Onondaga Works in the presence of a number of electricians, without a hitch of any kind being encountered.

THE ELECTRIC APPLIANCE COMPANY, Chicago, reports itself very well pleased with the recent convention of the Northwestern Electrical Association, held at Milwaukee, and claims to have received some substantial returns in the way of orders, and meeting new trade which gives promise of future business. It feels very much like refuting the statement which is so often made that convention meetings are monopolized by the supply men, at least so far as it refers to the Northwestern meetings, as it certainly has not held true of any of the meetings at which they have been present.

THE NICHOLSON FILE COMPANY, Providence, R. I., has issued a handsomely cloth bound and profusely illustrated catalogue of its manufactures of files, rasps and special tools used in connection with these. The pages are 11 by 14 inches in size and the fine quality of paper used brings out admirably the well executed and handsome cuts. Many of the pages containing cuts of tools are relieved by colored views at the bottom or corner showing among other matters of interest the various factory operations of manufacturing files, etc., and also the various buildings and offices of the company.

THE CENTRAL MANUFACTURING COMPANY, of Chattanooga, Tenn., is meeting with much success in its sales of pole line material and electrical moldings. The company manufactures yellow pine cross arms and insulator pins and brackets of split live white oak timber. It also makes genuine black locust pins and electrical moldings, and claims that its goods are equal to any in the market. Government tests made of its yellow pine cross arms showed a tensile, cross breaking modulus and breaking load of 21,300, 13,300 and 5,060 lbs., respectively, as against 10,700, 6,620 and 3,820 lbs., respectively, with cross arms made of white Northern pine.

THE GERSON ELECTRICAL COMPANY, 809 Sansom St., Philadelphia, was incorporated January 7, for the purpose of manufacturing electrical specialties. The company is capitalized at $50,000 fully paid, of which $5,950 has been subscribed to, and $5,500 has been paid in cash, the latter being over 10 per cent. of the capitalization, and on January 24 purchased the partnership of Louis Jay Gerson and Charles Heritage, doing business under the name of the Gerson Electrical Company, office situated at 809 Sansom St. In purchasing this concern, the corporation has assumed all assets and liabilities of the partnership mentioned.

THE SPERRY ELECTRIC RAILWAY COMPANY, of Cleveland, has received the following letter from W. B. Brennan, superintendent of the Chicago General Electric Railway Company: "Your electric brake which is attached to our new cars with new style Sperry controller is creating a 'furore in the electric railway world in Chicago. There isn't a day but what I have men connected with the electric railways here to examine your brake. I had a representative of the St. Paul and Minneapolis Street Railway Company here yesterday, and he was very anxious to learn what the cost of the brake would be and also how he could replace some of their old Sprague No. 6 motors with Sperry whaleback and electric brake."

E. P. ROBERTS & CO. AND H. W. WOODWARD, Cleveland, O., announce that they have made arrangements through which they may be of much assistance to intending exhibitors during the coming Electric Light Convention in that city. Space has been engaged in the Hollenden Hotel, and exhibits from firms will be received, exhibited and returned, without requiring the presence of any representative of the firm. Competent attendants will be present to distribute circulars for each exhibit, take addresses, etc. In addition a souvenir directory and street railway guide and map will be published, descriptive of Cleveland and its electrical interests, in which advertising space will be reserved for business announcements.

THE STANDARD UNDERGROUND CABLE COMPANY, PITTSBURGH, PA., held its annual meeting on Tuesday, January 22, 1895, and the old Board of Directors was re-elected as follows: George Westinghouse, Jr., Mark W. Watson, J. W. Dalzell, James H. Willock, John B. Jackson, George B. Hill, John Moorhead, Jr., Robert Pitcairn, Joseph W. Marsh. The gross business for the year 1894 was $963,464, which is an excess of $101,551 over the business for the year 1893. Out of the net profits for the year, four quarterly dividends of 1½ per cent. each have been paid, or $60,000 in all. The capital stock is $1,000,000, fully paid up, with a surplus of $531,000. The company has practically no debts, except for current purchases for the months of December and January. The prospects for the year 1895 are very good, the unfilled orders carried over from last year amounted to $58,000, in addition to which the third annual contract with the Philadelphia Traction Company for lead covered underground feeders has just been secured, besides an annual contract with an electric light and power company for electric light cables, which two contracts give promise of at least $250,000 worth of business during the year. The Philadelphia Traction Company has bought from the Standard Underground Cable Company about $700,000 worth of feeder cables (principally underground, but also some overhead) in the last three years. During the past year, the company has furnished many underground feeders for street railways, and had at one time four separate large contracts under construction simultaneously: two in Philadelphia, one in Boston, and one in Rochester, New York. It has in its employ a large force of experts and well organized gangs of trained workmen, experienced in and familiar with all classes of underground and overhead cable work, whether for telephone, telegraph, electric light or street railway service. In order to relieve the crowded condition of the factories, the company erected, during the past year, a two-story and basement building adjacent to its former factories at the corner of Sixteenth street, and this building will be ready for occupancy in a few weeks. The company also expects to erect, early this spring, a large four-story and basement building on the site of one of its present factory buildings, and when this is completed it will have an extensive and conveniently arranged plant, with sufficient capacity to keep up with any demands that may be made upon it for a good many years.

Business Notices

WOVEN WIRE BRUSHES.—The Belknap Motor Company, of Portland, Me., are the patentees and manufacturers of the best woven wire commutator brush on the market.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

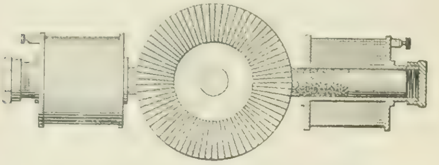
VALUABLE TELEPHONE PATENTS.—(United States and foreign.) Absolutely controls use of telephone systems for interior purposes. Will lease, sell, or form company to operate same. Address F. Post Office Box 1 546, Philadelphia, Pa.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JANUARY 22, 1895.

[In charge of Wm A. Rosenbaum, 177 Times Building, New York.]

532,760. INCANDESCENT LAMP; M. H. Branin, Lynn, Mass. App. filed April 1, 1893. The method of sealing in the lead wires of a lamp which consists in flanging a piece of tubing, sealing the wires into the unflanged end thereof, sealing the end of the flange to the neck of the lamp bulb, and drawing the tube toward the lamp base.



No. 532,782.—Magnetic Brush Holder.

532,769. CALL GENERATOR CONNECTION; F. B. Cook, Chicago, Ill. App. filed November 27, 1894. This comprises a main generator normally connected with a circuit, a normally quiescent auxiliary generator; and means actuated by the operation of the auxiliary generator for automatically disconnecting the main generator from its circuit and for connecting itself in place thereof.

532,795. ARMATURE FOR DYNAMO ELECTRIC MACHINES OR MOTORS; H. Lemp, Lynn, Mass. App. filed March 29, 1890. A sheet iron disc provided with one or more perforations within the circumference of the armature windings, and one or more slots connected with the perforations and extending outward to the edge of the disc.

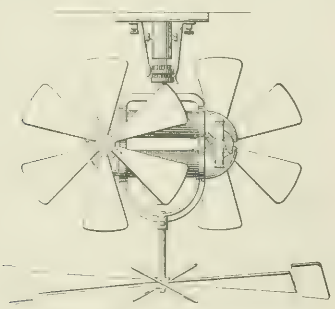
532,796. ELECTRICAL CONDUCTOR; E. D. Lewis, Savona, N. Y. App. filed June 16, 1894. An electrical conductor, oblong in cross section and grooved in one side to receive a contact wheel.

532,782. MAGNETIC BRUSH HOLDER; J. C. Henry, Westfield, N. J. App. filed December 11, 1894. The combination of a current-collecting device comprising a moving and a stationary part, and electromagnetic means adapted to cause the two parts to engage with pressure proportioned to the transmitted current.

5532,789. ELECTRIC FAN MOTOR; J. L. Ketcher, New York, N. Y. App. filed April 26, 1894. This comprises a tubular neck or stem, a motor provided with a pivot stem to enter the neck and anti-friction rollers arranged between shoulders of the pivot stem whereby it is relieved of undue friction and retained in place.

532,812. TROLLEY WHEEL; B. O. Paine, Millbury, Mass. App. filed June 11, 1894. A rotatable trolley wheel mounted to have lateral swivelling action in combination with a backwardly and forwardly swinging axle-bar horizontally journaled in the trolley pole head or fork.

532,814. ELECTRIC SAFETY DEVICE; C. T. Penton, C. C. Gartland and P. J. Casserly, Buffalo, N. Y. App. filed February 2, 1894. This consists of an auxiliary broken circuit secured to the field of a dynamo or motor at one end and to the frame at its other end, the break in the circuit being provided with carbon points which may be adjusted to and from each other so as to regulate the resistance of the auxiliary circuit and also cause the current to arc when passing from one carbon point to the other.



No. 532,789.—Electric Fan Motor.

532,821. MACHINE FOR WINDING ARMATURE COILS; J. Riddell, Schenectady, N.Y. App. filed October, 19, 1894. The combination of a frame, a gear wheel rotating in the frame and carrying a cam, a rack reciprocated by the cam form, carrying plates rotating in the frame, and gearing interposed between the rack and the form carrying plates; whereby the reciprocation of the rack by the cam gives a simultaneous rotary reciprocation to all of the form carrying plates.

532,826. GALVANIC BATTERY; C. B. Schoenmehl, Waterbury, Conn. App. filed November 14, 1893. The combination with an insulated top, an annular recess therein, a series of openings extending through the under side of the top into the recesses, carbons arranged within the openings with their end in the recesses, and metal within the recesses surrounding the ends of the carbons whereby they are retained and the metal connections between the carbons secured.

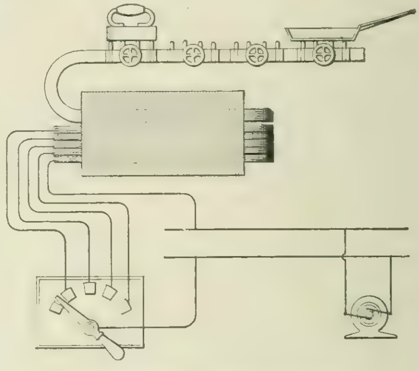
532,838. ELECTRIC WELDING APPARATUS; E. Thomson, Lynn, Mass. App. filed August 13, 1889. This consists in constructing a number of clamps in series, and an arrangement of switches whereby the clamps may all be used together or independently of each other, while they are, however, supplied with current from the same source.

532,839. ELECTRIC METER; E. Thomson, Swampscott, Mass. App. filed April 10, 1894. This comprises a vessel containing an electrolyte, electrodes therein, a second vessel adapted to collect the gas from the electrodes and to release the same upon a definite accumulation, and means adapted to vary the action of the collecting vessel in accordance with variations of temperature.

532,860. ELECTRIC ALARM MAIL BOX; E. C. T. Belding, Chicago, Ill. App. filed February 17, 1894. This comprises a mail box containing contact mechanism in circuit with an alarm in a house, a push button controlling the contact mechanism, and a secondary electric sounder inside the box in the circuit of the contact mechanism, thereby operating the push button device.

532,861. REGULATOR FOR DYNAMO ELECTRIC MACHINES; L. Bell, Boston, Mass. App. filed December 18, 1893. The method of regulating a dynamo electric machine having a separate exciter, which consists in causing the variations of speed in the armature of the main machine to effect an inverse variation of speed in the armature exciter.

532,905. TROLLEY BREAKER; W. B. Potter, Schenectady, N. Y. App. filed August 4, 1894. A metallic end piece for a trolley breaker or line section insulator, having diverging edges adapted to guide the trolley away from the insulator when it jumps away from the wire.



No. 532,909.—Electric Stove.

532,909. ELECTRIC STOVE; C. E. Roehl, St. Joseph, Mo. App. filed January 4, 1894. This comprises a transformer whose secondary coil is normally open, a series of high resistance rods in positive electrical connection with one side of a convolution of the secondary coil, the rods being grouped in sections or gangs, those of each section being connected to a common block of conducting material and a contact and adjusting spring therefor whereby the block may be thrown into and out of electrical connection with the other side of the convolution of the secondary coil.

532,930. RAILWAY SIGNAL; J. Wayland, Newark, N. J. App. filed May 23, 1894. The combination with a tread lever, shaft and clutch, of a lever loosely arranged on the shaft, a connection, weight, and a pulley arranged on the signal shaft and operated by the connection and the signal shaft.

532,979. TELEPHONE TRANSMITTER; W. A. Mason, Sumter, S. C. App. filed October 26, 1894. The combination of a series loosely leaning or gravitating carbon bars having flat sides adjacent to each other and an opening through their free ends, and a carbon electrode passing through the opening.

533,014. SIGNAL BOX; B. J. Noyes, Boston, Mass. App. filed May 27, 1892. This comprises a signal transmitting apparatus and a local alarm mechanism, the operating levers of both of which are simultaneously and automatically moved by the breaking or removal of a removable front plate.

533,015. TELEPHONE SWITCHING APPARATUS AND CIRCUIT; J. J. O'Connell, Chicago, Ill. App. filed May 1, 1894. This comprises a trunk circuit extending between each station provided with switching and looping apparatus at the receiving and trunking terminals thereof, and a disconnecting signal at the trunking terminal; means for legging the signal to one side of the talking circuit when the trunk circuit is connected with the called line; and means whereby on the disconnection of the looping apparatus at the receiving board the circuit of the signal is completed through a source of current at the receiving board.

533,038. COMMUTATOR BRUSH; M. R. Hirsch, Milwaukee, Wis. App. filed May 31, 1894. A composite sheet for the construction of commutator brushes consisting of alternate layers or films of metal and lubricating material.

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DRY BATTERIES.

In another column we print an instructive article from the pen of Dr. Böhm on dry batteries, which adds considerable information to a subject that thus far has been rather meagrely treated. It will be seen that the term "dry battery" is a misnomer, as the action of such cells is absolutely dependent upon the presence of moisture. In one of the first commercial forms of dry battery this moisture was supplied when the cell was set up for use by introducing water through an orifice provided for the purpose, but in the later types the excitant is placed in the cell in a moist state. As remarked by Dr. Böhm, the action of a dry cell does not differ from that of an ordinary voltaic cell, which explains the necessity for moisture to act as the electrolyte. The amount of moisture necessary is only so much as to supply a continuous electrolytic medium between the elements; how attenuated this medium may be is shown in the old forms of laboratory dry cells, one of which is in existence that has been continuously in operation for over two-score years, supplying continuously during that time a static charge to pith balls on an oscillating arm, the necessary moisture being derived from the air.

CRUDE PETROLEUM AS A FUEL.

The abstract we print elsewhere of a paper by Mr. A. M. Hunt gives some definite practical figures as to the value of crude petroleum as fuel compared with coal, which differ somewhat from corresponding data often printed. The tests from which the present data were obtained were made under practical conditions during the Midwinter Fair at San Francisco last year, and take into consideration several factors usually neglected. It is shown that the usual claim of great superiority of oil over coal is based upon an evaporative efficiency of a boiler unattainable in practice. The results reached in the Midwinter Fair tests show an evaporation of 14.2 pounds of water per pound of oil which, assuming the theoretical evaporation to be 20.7 pounds, gives a boiler efficiency of about 70 per cent. which is about what is commonly attained in ordinary practice. The table given is interesting as contrasting the efficiency of oil as often given with its actual efficiency, taking into consideration the economies resulting from there being no coal and ashes to handle, etc. The difference is not as great as might have been expected; with oil, for instance, at $1.50 per barrel the comparative cost of coal per ton is reduced from $5.51 to $4.94. This scarcely bears out the great claims sometimes made for savings due to these factors. From the figures given it will be seen that oil may be an economical substitute for coal where the price of the latter is high and where oil can be delivered at a reasonable cost for freight, and it is probable that these conditions apply in many cities west of the Mississippi and in parts of the South. The subject is one well worth looking up by central and power station managers where coal is dear, and to these the information in the paper of Mr. Hunt can be recommended as practical and reliable.

ELECTRICAL CONSONANCE.

The article by Dr. Pupin, printed elsewhere, is another illustration of the value of analogies in investigating or explaining an intricate subject. The phenomena of sound are so much simpler to comprehend than the phenomena of alternating circuits containing capacity and inductance, and the analogy between the two may be made so convincing, that it is surprising that more use has not been made of this method. In the present instance Dr. Pupin complements his notable investigations in resonance by one along similar lines into what, from analogy, is called electrical consonance. In the former case it was shown how by a suitable adjustment of capacity and inductance a circuit may be turned into synchronism with electromagnetic waves of a certain periodicity, while in the case under consideration an effect somewhat similar with respect to increase of current is produced by the action of one circuit electromagnetically connected with another, though the natural period of the latter is not the same as that of the impressed E. M. F. acting. Unlike the former case also, the current may be a maximum for two values, as the primary apparent self-inductance may be neutralized at either of two values for a given frequency, primary self-inductance or secondary resistance. While the present contribution of Dr. Pupin is one of much theoretical interest its practical significance is less than that of his former researches into resonance on account of the difficulty of producing the necessary adjustments. The author, while admitting this, remarks, however, that as a phase-changing device the method may be of service in the future, particularly in connection with a high tension primary circuit where a condenser could not well be directly introduced into the circuit.

THE MONOCYCLIC ALTERNATING SYSTEM.

Elsewhere we print an account of the monocyclic system of Mr. Charles Proteus Steinmetz, compiled from eight patents recently granted to the inventor. The main features of the system are the addition of a supplementary coil to the usual type of alternator generating simple alternating currents, and the employment of induction motors having primary windings similar to the armature windings of the generator. The main winding of the alternator generates simple alternating currents which supply incandescent lamps in the usual manner and furnish the working current of motors, the starting torque of the latter being obtained through the current supplied by the line connecting with the supplementary coils of the generator and motor respectively. It is shown that when the motors connected are in operation, little or no current is supplied by the supplementary wire; that under-loaded motors will supply current to this line and over-loaded motors will absorb current from it. If a number of monocyclic motors are installed it may not be necessary to have other than a simple alternator, as the supplementary current for starting a motor may, if other motors are in operation, be derived solely from the line connecting the supplementary coils of the various motors. Another method described which also allows the use of a simple alternator, consists in the employment of a motor generator, which is supplied with current from the simple alternating mains and generates an E. M. F. of displaced phase for the supplementary line, thus obviating running the latter line from, perhaps, a distant station. In addition to motor-generators for transforming phases—called phase converters—static phase transformers are also described, which seem to be identical in principle with those that formed the subject of Mr. C. F. Scott's notable paper read at the Convention of the National Electric Light Association last year. The reader will find many other interesting details in the article referred to, which strikingly illustrates the beautiful flexibility of the alternating current, while the patents furnish in themselves, it may be added, the best practical treatise on the alternating current, within the limits which the subject impose, that has yet appeared in print.

THE "DEADLY TROLLEY" IN CHICAGO.

One would scarcely think that at this day Chicago—bustling, hustling Chicago of all cities—would take up the absurd cry of the "deadly trolley," yet such seems to be the case. Recently the City Councils granted important franchises for trolley roads in streets located in the central part of the city, and immediately both editor and cartoonist sounded the alarum and called upon the public to take measures to avert a threatened calamity. In a city where, it is reported, the steam cars daily claim a victim, it is rather incongruous to raise such an outcry, particularly as experience with the steam roads should have rendered the citizens so proficient in dodging, that the trolley car, even if it possessed the dangerous character ascribed, would seem, after all, to give little occasion for alarm. In the present case, however, we are inclined to believe that the opposition to granting the franchise springs from a dislike for the unpopular personage who is to be the recipient of the favor of the Councils, which is another instance of the manner in which electric traction has to bear the burden of other evils. The most striking example of this unjust spirit is in ascribing the accidents due to the faster speed of electric cars to the motive power. If trolley cars were run at the same speed as the horse cars they have displaced, there would be little or no occasion for the cry of the "deadly trolley," for the accidents due to the electrical current employed are now so rare on account of more careful construction of lines, as to present no greater element of danger than did the horse traction system displaced. If the true cause of accidents—high speed—were not obscured by the senseless fulminations against the "deadly trolley," the public would be much the gainer, as attention would then be directed to the question of speed, which is the real matter to be considered in relation to the subject of accidents. We presume that the franchises referred to were sought because the public needs better facilities for travel in the territory covered, and if high speeds, involving danger to life, are contemplated, the remedy does not lie in refusing to grant the public any facilities whatever, but in regulating the speed. Were the question regarded from this point of view it would result in placing the responsibility where it belongs—with the public that demands rapid transit, and which now places on electric traction as a system the burden of any evil that ensues.

The National Electric Light Association.

Arrangements have been completed by the secretary of the National Electric Light Association with the New York Central and Hudson River Railroad Company for a special train to Cleveland of Wagner vestibule, parlor, dining room and buffet cars, leaving Grand Central Depot, 42d street, New York, at 9:30 a. m. Monday, February 18, running as second section of the fast mail on the following schedule: Leaving New York at 9:30 a. m.; Albany, 1 p. m.; Utica, 3:17 p. m.; Syracuse, 4:40 p. m.; Rochester, 6:30 p. m.; Buffalo, 7:25 p. m. (central time); Erie, 9:33 p. m. (central time); arriving at Cleveland, 11:55 p. m. (central time). Seats can now be secured on this train by applying in person or by letter to the office of the National Electric Light Association.

A special rate has been granted (on certificate plan) of a fare and one-third from all points in the United States east of the Mississippi River, Peoria and Chicago, Ill., to Cleveland. To obtain this rate it is necessary in purchasing a going ticket to ask the agent for a certificate, which, when properly endorsed at Cleveland, will entitle the purchaser to a one-third fare returning. That the best results may be obtained it is very desirable that delegates should make their application for space on the New York special at the earliest possible moment.

The following gentlemen have charge of transportation in their respective districts, to whom application can be made for all information: A. C. Shaw, 620 Atlantic avenue, Boston, Mass.; H. A. Cleverly, 1,018 Chestnut street, Philadelphia, Pa.; E. H. Heinrichs, Westinghouse Electric Company, Pittsburgh, Pa.; E. L. Powers, Monadnock Building, Chicago, Ill.

In addition to the papers and topics heretofore announced for the Cleveland programme, there will be a paper entitled "A New Method of Measuring Illumination," by Messrs. E. J. Houston and A. E. Kennelly. Among the topics for discussion are "Under-Writers' Rules vs. National Electric Light Association Rules," and "Practical Demonstration of Protecting Lines from Lightning," in which Mr. A. J. Wurtz will take part.

Combination Alternating and Direct Current Generators.

Expert W. S. Rugg, of the Westinghouse Company, successfully tried the experiment at Rochester last week of working three combination alternating and direct current generators in multiple arc as to both sides of the machines.

These generators furnish a two-phase, alternating current of 385 volts electromotive force from one set of brushes, which current is "stepped-up" to 2,000 volts line potential; the other set of brushes furnishes direct current at 500 volts. In the experiment all the alternating current windings were put in multiple arc on one set of bus bars, and all the direct current windings were connected in multiple on another set of bars. The result is reported as having been entirely satisfactory.

Electrical Difference of Potential.

BY WM. A. ANTHONY.

In a recent issue of THE ELECTRICAL WORLD I notice that a correspondent called in question the statement that maintaining a potential difference consumes no energy and claims that if energy is required to establish potential difference it must be required to maintain it. I do not see that this follows, for the energy required to establish potential difference is that represented by the transfer of the quantity of electricity required to charge the dynamo conductor and terminals—equal to $E\,Q$, where E is the potential difference, and Q the quantity required to charge the conductor and terminals to the potential difference E.

Suppose the E. M. F. of the machine to be one volt, and the capacity of the terminals one farad, then one coulomb must be transferred to create a potential difference of one volt. When this is done the potential difference exactly balances the E. M. F., the flow of electricity ceases and with it the consumption of energy. We may suppose the resistance, or self-induction, or both, to be such that any given time may be required to effect this transfer. If the transfer is effective in one-tenth second the average current is ten amperes, and the average rate of working ten watts; if it is effected in one second the average current is one ampere, and the average rate of working one watt. If it is effected in one minute the average current is $\frac{1}{60}$ ampere and the average rate of working $\frac{1}{60}$ watt. But in each case the total work done is 10^7 ergs. This work is done partly in heating the conductor—the armature winding—and partly against the rising potential difference. In any practical case the capacity is, of course, extremely small; the quantity of electricity transferred and the time and energy involved in the transfer are, therefore, extremely small.

But while it is true that no energy is required to maintain a potential difference once established it is not true that energy is not consumed in connection with the maintenance of the potential difference in machines of the ordinary types when running an open circuit. In a Gramme or Siemens armature the coil that connects directly to the positive brush at a high potential and the one connected to the negative brush is at a low potential. As the armature revolves the potential of a given coil will gradually change through a range equal to the E. M. F. of the machine, and as it changes a quantity of electricity must flow out of it or into it sufficient to change it to the potential due to that E. M. F. As an example, suppose a two-pole Gramme-ring machine running an open circuit at a potential difference of 100 volts. A coil at the positive brush is charged to a potential of 100 volts. It gradually loses its charge as it is carried toward the negative brush and at the end of half a revolution has entirely lost it. At the same time the opposite coil in moving from the negative to the positive brush gains an equal charge. It is exactly as though the quantity of electricity required to charge one armature coil to a potential of 100 volts flowed through the entire armature winding during each half revolution. If $q =$ the quantity required to charge one coil and n the number of revolutions per minute, $\frac{60}{2n}$ is the time of a half revolution and $\frac{q}{\frac{60}{2n}} = \frac{qn}{30}$ is the current flowing through the armature wires. If $r =$ the resistance of the armature winding considered as one continuous wire, then $\left(\frac{qn}{30}\right)^2 r$ is the power continually consumed.

In an alternating current machine on open circuit electricity is being constantly transferred back and forth from one terminal to the other, and if the machine is connected to line, the circuit still open, the electricity required to charge the line is alternately transferred through the machines from one side to the other. Suppose the line to have a capacity of one microfarad—not an excessive capacity for long distance transmission, especially for concentric conductors—and the potential to be 10,000 volts, $\frac{1}{100}$ of a coulomb is required to charge the line to this potential, and this amount must flow through the machine during every half period. If there are 250 half pounds per second there is an average current of 2.5 amperes. In other words, if the machine were connected to line through 5 incandescent lamps in parallel each requiring ½ ampere the lamps would be maintained at full incandescence.

The point I wish to make is that the energy required to establish a potential difference is accounted for by the flow of the electricity necessary to charge the conductor and is computed exactly as in any other case of electric flow. When the potential difference is established and the flow ceases there is no longer anything to account for a consumption of energy, hence no energy is required to maintain the difference.

The Record of the Year 1894 In Great Britain.

(From Our Own Correspondent.)

The past year, although by no means one of great prosperity, has not, on the other hand, been so bad as many would like to make us believe. The total volume of business transacted has not, apparently, been unsatisfactory, although, owing to the number of firms engaged in the business, there has been the natural consequences: keen competition, keeping down prices, and each individual firm's share of the total work being diminutive. Judging by the returns of the various electricity supply companies for the year ending December 31, the progress of electric lighting in this country does not, as yet, show any sign of slackening, and although some contend that the growth of central station supply checks the demand for isolated plants, there have been, so far as one can tell, a large number of orders for big isolated plants for railway stations, goods yards, monster hotels, and country houses. Ship lighting, also, is ever with us in undiminished popularity. There are, at the present moment, nearly 1,600,000 8 cp lamps connected to the mains of electricity supply companies in the United Kingdom; the lamps being almost equally divided between alternating and continuous current systems. This figure is an increase of over 400 per cent. upon the total for 1893. It is curious to note that, notwithstanding the other that has been made about municipal electric lighting, it is, judging by its lamp connections, still insignificant, compared with the electric lighting undertaken by private capitalists. At the end of 1894, the lamps connected to the mains of statutory electricity supply companies amounted to 1,200,000 in round figures; the lamps connected to the mains of municipal concerns only aggregating 400,000. This state of things, however, is entirely due to London. Taking the provinces alone, there are 36,800 lights connected to municipal concerns, against 300,000 connected to the mains of companies. Our largest concern continues to be the Metropolitan Electric Supply Company, which supplies 206,000 8 cp lamps by means of transformers in consumers' houses. The next biggest company is the Westminster Electric Supply Corporation, which supplies 168,500 8 cp on the three-wire system. The third largest concern is the City of London Electric Lighting Company, the lamp connection of which at the end of the year was 136,000, supplied by transformers' sub-stations. The total lamp connection all over the metropolis, I may remark, is not far short of one million.

Electric traction on the other hand, still remains in a state of stagnation. There has not been a single new tramway or railway brought into operation during the past twelve months, and with the exception of the steel-tube underground electric railway which is to run from Waterloo station to the City, no work of first-class importance has been commenced, nor is there any in immediate prospect. Apart from climatic and social causes which militate largely against the success of tramways in this country, there can be no doubt that the continued existence of the municipal purchase clause in its present state must inevitably act as a deterrent, not merely to the promotion of new lines, but to the adoption of any improved system of traction. Either the municipalization of the tramways must be thoroughly carried out or a free hand must be given to private enterprise. The introduction of electricity in mines, like the adoption of electric traction, still hangs fire, and for reasons of much the same character. Mining is not a profitable businses just at present, and most of the men and many of the managers have naturally a rooted disinclination to give electro-mechanical devices fair play.

The advent of the incandescent gas burner has created something like a panic on the Continent, but has not made much stir with us; it being generally considered that it is not likely to replace the glow lamp anywhere where that lamp has already been installed, and that it need not be generally feared that it will induce people to retain gas, in place of going over to electricity. Although the tone of electric business men has been a subdued one, it is probable that more sound business has been done in 1894 than in any other year.

Consolation for Cranks.

Everyone wrestling with the forces of Nature is, in a sense, says the London *Engineer*, a perpetual motion man. We cannot think, it adds, that all this means so much waste of mental energy. No man trained to think will say that he knows what is and is not impossible in the future; at the best, he can but believe.

Direct-Connected Arc Lighting Station.

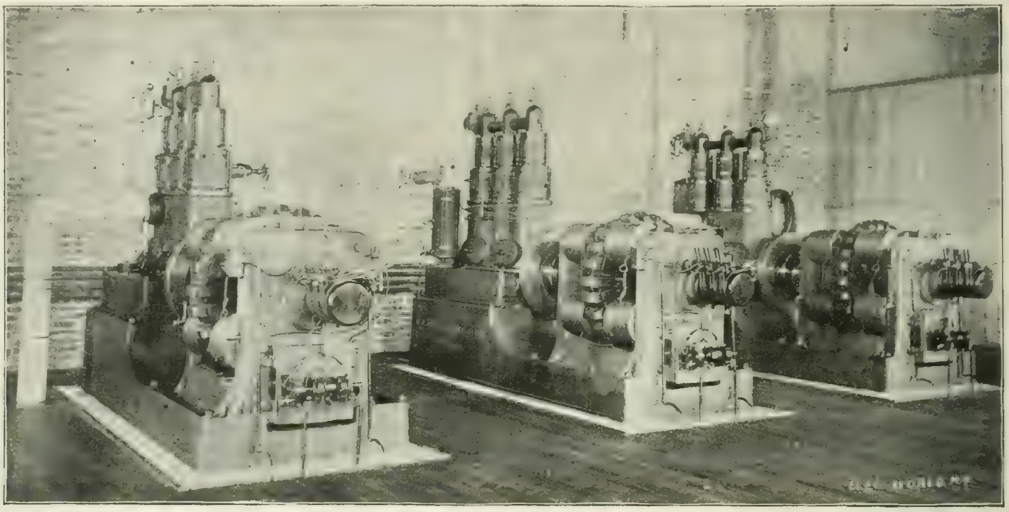
In The Electrical World of Dec. 29, appeared a brief announcement of the starting of the first direct connected arc lighting plant in the United States. We are able this week to give an illustration and fuller description of this interesting station.

The plant was installed and is operated by the Mutual Electric Light and Power Company, Chicago, the station of which is located at the intersection of Eighty-ninth and Loomis streets, about a mile from South Englewood station.

The building is 90 x 110 feet and of the best modern construction, with brick walls, terra cotta trimmings and iron roof. The dynamo room is about 40 x 100 feet and can accommodate a direct-connected plant of over 2,000 arc lamps capacity, of the type installed.

The plant at present includes three 125 arc Brush dynamos connected direct to three Willans high-speed engines as shown in the illustration; Brush-Adams 2,000-cp arc lamps, are used. Two 3,000 hp water tube boilers, built and installed by the Link Belt Manufacturing Company, of Chicago, constitute the boiler plant.

The shaft of the Willans engine is connected direct to the shaft of the dynamo by means of an insulated Brotherhood coupling, the engine and dynamo resting upon one bedplate 4 feet 6 inches x 10 feet 3 inches. The speed is 500 revolutions per minute. The manufacturers of the Willans engine guarantee as low as 21 pounds of water per horse power per hour, and expect to show even better results than this when the final tests are made.



Direct-Connected Arc Lighting Station. Interior of Dynamo Room.

The first dynamo started on the night of Dec. 17, 1894, and the last pair about the middle of January. The start was made without a hitch, and 15 minutes after the first revolution the entire load of 125 lamps was thrown on and continued to operate for the balance of the evening. The automatic regulator of the dynamo regulates so closely that any number of lights may be thrown on or off at will with impunity. The engine is very quick to govern, easily taking care of its end of the business, and thus the two work in perfect harmony and with economy, the amount of steam used being always approximately proportionate to the load carried by the engine.

This compact and efficient arc lighting plant is such an innovation in the matter of economy of floor space that its adoption in this instance will probably change the character of all future arc lighting stations, especially in cities where real estate is valuable. A space of four feet has been left between the floor of dynamo room and the ground which provides a convenient place for running wires from dynamos to switchboard and steam pipe from engine to heaters. This arrangement also provides a very easy method of installing additional pairs.

Taking into consideration this entire plant from beginning to end it embodies throughout the best machinery and best construction, and contains all the latest and best thought in the arc lighting industry.

Maltha.

Considerable litigation is now pending relating to the use of maltha or insulating compounds and paints, and the following information in regard to this material may be of interest. "Maltha" was originally a Greek word applied to soft pitch and it is still used in connection with semi-fluid bitumen, which is found abundantly at the pitch or tar springs of California. By absorbing oxygen from the atmosphere the semi-fluid mass gradually hardens into asphaltum, and it is in this manner that the great pitch lakes of California have been formed as well as the extensive asphaltum deposits of Cuba and Trinidad. There is, however, one respect in which these otherwise similar substances differ, and that is in capacity for further oxidation, which is decidedly greater in the softer varieties. The hard asphaltums are more suitable for insulation purposes, and it is of these that the so-called insulating compounds and paints are made. The soft malthas forming the basis of these electrical insulators are concentrated by distilling off the oil, after which the residue is more or less clarified by settling.

From another source we obtain the information that while the derivation of the word "maltha" refers to soft pitch, there is no evidence whatever that the word was generally used in California to designate the material found in the pitch or tar springs of that State, previous to 10 years ago, when the word was first used there in connection with the residuum resulting from an application of processes at that time first applied. This residuum was described in the patents relating to it as being a "solid residuum of the distillation of heavy grades of petroleum," which we call "maltha," and the courts have taken the view that this word was merely a "fancy" name adopted by the owners of these patents at the beginning of operation, and in no way limited to the former definitions of the same word.

There is more than one way in which these residuums may be used in manufacture, as they can be applied both by reducing the residuum to a liquid by heat and also by putting it in the form of a liquid by the use of bisulphide of carbon or other solvents. It is claimed that a long series of experiments covering many years has shown the best solvent for this purpose is bisulphide of carbon, the use of which is patented. The action of this solvent is simply that of a vehicle which passes off rapidly after fulfilling its office, which is that of depositing on surfaces the residuum which has been found so excellent a preservative as well as acid and moisture resistant.

A decision of Judge Dallas of the Circuit Court of New Jersey holds as valid a patent for the coating of paper with a residuum of petroleum by means of the process just referred to.

The Niagara Power Transmission Plant.

BY FRANK C. PERKINS.

The Niagara Falls Power Company has applied to the city of Buffalo for a franchise to supply its citizens with electric current from the Niagara Falls plant. Thirteen deeds of right of way over property between Buffalo and Tonawanda in favor of the Cataract Construction Company were filed recently in the County Clerk's office. This gives the power company an almost complete line between the northerly city line of Buffalo and the southerly line of the village of Tonawanda; each of the deeds grants the use of a 30-foot strip west of and adjacent to the property of the N. Y. C. & H. R. R. In each deed it is specified that within two years the company will construct and operate power transmission lines for power, lighting and heating purposes, at its own cost and expense, either above or below the surface, the company agreeing to furnish power to each of the property owners on the most reasonable terms for which power is selling. Where or how the power line will go through the Tonawandas has not been settled, but that rights of way are being secured between Niagara Falls and Tonawanda is known to be a fact.

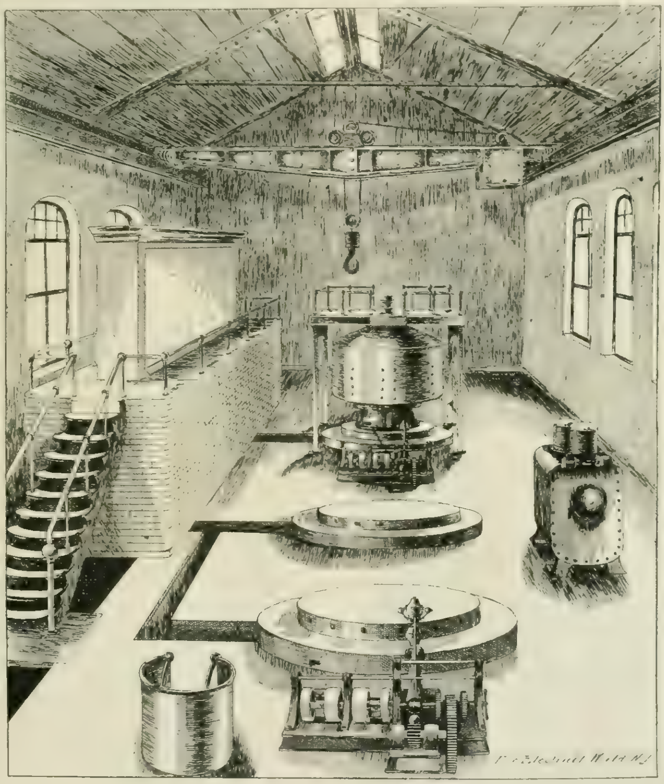

The Electrical World N.Y.

Fig. 1.—Governor, Stairway and Visitors' Gallery.

In Buffalo a resolution was defeated before the City Council proposing that the matter of dealing with the question of introducing current from Niagara into the city be taken from the street committee and placed with a special committee. Mr. George Zink proposed that a committee of three from the Board of Aldermen and three from the Board of Councilmen and the incoming Mayor make an effort to learn what the cost of power will be at the city line, and suggested that the city might distribute the power itself, taking care of all the poles, wires, etc. "All the factories along the canal could first be supplied, and a belt line formed around the city," said Mr. Zink. "Then as the demand increased, provision could be made for supplying the central portions of the city. The city could afford to be a loser for a year or two by giving a cheap rate. A cheap rate would boom the city. Why is the city going to allow a company to come in second hand and take care of the distributions? Why not let the city be the purchaser and the distributor? Mr. Zink continued, "For my part I had sooner see the city rather than any corporation handle and distribute this power." The Council adjourned without acting on the suggestion. The following resolution and others similar to it have been submitted by various associations in the city of Buffalo:

"Whereas, the Niagara Power Company and the Schoelkopf Canal Company are at present making application to the city for permission to use the public streets and roadways for the distribution of electric power;

"Resolved, That it is the opinion of this association that in view of the difficulties that present themselves in arranging satisfactory terms, it would be advisable that a committee be appointed to look into the subject of the city taking the power at the city limits and making the distribution within the city limits itself." There is at the present time an animated discussion going on in the city of Buffalo on the actual cost of steam power, the method of distribution, and the maximum price to be charged for electric power. The Buffalo Electrical Society, the Merchants' Exchange, the Real Estate Exchange and other associations have been invited to appoint committees to act in an advisory capacity with the street committee, and it is expected that the conditions of the franchise and the granting of the same will be settled in a few days. The city officials are to visit the Niagara Falls power plant shortly to learn the exact condition of affairs at the present time.

The State of Affairs at the Power House. Leaving the exciting scene of discussion in Buffalo, we will look over the power plant and view the preparations made to furnish the necessary current mentined by the company in the application for a franchise.

The first view the visitor has of the magnificent white stone power house impresses upon his mind the idea that the work is near completion and the vast storehouse of energy is soon to give forth the electric force which will operate mills and factories, propel street cars and railway trains, light the streets of the neighboring cities, and heat the stores and residences of their citizens. The illustration, Fig. 1, shows the completed power house at the right and the covered conductor bridge connecting it to the recently constructed transformer house at the left.

On entering the power house we find the electric crane in operation, assembling the heavy parts of the dynamos and other apparatus which are being placed in position. The electric crane was built by William Sellers & Co., of Philadelphia, and is operated by a Billberg electric motor at a potential of 220 volts. The electric elevator is being used continuously to carry workmen from the bottom of the wheel-pit to the various galleries where they are busy finishing and scraping the bearings of the vertical shafts. The elevator was designed and constructed by Otis Bros. & Co., and is operated by a 220 volt direct current motor. The switchboard for the elevator and lighting installation is constructed of marble, and is enclosed in a small room. The electric motor and hoisting apparatus is also temporarily enclosed in another small building in the power house to keep out the moisture arising from the wheel-pit below.

On going down the winding stairs through the circular opening, shown in the foreground of Fig. 1, the elevator landing is reached. On this landing one may see the perfectly balanced levers which are operated by the governors or regulators in opening or closing the gates of the turbines. The gearing may also be seen which connects the governors to the dynamo and to the turbine shaft.

One may also pass directly under the electric generators and see the various pipes which convey the lubricating oil and water to the bearings. One pipe conveys oil to the upper bearing of the dynamo, a second conveys oil to the lower bearing of the same machine, a third pipe allows water to pass to a cooling chamber of the upper bearing, and a fourth pipe allows water to pass to a similar chamber in the lower bearing.

The Elevator and Wheel-Pit.—The elevator descends to the bottom of the wheel-pit, stopping at the various galleries and sub-galleries until the lowest landing above the turbines is reached. There are four galleries in the wheel-pit and three sub-galleries. Each gallery is now provided with four permanent incandescent lights, the conductors being run in iron pipes lined with insulating material. Each lamp is hermetically sealed in closed globe, and sockets, etc., are of rubber and carefully constructed to keep out moisture. The risers run from the bottom to the top of the wheel-pit in iron pipes, and iron junction boxes are provided on each gallery to supply the necessary lights. This construction work was done by the Western Electric Company, of Chicago, Ill. The current for supplying the electric elevator, electric crane and lighting is generated in a building near the river next to the city water works. The boiler is installed in the pumping station and furnishes steam to a Westinghouse Kodak plant. A 100 hp Westinghouse direct current generator of 220 volts is connected directly to a compound Westinghouse engine. The current is transmitted to the power house by an overhead pole line.

The view from the visitors' gallery shows the switchboard and foundation nearing completion, the subway running the length of the power house and under the switchboard, the conduits connecting the electric generator foundations with the switchboard, the governors being completed, the alternators being placed in position, and the oil-filtering cylinders, tank and pumps being made ready to lower into position on the deck at the bottom of the wheel-pit just above the turbines.

The opening of the gates which allow the water to pass from the canal to the turbines is to be accomplished by means of electric motors and suitable gearing, now being installed. The motors are Westinghouse 8-kw direct current motors of 220 volts potential and they are to be operated by the same current which is supplied for the electric elevator and electric crane. Two of these motors have already been installed, but are not coupled to the gearing or connected by electric conductors as yet.

The Regulating Apparatus.—The governor is seen in the foreground of Fig. 1, near the circular opening which leads to the elevator landing in the wheel-pit. There is a visitors' gallery, not shown in the illustrations. The levers connected to the governor are so delicately balanced that it only requires about four pounds to move the massive gates of any turbine. This may be done by hand or automatically operated by the governor. The governor is located beside the alternator and is coupled to it below the floor. It controls the speed of the generator by means of the levers above mentioned. This regulator is of a new type and is very sensitive to variation in speed, and in electrical installations is said to have done very good service. This regulator is calculated to control the speed at a normal rate of working within one-half of 1 per cent., and within about 3 per cent. if the load at the turbine is increased or diminished suddenly by one quarter load, or 1,250 hp. This is a remarkable result for any regulator in hydraulic work, and the working of this apparatus in practice with this great plant will be watched with interest. The designers of the turbines, Messrs. Faesch & Picard, of Geneva, Switzerland, are also the designers of this interesting regulating device. With a variation of from full load to no load, as in case of dead short circuit and the blowing of fuses or the circuit being opened by mistake, the engineers claim the speed will not exceed 400 revolutions. The turbines and accompanying apparatus are designed to stand strains where the speed reaches 500 revolutions per minute, the normal speed being 250 revolutions per minute.

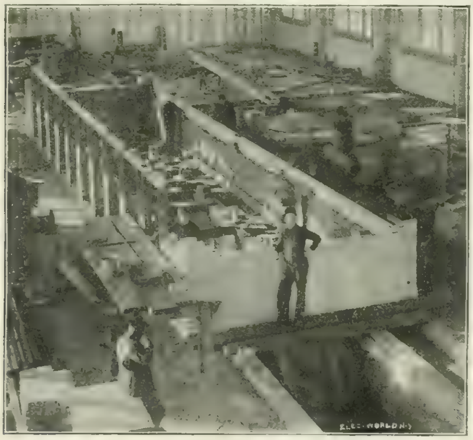


FIG. 2.—INTERIOR OF POWER HOUSE.

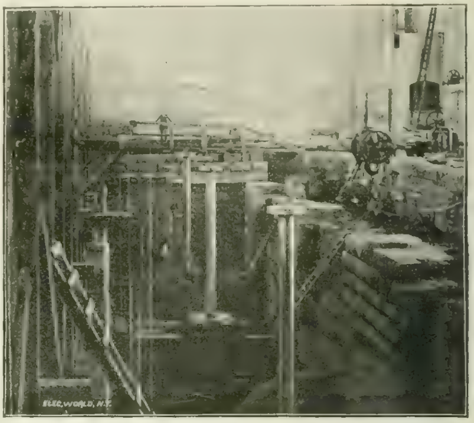


FIG. 3.—VERTICAL SHAFTS AND WHEEL-PIT.

The Lubricating Apparatus.—The lubricating apparatus is especially interesting. The tank, cylinders and pumps are to be located at the bottom of the wheel-pit shown in Fig. 3; much attention has been given to these details. The main clean oil tank is constructed of steel and is located near the roof of the power house over the door. It will hold 200 cubic feet of oil; clean oil is to be placed in this tank, and conveyed by iron pipes to the bearings of the dynamo, and may also be allowed to pass through the various shaft bearings; the latter, however, having a separate and independent means of lubrication. After having accomplished its purpose in lubricating these bearings the oil is conducted into the filtering cylinders, and after the dirt has been extracted the clean oil passes into the tank below the cylinders. The pumps on the top of the tank then force the clean oil into the large tank near the roof of the power house. These pumps are operated by the waste water in the wheel-pit. The oil which comes from the bearings is first washed by passing it through water in the filtering cylinder and is then forced through felt in the upper part of the same cylinder. Only one filtering cylinder and pump are used at a time, the other being held in reserve to be used when one must be cleaned.

The main shaft bearings have an independent means of lubrication which is quite novel. A large cast iron cup is attached to the revolving shaft below the bearings; this cup is several feet in diameter and contains the lubricating oil; a pipe dips into the oil, and the centrifugal force carries the oil upward through the pipe to the top of the bearing and after thoroughly lubricating the bearing it finds its way back into the revolving cup. To supply the cup with fresh oil it is only necessary to open the valve and allow the dirty oil to pass to the filter below and the clean oil to fill the cup from the tank above.

Both the main shaft bearings and the dynamo bearings are also provided with chambers and pipes so connected that cold water may be allowed to pass from the city water mains through the bearings if it is found necessary to cool them.

The Switchboard and Foundation.—The switches are all to be mounted within the switchboard foundation and operated by compressed air by means of levers on the switchboard platform or gallery above. There will be mounted upon the switchboard the various indicators, ammeters, voltmeters and other measuring instruments which will require the attention of the engineers in charge. It is understood that the main switches are to be operated by compressed air mechanism similar to the Westinghouse air-brake apparatus, the air compressor being operated by water power in the wheel-pit below. The openings in the switchboard foundation, in which are to be placed the plate glass doors leading to the cables and main switches, may be seen in Fig. 2. The switchboard is mounted on an iron and brickwork foundation, and is 58 feet long, 13 feet wide and 8 feet high. Fine white enamel brick are used in its construction, giving it a fine appearance. The side nearest the generators is smooth, unbroken enameled brickwork, while the side opposite the generators has ten doors of white pine with square windows of heavy plate glass opening into the foundation, where are mounted the heavy main switches and cables. The switchboard and foundation stand just over the subway, which contains the conductors leading to the transformer house. A metallic staircase leads to the gallery of the switchboard, a metallic rail surrounds the foundation, and the floor of the gallery is constructed of slate. The only foreign measuring instruments to be used, it is said, will be some wattmeters, while the voltmeters, ammeters and other measuring instruments will be furnished by the Weston Instrument Company, of Newark, N. J., and the Westinghouse Electric and Manufacturing Company of Pittsburgh, Pa.

The 5,000-hp Alternators.—The 5,000 horse-power alternators are now being placed upon their foundations in the power house. The wheel-pit is arched over to form the floor of the power house, and a cement floor has been laid thereon; the ends of the vertical shafts may be seen in illustration Fig. 3. The first generator being set up is the one nearest the main entrance, the foundation base of which is seen in the foreground of Fig. 1. The alternator shown erected will be the last of the three to be set up, but in the position given shows the other foundations and governors to better advantage.

The two circular cast iron bases mounted upon the stone foundation shown in Fig. 1 are ready to receive the stationary armature, which is bolted to a vertical cast iron cylinder. The mechanical construction of these alternators is practically the same as designed by Prof. Forbes, but the electrical work and details of winding are said to have been modified by the engineers of the Westinghouse Electric and Manufacturing Company. The wrought steel ring, upon which is bolted the inwardly projectng cast iron magnet pole pieces, forms a massive fly-wheel field magnet, and is attached to the vertical shaft of the turbine by a large steel spider. The shaft supporting the rotating fly-wheel field magnet has its bearings supported by the cylindrical frame on which the stationary armature rests. The bronze bushings of the bearings are provided with means for oil lubrication and for cooling by allowing water to pass through an outer chamber when necessary. The highest grade of mica insulation is used throughout the windings of the armature, which consist of copper bars placed in the holes of the armature core. There are two separate circuits from each dynamo, a pair of cables conducting the current for each circuit through a conduit in the cement flooring to the switchboard which stands over the subway that runs the full length of the power house. The alternators, which are 13½ feet high each generate two alternating currents differing in phase from each other by 90 degrees with a frequency of 25 periods per second. The current conducted through each circuit is designed to be 775 amperes at a potential of 2,250 volts. The field coils consist of bent copper bars which receive the current from rotary transformers by means of brushes and copper rings fixed to the shaft which supports the field magnets. The speed of the revolving field magnets is 250 revolutions per minute, and the turbine is said to be so designed that the maximum speed possible will be less than 500 revolutions per minute.

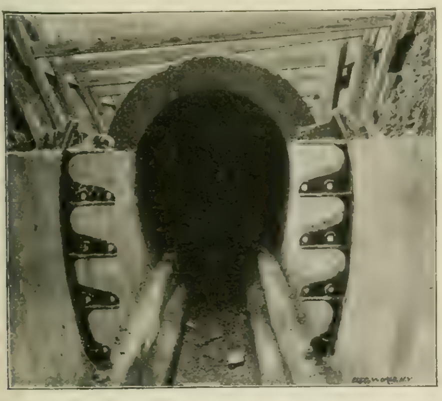


Fig. 4.—Subway Under Construction.

The Rotary Transformers.—The direct current for exciting the field magnets of the alternators as well as that utilized in lighting the building and wheel-pit, and driving the motors for the elevator, crane, and gate-gearing will ultimately be supplied by rotary transformers located at the further end of the power house near the end of the switchboard and directly over the subway. The rotary transformers were designed by the Westinghouse Company and are each of 200-kw. capacity. These machines are of the six-pole type and deliver a direct current at 220 volts potential. Four stationary step-down transformers will also be used in this connection and will be erected in the subway just beyond the rotary transformers at the end of the switchboard. Two of these stationary transformers will be used for supplying current while the other two are held in reserve. The exciting current delivered by these rotary transformers is conducted from the subway under the switchboard to the dynamo base through a conduit in the floor of the power house, and thence to the brushes of the alternator through the upright iron columns which support the gallery or platform of the generator. The upright columns in the sketch Fig. 2, are not in the correct position, but should be shown directly in front of the alternator and next to the governor, but the sketch as shown gives a better view of the platform and upright columns than it otherwise would. Beneath the floor of the power house a pit is being constructed about 6 feet deep and 18 feet long and 12 feet wide, directly in front of the switchboard, and opening into the subway under the switchboard by a small archway. Into this pit the necessary resistance will be placed, and the conductors leading to it will be carried through the subway.

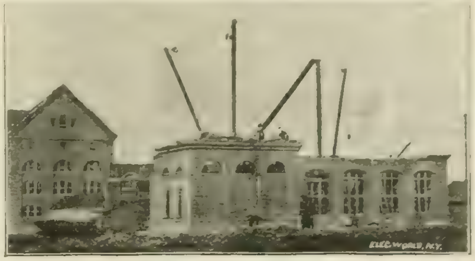


Fig. 5.—View of Power House, Conductor Bridge and Transformer House.

The Transformer House.—The transformer house was constructed to hold all of the transformers for the total 100,000 hp, and is nearly completed. The transformer house is now occupied by cars loaded with parts of the alternators, including the top casting, field magnet coils and cast iron cylinders for supporting the stationary armature. A car of cables is also standing in the transformer house ready to be laid in the subway (shown in Fig. 4 during construction), connecting the Pittsburgh Reduction Company's works with the transformer house and switchboard. These cables were furnished by the General Electric Company. The current for the Pittsburgh Reduction Company will be transformed at the company's works, and therefore, no transformation of this current will be made in the power company's new transformer house. The stationary transformers, bus bars, and switchboard of the Pittsburgh Reduction Company are said to be rapidly being placed in position, and that the company will soon be in a position to receive the current from the first alternator operated at the power house.

The current from the alternators will be a two-phase alternating current, and four conductors will be necessary to carry the current from the generator to the switchboard and transformer house in two circuits. It is understood that instead of utilizing the two-phase current throughout, as was first planned, it may be decided, if it has not been already, to change the current at the transfomers from a two-phase to a three-phase current; in which case three conductors will be employed instead of four.

Electrical Consonance.

BY M. I. PUPIN.

The question has often been asked whether there is any difference between neutralization of self-induction by capacity and resonance. A similar question is invariably put by young students when they first attempt to grasp the distinction between consonance and resonance in the case of sound. Consonance means strengthening of sound emitted by a vibrating body by connecting this vibrating body to a sounding-board, as for instance, when a tuning fork is put upon a table. Resonance means equality of periods of vibrations, and therefore synchronization.

So in electrical circuits; the self-induction of a circuit may be neutralized and a large current produced in it by a given impressed electromotive force, although the natural period of the circuit is not the same as that of the impressed electromotive force. This will happen, just as in the case of sound, when the circuit is electromagnetically connected to another secondary circuit capable of electrical vibrations. The name *electrical consonance* might well be applied to phenomena of this class. I propose to discuss a case of this kind:

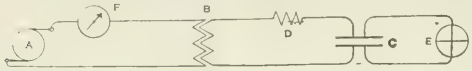


Fig. 1.

In Fig. 1 let A be an alternator, B a transformer, C a condenser in series with the secondary of the transformer, and D an inertia coil of adjustable self-induction. F is an electro-dynamometer, and E is an electrostatic voltmeter.

Let L be the self-induction of the primary circuit.

Let R be the resistance of the primary circuit.

Let N and S be the corresponding quantities of the secondary circuit; let, finally, C be the capacity of the condenser.

Denoting now by x and y the primary and the secondary current, respectively, we shall have by the generalized form of Ohm's law:—

$$L\frac{dx}{dt}+M\frac{dy}{dt}+Rx=E\sin pt$$

$$N\frac{dy}{dt}+M\frac{dx}{dt}+Sy+P=0$$

where P is the potential difference of the condenser at any moment.

By elimation we obtain

$$\left(LN-M^2\right)\frac{d^3x}{dt^3}+\left(RN+SL\right)\frac{d^2x}{dt^2}+\left(RS+\frac{L}{C}\right)\frac{dx}{dt}+\frac{R}{C}x=$$

$$=p^2\left(\frac{1}{p^2C}-N\right)E\sin pt+pSE\cos pt$$

Hence the solution

$$x=\frac{E}{\sqrt{p^2L_1^2+R_1^2}}\sin(\text{pt}-\varphi)$$

$$\text{Where } L^1=L+\frac{p^2M^2\left(\frac{1}{p^2C}-N\right)}{p^2\left(\frac{1}{p^2C}-N\right)^2+S^2}$$

$$R^1=R+\frac{p^2M^2S}{p^2\left(\frac{1}{p^2C}-N\right)^2+S^2}$$

$$\text{Tan }\phi=-\frac{pL'}{R'}$$

The zero value of the phase difference of x evidently when L', the apparent self-induction of the primary circuit, is zero. We shall have then:

$$x=\frac{E}{R'}\sin pt$$

To obtain this neutralization of the apparent self-induction of the primary circuit, we can vary any one of the four quantities, viz: L, p, C N. If, however, for a given periodic speed p

$$\frac{1}{p^2C}-N>0$$

then no value of L will reduce L' to zero for that speed. Then either C or N must vary.

The values of C and N which will reduce L' to zero, can be determined as follows:

$$\text{Let }\frac{1}{p^2C}-N=Z.$$

$$L'=0\text{ when }L+\frac{p^2M^2Z}{p^2Z^2+S^2}=0$$

$$\text{or }Z=-\frac{1}{2pL}\left\{pM^2\pm\sqrt{p^2M^4-4L^2S^2}\right\}=\frac{1}{p^2C}-N$$

Hence, for a given frequency, primary co-efficient of self-induction, and secondary resistance there are two values of the capacity and also two values of the secondary co-efficient of self-induction at which the apparent co-efficient of self-induction of the primary circuit will be neutralized. A case may arise, however, in which no value of C or N can reduce L' to zero. This will evidently take place when

$$p^2M^4<4L^2S^2$$

for in this case the expression for

$$\frac{1}{p^2C}-N\text{ becomes imaginary.}$$

It will also be readily seen that for given values of the electrical constants of the two electromagnetically connected circuits there will be two frequencies at which L' will be equal to zero. For from the relation

$$L+\frac{p^2M^2\left(\frac{1}{p^2C}-N\right)}{p^2\left(\frac{1}{p^2C}-N\right)^2+S}=0$$

We obtain

$$p^4-\frac{2LN-M^2-LSC}{NC(LN-M^2)}p^2=-\frac{L}{NC^2(LN-M^2)}$$

$$\therefore P^2=\frac{2LN-M^2-LSC\pm\sqrt{(2LN-M^2-LSC)^2-4LN(LN-M^2)}}{2NC(LN\pm M^2)}$$

Hence there are two distinct frequencies at which the apparent inductance of the primary circuit will vanish. It is plain, however, that the electrical constants of the two circuits may have such values that the neutralization of the primary inductance will be impossible at any frequency.

These considerations show, first, that the neutralization of the *apparent inductance* of a circuit has nothing whatever to do with resonance or synchronization, and secondly, that the experimental adjustments necessary to produce this neutralization are very much more difficult and uncertain than the adjustments necessary to produce electrical resonance. This explains why this phenomenon has not received that attention which at first glance it would seem to merit.

It is interesting and instructive to examine carefully the two values of the secondary apparent self-induction which will neutralize the apparent self-induction of the primary circuit. We have seen that at the point of neutralization x is given by:

$$x=\frac{E}{R'}\sin pt$$

$$\text{Where }R'=R+p^2\frac{p^2M^2S}{\left(\frac{1}{p^2C}-N\right)^2+S^2}$$

$$\text{But since }L=-\frac{p^2M^2}{p^2\left(\frac{1}{p^2C}-N\right)^2+S^2}\left(\frac{1}{p^2C}-N\right)$$

we can also write

$$R'=R-\frac{LS}{\left(\frac{1}{p^2C}-N\right)}$$

Hence, since $\left(\frac{1}{p^2C}-N\right)$ can have two values for which $L'=0$ we shall also have two values of R' and therefore, the current x can have two values when the primary apparent self-induction is neutralized. Denoting these two values by subscripts we shall have

$$x_1=\frac{E}{R+\frac{2pL^2S}{pM^2+\sqrt{p^2M^4-4L^2S^2}}}\sin pt$$

$$x_2=\frac{E}{R+\frac{2pL^2S}{pM^2-\sqrt{p^2M^4-4L^2S^2}}}\sin pt$$

These two values of the primary current can and will generally differ considerably. For it is possible, theoretically, at least, to make x_1 as many times as large as x_2 as we choose. So, for instance, by making $pM^2-\sqrt{p^2M^4-4L^2S^2}$ very small x_2 will become very small indeed, whereas x_1 may be very large if we choose to take the trouble to make it so.

A numerical example will assist one to see this interesting relation more clearly. Let

$N=1$ Henry.
$M=.5$ "
$L=2$ "
$S=20$ ohms.
$R=50$ "
$p=2\pi\times110=700$ (very nearly)

The capacities in the secondary circuit at which the apparent self-induction of the primary circuit is neutralized will be

$C_1=2.3$ microfarads.
$C_2=2.03$ microfarads.

There is only about 12 per cent. difference in the two capacities. But if we examine the corresponding apparent resistances of the primary circuit we find

$R'_1=358$ ohms.
$R'_2=5945$ "

Hence, the ratio of the two possible currents in the primary circuit when its inductance is zero will be 1 : 16.6 (about).

We see, then, that the neutralization of the inductance does not necessarily increase the primary current. On the contrary, it may diminish it very much and it will do that whenever this neutralization increases the impedance of the primary circuit. In fact, a moment's reflection will convince us that the physical meaning of the existence of the two values for each the secondary self-induction, the capacity, and the frequency each of which will neutralize the primary reactance is simply this. One value will make the primary impedance a maximum and the other will make it a minimum.

There is, therefore, a radical difference between the following two distinct methods of neutralizing the self-induction of a circuit by means of a capacity. The first method consists in placing the condenser in *direct* connection with the self-induction which is to be neutralized. It gives the circuit a definite periodicity, and neutralization takes place at the point of resonance or synchronism. The capacity acts upon the self-induction alone and upon nothing else. The second method consists in placing the condenser in a secondary circuit, so that its capacity acts *indirectly* upon the self-induction which is to be neutralized. It modifies, however, not only the self-induction but also the resistance of the circuit, so that although it may sometimes reduce the reactance it will not always reduce the impedance, but on the contrary, it may increase it very much. The neutralization does not take place at the point of resonance or synchronization; and it is quite natural that it should not; for a circuit which has no direct connection to a capacity can no more have a definite period of oscillation than a body can have which is devoid of elasticity, and in the absence of such a period there can be no resonance effects. It is, therefore, not at all surprising that for any given values for the electrical constants of the circuit and its secondary there should be two frequencies, if there is any at all, at which the reactance of the primary circuit is reduced to zero. *One frequency, however, will give the minimum and the other the maximum impedance.*

The following experimental method was employed for the purpose of testing the validity of the theory just given.

An alternating current of 133 p. p. s. was sent through the primary turns (No. 12 B. & S.) of a small hedgehog transformer *B*. (Fig. 1) The secondary was connected to a coil *D* of adjustable self-induction and to two large condensers *C* in series with each other. The extreme poles of the condenser battery were connected to a Thomson electrostatic voltmeter *E*. A Siemens electrodynamometer *F* was employed to measure the primary current. The capacity was gradually varied and for each particular capacity the primary current and the difference of potential in the condenser were read and recorded. The following table records the results of one of the series of these experiments.

The rise of the primary current is gradual just as the theory indicates it. I have not been able to produce a very large increase, although I have taken considerable pains to do it. The capacity at which the primary impedance is reduced to a minimum is always greater than the one at which the impedance is made a maximum. Both these capacities are always greater than the capacity which produces resonance in the secondary circuit. The two capacities can be made to approach each other as near as we choose to make them. When $p^2M^2=4L^2S^2$ then the two capacities coincide. In this case, however, there is neither a maximum nor a minimum in the impedance when the phase difference of the primary current is reduced to zero by the variation of the capacity. As a rule the capacity which makes the impedance a maximum is near the capacity which produces resonance in the secondary circuit. Such a case is illustrated in the table given above.

Capacity in Microfarads.	Primary Current.	Difference of Potential in the Condenser.
4.94	11.3	Below the lowest reading
4.36	11.4	" "
3.68	11.45	" "
3.10	12.00	" "
2.48	11.95	" "
2.12	11.6	" "
1.96	11.2	500
1.49	9.5	925
1.19	2.5	1,135
.48	6.5	Below the lowest reading.

This class of capacity effects does not present those very interesting features which electrical resonance presents. I have observed them several years ago, but failing to detect in them any purely scientific interest or technical importance I have never paid very much attention to them. This brief note, however, seemed necessary in order to draw a clear distinction between them and electrical resonance. As a phase-changing device this method of modifying the reactance of a primary circuit by a condenser in the secondary will no doubt do very good service some time, especially in the case of high tension primary circuit where a direct introduction of condensers into the circuit would be neither advisable nor perhaps very effective.

Crude Petroleum as Fuel.

In the paper read by Mr. A. M. Hunt before the Technical Society of the Pacific Coast, the subject of the use of crude petroleum as a fuel is very thoroughly considered.

Mr. Hunt describes the various methods of burning fuel oil, which are as follows: First, by hearth fires where the oil is burned in open pans or on plates, or in drops from small pipes and which spread over the bottom of a furnace. The bottom of the furnace may be covered with some porous non-combustible substance, itself being saturated with the oil, which is fed from a tank by gravity. This method is condemned. Second, where the fuel comes into the furnace as a gas, being vaporized in a supply pipe. This method is stated to have fallen into disuse. Third, by spray burners which inject oil into the furnaces as a spray or in fine jets, or by means of steam or air. A vast number of such burners have been devised, and a number are in successful use.

The burner used at the Midwinter Fair consisted of a central tube about one-eighth of an inch in diameter through which the oil passed, its flow being regulated by a stop cock. The steam by means of spiral grooves was given a rotary motion and passed out at the tip in a cylindrical sheath inclosing the jet of oil, catching and spraying it into the furnace; the construction is such that the oil tube can be made to discharge at the same point as the steam, or as much as an inch in advance of it, an adjustment enabling the flame to be focussed or sprayed as may be desired. The author has had a burner made similar to the one described, but with the oil issuing in a hollow sheath with a jet of air inside of the sheath, and a surrounding envelope of steam, as above. This should be equally as capable of adjustment as the previous one and use less steam. In thus using oil it should be thoroughly broken up and atomized in order to insure perfect combustion, and that burner is the best which accomplishes this result with the least amount of steam and air, and at the same time is not likely to be disarranged and is capable of being easily cleaned out. A number of small burners are better than one or two large ones, as in the former the oil can be better atomized, the flame better distributed and, when the boiler is doing a small amount of work, better service can be had from one or more of the small burners operated at normal capacity than from one large burner throttled down.

It is further desirable to have the air for the combustion heated before admittance to the burner, not only on account of economy but to prevent the deposit of asphaltum, which is apt otherwise to take place in front of or below the burner tip. In some cases the oil is also heated before entering the burner.

At the Midwinter Fair the best results were always obtained by so manipulating the burner with the air full on as to get a blue Bunsen-burner-light flame and then adjusting the admittance of steam and air until a tinge of luminosity began to show, chasing through the furnace in waves. Under such conditions the carbon in the oil is entirely consumed and the air supply limited to the point necessary for its combustion. After the furnace once becomes thoroughly heated, there should be absolutely no evidence of smoke issuing from the chimney. Care should be taken that the flame does not impinge directly against the iron of the boiler, as overheating of the metal might result.

Thorough tests were made at the Midwinter Fair to determine the efficiency of oil as a fuel, and the average result was that 14.2 pounds of water were evaporated from and at 212 degrees F. per pound of oil, the highest evaporation of any test being 15.13 pounds.

Mr. Hunt remarks that it is a very common thing to hear oil men say that they have obtained an evaporation of 17 or even 18 pounds of water per pound of oil. He states that the theoretical evaporation of oil is about 20.7 pounds to one. An evaporation of 18 to one would indicate a boiler efficiency of 87 per cent., and assuming that the furnace temperature is 400 degrees F. the temperature of the issuing gas would be 312 degrees; if the temperature of the issuing gas were 450 degrees, as would be more probable on the above assumption, the furnace temperature would be 3,461 degrees, an excessive amount.

Mr. Hunt gives a table showing the equivalent prices of oil and coal. A third column is added which takes into consideration the various economies that attend the use of oil, resulting from the fact that there are no coal and ashes to handle, and that boiler repairs are less. The calculation is based upon the assumption that a good burner should not use more than 3 per cent. of the steam furnished by the boiler, and that the weight of a barrel of oil is 310 pounds. The comparison is made with Carbon Hill coal on a basis of an evaporation of 7.6 pounds of water per pound of oil.

Oil per barrel at	Coal per ton at	All economies considered. Coal per ton at
$1.00	$3.66	$3.30
1.10	4.03	3.62
1.20	4.40	3.95
1.30	4.77	4.29
1.40	5.14	4.61
1.50	5.51	4.94
1.60	5.87	5.27
1.70	6.23	5.61
1.80	6.59	5.94
1.90	6.95	6.27
2.00	7.21	6.60

The Electric Light in the Church.

Recently, says London *Lightning*, there was an eclipse of the electric light at Elm Road Baptist Chapel, Southsea, and curiously enough, the pastor had chosen for his texts: Proverbs lxxiv., 20—"The candle of the wicked shall be put out," and Psalm xvii., 28—"For Thou wilt light my candle; the Lord my God will enlighten my darkness," a combination rather cruel to the electric light, for when the lights went out some of the congregation went out also, and obtained candles and lamps, whereupon service proceeded. The pastor could not conveniently change his texts, in consequence of what had happened, and he may have been prepared for the general titter which followed their announcement. Lately a somewhat similar case occurred in an American church, and the amusement was heightened by the action of a deacon who absent-mindedly lighted a match and applied it to one of the electric lamps.

Electrical vs. Sentimental Attraction.

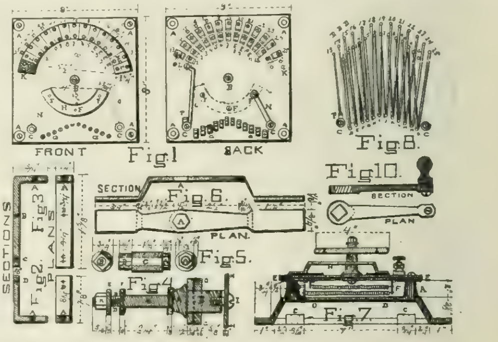
An analogy used by Prof. J. A. Fleming in a lecture to explain the theory of an electrolytic cell was, says London *Lightning*, particularly happy. "Imagine," he said, "a ball-room full of ladies and gentlemen dancing together, but frequently changing partners. Suppose that at one end of the room there is something especially attractive to ladies, and, at the other, something especially attractive to gentlemen; then at each change a gentleman would take a partner nearer the end of the room to which he was attracted, and so with the ladies. Ultimately all the gentlemen would be found at one end of the room and all the ladies at the other." It was part of the professor's case, *Lightning* adds, that the ladies and gentlemen should be mutually attracted to one another, but that the ends of the room should have a still greater attraction for them, and that what attracted the one sex should repel the other. He prudently forbore to press the analogy further. Our contemporary thinks that some of its readers, less gallant than the professor, may be tempted to fill up the hiatus, and suggest what might be found at the two sides of the ball-room.

How to Build a Rheostat—For Amateurs.

BY G. E. DUNTON.

A very simple and efficient rheostat may be constructed at a very small outlay as follows: The back or base shown in section, Fig. 7, and in the illustration, is cast iron. The pattern is easily made of ¼ inch pine stuff. It will not need to be halved, as it will draw out of the sand in one piece. It is 12 inches square over all, 4¾ inches deep, including studs. The stud on each corner (to hold the slate front) is 2 inches long, 1 inch in diameter at the bottom, ⅝ inch at the top, cast into the base. Each is drilled in its end and tapped to receive a "14-20" machine screw. The four bosses on the side rims at the back are drilled with ¼ inch holes.

For the front, procure two pieces of the thickest ordinary roofing slate, that will square up to 9 inches. It can be sawed with an old hand (rip) saw. In each corner drill ¼ inch holes, in 1 inch from the end and side, Fig. 1 A, front. Cut four thicknesses of asbestos paper 9 inches square; lay between the two pieces and fasten together temporarily with ¼ inch (short) stove bolts. Select which side shall be the front and smooth down with sandstone and water. Locate the centre and strike the circles for the segments L and H. Fourteen in the upper circle are of copper or brass ⅛ inch stock, are 1¼ inches long, ¾ inch wide at the top and ½ at the bottom. That at the extreme left of the circle, K, is of fibre. Each is drilled and tapped at points D and E for "6-32" screws. The segment H is one circular piece, the same stock, ¾ inch wide, and drilled and tapped the same at points F. 9-64 of an inch holes are drilled through the slate where the holes in the segments will come at the points D, E and F. The segments in the upper circle should not come snug together, but have a space between of at least 1-16 of an inch. Twelve 9-64 inch holes should be now drilled at points G in the shape of a V from the edge of the slate; also one each at C. Carefully drill a ⅝ inch hole through the centre at B. All the foregoing is shown in Fig. 1.

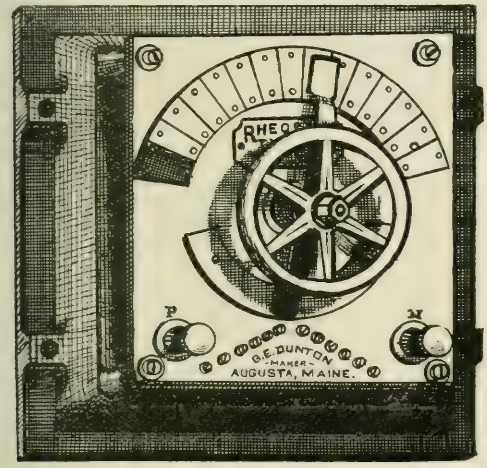


DETAILS OF RHEOSTAT.

Shape twenty-six brackets out of ⅛ inch brass, as shown in Fig. 3. Drill fourteen of them at A with a 9-64 inch drill and at C only with a 1-16 inch drill. The other twelve are drilled at A and tapped for a "6-32" screw, and 1-16 inch holes are drilled at both points B and C. Twelve shorter brackets (about half the length of these), Fig. 2, are drilled with 9-64 inch holes at A and 1-16 inch holes at D. These are the same stock. All these brackets go on the back of the slate in Fig. 1. Thirteen of the fourteen long ones go on the upper circle as shown at D the screws passing through them and through the slate and thread into the hole tapped in the segment on the front. The remaining long bracket of this fourteen goes under the binding post at P. The short brackets go on the inner side of this same circle, at points E, beginning at the second place from K, numbered 12 (see Fig. 1, back). The other twelve long brackets go on at points G, the screws coming through the front of the slate and threading into them. The stud carrying the follower on its hub is shown in Fig. 4. The base at B is turned ⅝ of an inch in diameter; the shank C is ⅜. D is turned to 5-16 and threaded with a "16" thread. The nut K is tapped out "16-16" to screw on this end. All the washers on this stud are loose fits; that at F is allowed to slide down over the turned part of the shank C. An open coil spring of four or five turns of No. 16 brass spring wire goes in between E and F. This stud goes into the slate at B, Fig. 1, from the front and fastens from the back, with the washer and screw, I and H, Fig.

4. The hub carrying the follower and wheel, shown in Fig. 5, is turned to ¾ inch diameter from round brass, the ends as shown at A and B being shaped by filing. It is drilled through its length with a 25-64 inch hole. The follower itself is made from ⅛ inch sheet brass, shape and sizes as shown in Fig. 6. This fits on over the end A of Fig. 5, the end being swaged out to hold it in place firmly and the surplus metal filed off smooth. If the builder is in with some steam fitter and can secure a 4 or 5-inch wheel off an old steam valve, it will add greatly to the appearance of the rheostat. Otherwise a handle can be shaped from ½ inch brass, 3 inches long, as shown in Fig. 10, and fitted on to the end of B of the hub in Fig. 5. The follower on its hub may be slipped on over the spindle, the washer F put on, then the spring, the washer E and the nut set up in place. There should be spring enough in the coil to hold both ends of the follower down firmly, in order that it shall make good contact with the segments as it slides over them. Two strips of 1-16 inch copper, ½ inch wide, drilled with 9-64 of an inch holes where the screws pass through, connect from C to F at N and from C to L Fig. 1, back.

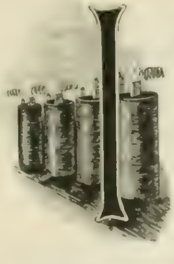
For the resistance coils, German silver wire should be used, if it can be afforded by the builder. Iron wire can be used, but the resistance is only half as great, which lessens the efficiency in that proportion. Two hundred and sixty feet will be needed. Cut this into lengths ten feet and three inches each, making twenty-five lengths. These should be wound up into close coil, spiral springs, over a ⅜ inch arbor, winding very tight; leave about 1½ inch of wire on each end and bend it up at right angles or on a line with the length of the spring. Before putting the coils in place between the brackets they should be pulled out some, to make them nearly as long as they should be when in position, leaving just spring enough to hold them tight and keep them in place without sagging. The end of the wire on each end of the coil passes through the 1-16 inch holes in the bracket, is pulled up tight, twisted round into the shape of an eye with round-nosed pliers and the surplus snipped off. This holds the coil firmly in position; the two are shown in Fig. 7, F. The plot of the coils is shown in Fig. 8, and is extremely simple and can be easily comprehended by a few moments' study. The two coils connect one segment to the next to it around the series, forming the wire into one long loop of a little over 250 feet. The function of the segments and follower is to switch in or cut out of the circuit more or less of this wire in equal portions as the operator desires. By turning the follower way over onto the fibre segment the circuit through the rheostat may be opened. If it is turned in the other direction to L, all the resistance is cut out and the circuit closed. After the coils are all in place, the slate is put in position on the back or base studs, with a 1-inch iron washer between the studs and slate, then the screws with washers under the heads are set down through the slate and screwed fast into the stud. The binding posts, which are screwed on at C, front, Fig. 1, can be bought at any of the supply stores. The base and wheel should be given a coat or two of good black paint and allowed to dry thoroughly. Make the left hand binding post the positive receiving the current.



Rheostat as Completed.

Dry Batteries.

BY L. K. BÖHM.



In a certain sense, galvanic batteries may be distinguished as closed circuit batteries and open circuit batteries. Of the first type is required that they give a constant current for a certain length of time, because they are often used for several hours continually without interrupting the current. The typical battery of this kind is the Daniell cell; it consists of a glass jar in which rests a copper cylinder in a solution of sulphate of copper, and a porous cup of clay which acts as a diaphragm, and contains diluted sulphuric acid, wherein is a circular zinc cylinder. Another well known cell which gives a still stronger current than the Daniell is the Grove battery. It contains a zinc cylinder in diluted sulphuric acid and in the porous cup is a thin platinum sheet in concentrated nitric acid. Another battery of this kind is the Bunsen, which is constructed like the Grove, but has carbon in place of the platinum sheet, because carbon is very cheap. These batteries give a constant current for quite a while, but the salt solutions and the acids are exhausted before long and then have to be renewed, and the zinc cylinders are gradually eaten up.

Open Circuit Batteries.—The open circuit batteries on the contrary are quickly exhausted; they decrease in strength considerably if closed for a few minutes only, and they must rest for some time before they come up to the original strength again, therefore these batteries are used where current is needed for a few moments at a time, as for instance in connection with electric bells in houses, where, by touching the button, contact is made and a circuit is closed for a few moments only at a time, while the rest of the time the circuit is open; hence these batteries are termed open circuit batteries. The typical battery of this kind is the Leclanche cell, which consists of a glass jar containing a solution of sal ammoniac, in which is a zinc rod, and a porous cup containing a mixture of carbon and manganese dioxide and a carbon plate. The upper rim of the glass jar and of the porous cup has to be covered with paraffine or grease in order to prevent the creeping up of crystallized sal ammoniac, which would settle all over the glass jar. This battery has been extensively used for operating house and hotel annunciators, electric bells, domestic telegraphs, telephones, burglar alarms, electric clocks, and in electric gas lighting, etc. As the above named uses indicate, the open circuit battery is employed principally in private residences and hotels, and if overturned by accident the sal ammoniac solution will ruin wooden fixtures, carpets, etc., and notably by this deficiency the attention of inventors was turned to the construction of batteries without solutions for open circuit work, that is, to dry batteries.

Historical Dry Batteries.—In the early days of electrical science it was believed that conducting liquids were absolutely necessary for constructing a galvanic battery. Then the crude dry cells were invented, which seemed to prove that no liquids need to be in a galvanic cell. However, moisture at least is necessary for making a galvanic cell operative. This has been proved by Ermann,[1] who placed a dry battery in an artificially dried space and observed that there was no electricity then.

The first dry cell was constructed by Behrens,[2] who used zinc and copper plates, which were separated by gold paper impregnated with table salt. De Luc[3] employed tin, silver and writing paper. Zamboni[4] used artificial silver, paper and manganese dioxide. In those days a dry cell was often constructed of round pieces of paper, which were covered on one side with artificial gold (copper and zinc) and on the other with artificial silver, zinc and tin. The small diameter of these leaves made it possible that thousands of them could be used in a varnished tube, so that a pretty strong battery was obtained. Binding posts were provided at the ends of the tube, so as to allow the connection of the battery for work.

These crude dry batteries showed plainly the advantages of them in comparison with the wet cells. The absence of solutions in them guarantees absolute cleanliness; glass jars which easily break are not necessary; the cleaning and renewing of the zincs and the refreshing of the solutions is dispensed with, which renders the dry battery cheaper and more pleasant in use, and prevents disagreeable interruptions while the same are in operation. Although quite a number of dry batteries have been constructed within the last ten years by various inventors, still the dry cell has not received that attention by inventors which has been displayed in other branches of electrical science, and which this subject really deserves.

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[1] Ermann, Gilb. Ann., XXV., 1.
[2] Behrens, Gilb. Ann., XVIII., 1.
[3] De Luc, Gilb. Ann. XLIX., 100.
[4] Zamboni, Gilb. Ann., XLIX., 41.—LI., 182.

Modern Dry Batteries.—In the modern dry batteries zinc is generally employed as one electrode, and it is advisable to provide the zinc in the form of a cylindrical case, and to mount the other parts of the cell therein so that the glass jar is dispensed with. In its plainest form the modern dry battery consists of the zinc case A, which acts as the zinc rod in a wet galvanic battery, and is provided at the top with a binding post to which a wire can be attached, a carbon plate B, which is generally mounted in the centre of the zinc case without touching its bottom, and which is provided with a second binding post for attaching the second wire; a porous diaphragm or cylinder D, between the zinc case and the carbon, made usually of paraffine or wax paper; an excitant C around the carbon plate and in the diaphragm cylinder and a seal on the top of wax, pitch or the like. The excitant may contain any salts which are used in wet batteries. Thus it is plainly seen that every one can construct a dry cell for himself; the zinc cases and the carbons are found in the market and only the excitant has to be prepared. The excitants, whose composition is often a trade secret, are generally prepared in a pasty condition. Quite a number of dry batteries have been put on the market within the last decade and some of them will be described further down, when at the same time the components of the excitants will be given. Among the dry batteries which are on the market may be mentioned those of Dr. Gassner, Burndey, Bryan, Koller, Hellesen, Crosby, Hussey, Hewett and "The Mesco" of Harry T., Johnson.

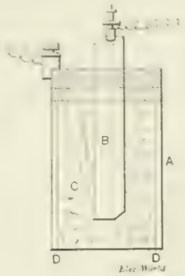


Fig. 1.—Plain Form of Battery.

Hellesen's Battery.—Although there is hardly any evolution of gas in dry batteries, still some gas may be formed, and in a hermetically closed battery these gases may force their way through some weak point or even injure the battery, therefore in Hellesen's construction little openings are provided in the top and above the active substances for allowing such gases to escape. Hellesen's battery consists of an outer receptacle A, and an inner receptacle B, of zinc, the carbon C, which is surrounded by a bag H, wherein a paste is contained of di-polarizing substances; the space between the bag and the inner walls of B is filled up by a thick, slimy matter containing the electrolyte G, which causes the electrical excitation. Above the bag a layer E, of plaster of paris, or the like, is put in, and on the top is a layer of pitch. The space between the inner and outer receptacle contains sawdust or slag wool. The inner case B has two small air holes a in the portion where the plaster of paris is. The outer receptacle A has two small air holes d near the bottom. Any gases arising in the electrolyte G will pass through this mass, through the plaster of paris and leave through the hole a going through the sawdust or slag wool, and will pass out through the little holes. The carbon is provided at the top with a metal head C, in form of a binding post, and the inner receptacle B is provided with a wire or binding post, which passes through the pitch, so that the current can be taken off.

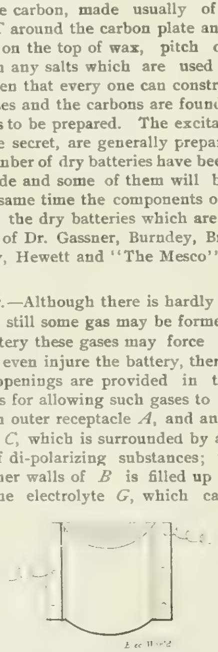


Fig. 2.—Bryan Battery.

Bryan's Battery.—Bryan has invented a battery for especial use in connection with electric belts. It consists of a semi-cylindrical zinc case A, which is flat on the inner surface so that it can be fastened on the belt, a carbon plate B and an excitant C, enveloping the carbon plate B inside of the case A. A strip of paraffine paper insulates the carbon from the zinc. The excitant consists of sulphate of iron, six parts; bisulphate of mercury, one part, and sulphate of calcium, five parts, all by measure. Water is added to this mixture until the whole is plastic; it dries out in time and hardens. The sulphate of calcium acts merely as a body for the active ingredients of the excitant. The compound forming the excitant may be filled into the case while in a plastic condition. The top through which the excitant is introduced is sealed with wax.

Koller's Battery.—In Koller's dry battery the excitant consists of plates of exciting material in a gelatinous consistency; the diaphragms in the cell are made of perforated sheets of waterproof insulating material, for instance, gutta-percha paper, paraffine paper, or wax paper. In order to prepare these plates agar-agar is boiled in sixteen to thirty times its weight of water until its structure is lost, when six parts of sugar syrup may be added to prevent the drying and shrinking. The mass is evaporated to a desired density, and before it solidifies metallic salts are stirred in there in dry form or as concentrated solution; these salts give the electric excitation in these batteries. Any salts which may be used in a galvanic battery can be employed, except those which prevent agar-agar from coagulation. Sulphate of copper, for instance, will prevent the coagulation if too long in contact with the liquid agar mass. The amount of salts stirred in the agar mass is the same as would be used in a solution for this respective size in a wet battery. The pasty or solid mass, with the excitant salts, are cast into blocks, these blocks are cut into plates, which are inserted between the plates of the cell, the diaphragms are mounted so that the perforation of one diaphragm stands against the full part of the other. In the sketch A is the zinc plate, B is an agar plate containing sulphate of zinc; then follow two diaphragms C with space F between them, then comes an agar plate containing sulphate of copper, then comes a copper plate. The copper and zinc plates are provided with binding posts so that the current can be taken off.

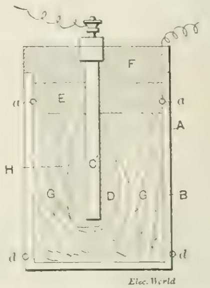


Fig. 3.—Hellesen Battery.

The Efficiency of Dry Cells.—The time which a dry battery will last depends upon the work it is to perform. For ordinary call bell or burglar alarm service it will last from one to two years. It is asserted that a dry battery rang an electric bell for over two hundred hours without interruption, a result which can hardly be obtained by the use of a Leclanche battery. A primary clock may be driven by a dry battery for over half a year. A primary clock connected with a secondary clock can be driven by three batteries for over nine months without being stopped for a moment. The electromotive force of dry batteries varies from 1.30 to 1.50 volts. Prof. Eric Gerard, at the Electro Technical Institute in Liege, Belgium, found 1.44 volts E. M. F. and 0.32 ohms internal resistance. The amperage varies according to size; some show six to eight amperes. The dry batteries are manufactured in various sizes, the outside dimensions of the most used sizes are, height 4¼ to 7⅜ inches, and the diameter is from 2⅞ to 7⅜ inches. For working bells a small cell will answer, while for telephone service a cell 7⅜ inches high and 4⅞ inches wide is generally employed.

Electrical Power Transmission.—XII.

BY LOUIS BELL, PH. D.

On long lines, the direct current has the advantage of producing no inductance in the line, an advantage, however, which does not apply to plants of voltage such as would be ordinarily used on long lines, and which, therefore, can advantageously be operated only as single units. Such a single unit system, arranged for alternating currents, can have the inductance of the circuit completely nullified by the simple expedient of strengthening the field of the motor. In plants of moderate voltage, involving distribution of power, and in such plants only, does this property of avoiding inductance become of any value, and we shall see later that even here the advantage is more nominal than real, on account of the trifling inductance found in alternating lines up to a distance at which direct current distribution would become inadvisable on account of limited voltage. In cases of distribution direct current voltages of over 1,000 volts are nearly impracticable on account of the difficulty of winding motors of moderate size for more than this voltage. If the number of units be considerable, the three wire system affords some relief in this particular. When, therefore, distances of several miles are to be covered and power is to be distributed, direct current is at a disadvantage by reason of the available voltage, which compels a considerable lowering of the efficiency of the system, or a very great increase in the amount of copper.

It must be remembered, however, that in several particulars direct current has peculiar advantages. In the first place, it must be admitted that a direct current is decidedly less dangerous than an alternating current of the same nominal voltage, so far as the question of life is concerned. The difference between the two is probably even greater than would be indicated by the difference in maximum voltage. An alternating current has a maximum voltage of approximately 1.4 times its mean effective voltage, and in addition to this an alternating current is certainly intrinsically more dangerous by reason of the greater shock to the nervous system produced by the alternations of E. M. F. The ease of transforming alternating current to a lower voltage partially obviates this objection, but the fact remains. So far as dangers of fire are concerned, the direct current has the power of maintaining a much more formidable arc than an alternating current of the same effective voltage; but, on the other hand, the alternating current has somewhat greater maximum voltage with which to start the arc, so that, practically, honors are even. It is a mistake, however, to suppose that the increased maximum voltage in an alternating current embodies greater danger of leaking, or breaking down insulation under all circumstances. Under many conditions it is highly probable that the electrolytic strain from direct current on insulating materials, particularly when damp, may be more destructive than the added electrostatic strain of an alternating current. Within any voltages now employed, the total difference is probably immaterial. In the matter of one of the great dangers to an overhead line and apparatus, *i. e.*, injury from lightning, direct current has a very material advantage in that it is possible to use coils of considerable self-induction in connection with such circuits, so as to keep oscillatory discharges, like lightning, out of the machines. This is well shown in the singular freedom of arc lighting stations from serious damages to the machines by lightning, as compared with stations containing other kinds of electrical apparatus. In this case the magnets of the arc machines themselves act as a powerful inductance, tending to throw the lightning to earth. High voltage, shunt wound dynamos and alternators are much more sensitive in this respect. As a consequence, part of the price one has to pay for the privilege of utilizing alternating currents is extra care with respect to protective devices against lightning. In the present state of the art, the best field for transmission and distribution of power by direct currents is in problems involving distribution over moderate distances, within, say, a couple of miles from the centre of distribution, and even then in problems where lighting is not an essential part of the work. The voltage of lighting circuits is determined by the voltage of the lamps which can be employed upon it, and this is so limited that if lighting is to be done on the same circuit as power distribution there are very few cases where such a combined system can be successfully used.

At all long distances direct current is at a disadvantage in the matter of available voltage where distribution is employed, and has no very material advantages for single unit work. Nothing short of a revolution in the art of making commutators can render the direct current thoroughly available for high voltages, and even then only in fairly large units. In this lies its weakness. Its strength is largely in its present firm foothold in electrical practice, and the fact that standard apparatus of this kind is available everywhere and is manufactured in large quantities by numerous makers. It is, furthermore, interchangeable to a degree which will never be true of alternating current machinery until there is far greater unity in alternating current practice than we are likely to have for some years to come.

The Line.

The line is the most critical part of a power transmission system, for on its integrity depends the continuity of service without which even the most perfect apparatus is commercially useless. In most cases the customer who uses electrical power neither knows the efficiency of his motor nor cares much about it so long as the machine goes steadily along without the annoyance and expense of frequent repairs. But if the service frequently fails, suspending the operation of all his machinery while repairs are being executed, the electric motor, so far as he is concerned, is a commercial failure, and a nuisance to boot, and no representations of cheap power can be of much avail when a single stoppage may cause more loss than could be recompensed by free power for a month.

Modern dynamos and motors of almost every class are reasonably efficient and reliable, so that as a rule the line is the weakest portion of the system. More particularly is this the case when the distance of transmission is great and many miles of line must be guarded, inspected and kept in perfect working order. In such lines not only is the actual labor of maintenance increased, but the principal engineering difficulties will there be encountered. With apparatus of the character even now available, the future of electrical power transmission depends in very large measure on the development that takes place in the construction, insulation and maintenance of the line, together with the solution of certain electrical problems that arise as the line grows longer. It is therefore important to go into the matter very carefully, as regards not only the general arrangements and the electrical details of the work, but with respect to methods of construction.

We may thus with advantage divide our consideration of the line into three heads. First, the line in its general relations to the plant, considering it merely as a conductor. Second, the line as a special problem in engineering. Third, the line as a mechanical structure. Of these heads the first has to do with such questions as the proper proportioning of the line as a part of the system, its function as a distributing conductor, and its bearing on the general efficiency of the plant of which it is a part. Next come up for examination the electrical difficulties that inhere in the line, and finally the materials of construction and the methods of applying them.

One of the first questions that arises in designing a plant for the transmission of power is the character and dimensions of the conducting system in their relation to the rest of the plant. Efficiency is generally the first thing thought of—cost comes as a gloomy afterthought—and between these two service is only too frequently neglected. In taking up a transmission problem the layman's first query generally is, "How much power will be lost in the line?" and when the engineer answers, "As much or as little as you please," the subject of line design is opened up in its broadest aspect.

Whenever an electrical current traverses a conductor there is a necessary loss of energy due to the fact that all substances have an electrical resistance which has to be overcome. The energy so lost is substantially all transformed into heat which goes to raising the temperature of the conductor, and indirectly that of surrounding bodies. The facts in the case are put in their clearest and most compact form by Ohm's law, $C=\frac{E}{R}$. This states that the current is numerically equal to the electromotive force between the points where the current flows, divided by the resistance. Hence, this E. M. F. equals the current multiplied by the resistance between these points.

$$E = CR.$$

This tells us at once the loss in E. M. F. between the ends of any line provided we know the current flowing and the resistance of the line. And inasmuch as the energy transmitted by the same current varies directly with the working E. M. F. a comparison of the loss in volts determined as above, with the initial E. M. F. applied to the circuit, shows the percentage of energy lost in the line. Obviously its absolute amount in watts is equal to the E. M. F. lost, multiplied by the current, *i. e.*, $C\,E$, or from the above, $C^2\,R$, if we prefer to reckon in terms of the resistance.

(To be continued.)

Practical Notes on Dynamo Calculation.—XXV.

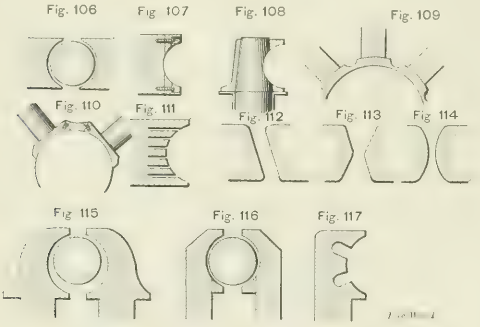
BY ALFRED E. WIENER.

Chapter 11 —Pole Pieces.

(a) Material.

The pole pieces, if the shape and the construction of the magnet frame permits, should be of *wrought iron* or *cast steel* in order to reduce their size, and therefore their magnetic leakage, they being of the highest magnetic potential of any part of the magnetic circuit. In forging, care should be taken that the "grain" or texture of the iron runs in the direction of the lines of force. The pole pieces, however, usually have to embrace from .7 to .8 of the armature surface (compare Chapter 1), and are, therefore, particularly in the case of bipolar machines, often comparatively large. If in such a case their cross section, in order to give sufficient mechanical strength, is to be far in excess of the area needed for the magnetic flux, there is no gain in using wrought iron or cast steel, and the pole pieces should be made of cast iron. The *cast iron* used should be as soft and free from impurities as possible. It is preferable, whenever practicable, to have it annealed, and, if not too large in bulk, to have it converted into malleable iron; this is especially to be recommended for small machines.

An admixture of *aluminium* has been found to increase the permeability of the cast iron; by adding 1½ per cent., by weight, of aluminium, the maximum carrying capacity of the cast iron is increased about 5 per cent., by 3 per cent. admixture it is increased 7 per cent., and by adding 6 per cent. of aluminium, the induction increases about 9 per cent.; above 7 per cent. of admixture, the permeability decreases, and at 12 per cent. addition of aluminium the gain in magnetic conductivity falls down to 7 per cent. From this it follows that an addition of from 6 to 7 per cent., by weight, of aluminium is the proper admixture for the purpose of improving the magnetic qualities of cast iron, which is explained by the fact that the latter percentage is the limit from which up the hardening influence of the aluminium upon the cast iron becomes appreciable.



FIGS. 106 TO 117.—TYPES OF POLE PIECES.

In large multipolar machines combination frames consisting of wrought iron magnet cores, cast iron yokes, and cast steel pole pieces, give excellent results, having the advantages of the high permeability and uniformity in the magnetic qualities of the wrought iron, of cheapness of the cast iron, and of reduction in size of the cast steel pole pieces, and being easier to machine, requiring less chipping and being more easily finished than a magnet frame made entirely of cast steel.

A material which a few years ago was quite a favorite with dynamo builders, but which since has to a great extent been displaced by the cheaper cast steel, is the so-called "*Mitis metal*," or *cast wrought iron*, obtained by melting down scrap wrought iron in crucibles and by rendering it fluid by the addition of a small quantity of aluminium. The trouble with this material was that a great many extra precautions had to be taken to procure sound castings, and that as a rule the castings were rough and difficult to work on account of their toughness. The magnetic value of Mitis metal differs very little from that of cast steel, its permeability at the inductions used in practice, being but a trifle lower than that of the latter.

Edges and sharp corners are to be avoided as much as possible, for if they protrude sufficiently they will act to a certain extent as poles and give cause to a source of loss. In castings thin projections are apt to chill while being cast, thus making them quite hard and destroying their magnetic qualities; when necessary for mechanical reasons they should therefore be cast quite thick and massive and may afterwards be planed or turned down to the required size.

(b) Shape.

The pole pieces have for their object the transmission to the armature of the magnetic flux set up by the field magnet, and the establishment of a magnetic field-space around the armature. The shape to be given to them must therefore effect the concentration of the lines of force upon the armature and not their diffusion through the air. This, in general, is achieved by making the polar surfaces as large as possible and bringing them as near to the armature as mechanical considerations permit, and by reducing the leakage areas of the free pole surfaces as much as possible. For practical rules of fixing the distance between the pole corners and the clearance between armature surface and pole pieces for various kinds and sizes of armatures see Tables XLVII. and XLVIII., Chapter 34, respectively.

Since Foucault or eddy currents are produced in all metallic masses, either by their motion through magnetic fields or by variations in the strength of electric currents flowing near them, the pole pieces of a dynamo-electric machine are seats of such currents which form closed circuits of comparatively low resistance and thereby cause undue heating. These currents are strongest where the changes in the intensity of the magnetic field or of the electric current are the greatest and most sudden; this is the case, and consequently the eddy currents are strongest at those corners of the pole pieces from which the armature is moved in its rotation, for owing to the distortion of the magnetic field by the revolving armature a density greater than the average is created at the corners where the armature leaves the pole pieces and a density smaller than the average at the corners where it enters. In order to reduce and eventually to avoid the generation of these eddy currents in the pole pieces as well as in the armature conductors, it is therefore necessary to prevent the crowding of the magnetic lines towards the tips of the pole pieces and to so arrange the poles that the magnetic field does not suddenly fall off at the pole corners, but gradually decreases in strength towards the neutral zone. This object in a smooth armature machine can be attained (1) by gradually increasing the air-gap from the centres of the poles towards the neutral spaces in boring the polar faces to a diameter larger than their least diametrical distance apart, thus giving an *elliptical* shape to the field space as illustrated in Fig. 106; (2) by providing wrought iron pole pieces with *cast iron tips* forming the pole corners and terminating the arcs embraced by the pole faces (see Fig. 107 and 108); or (3) by establishing a magnetic shunt between two neighboring poles in connecting the pole pieces either by a cast iron ring of small sectional area (Dobrowolsky's *pole-bushing*) or by placing thin *bridges* across the neighboring pole corners, as shown in Figs. 109 and 110, respectively.

The *ellipsity* of the field space has the advantage that it confines the lines of force within the sphere of the pole faces by proportionately increasing the reluctance towards the pole corners, thus preventing an increase of the magnetic density at any particular portion of the pole piece. The application of *cast iron pole tips* with wrought iron (or cast steel) pole pieces does not prevent the crowding of the lines at the pole corners, but by reason of the low permeability of the cast iron reduces their density to a figure below that in the wrought iron, and consequently effects a graduation of the field strength near the neutral space, the maximum density being in the wrought iron at the point where the cast iron tips are joined. In the *pole bushing* or its equivalent, the *pole-bridges*, the reach of the magnetic field is greatly increased, the percentage of the polar arc being practically=100, and also a more or less gradual decrease of the field strength at the neutral point is obtained, but the length of the non-sparking space is greatly reduced and thereby its uncertainty increased, thus making the proper setting of the brushes a very difficult operation.

It has also been recommended to *laminate* both the pole pieces and the magnet cores in the direction parallel to the armature shaft in order to prevent the production of eddy currents, but this can only be applied to small dynamos, as the additional cost connected with such a lamination in large machines would be in no proportion to the small gain obtained. Besides, there is another reason against lamination; a laminated magnet frame is very sensitive to the fluctuations in the load of the machine, which naturally react upon the magnetic field, and in following these fluctuations, an unsteady magnetization is produced, which, in turn, again tends to increase the fluctuations causing its variability; while in a solid magnet frame the eddy currents induced by the changes of magnetization caused by the fluctuations of the load tend to counteract the very changes producing them, and therefore exercise a steadying influence upon the field, thus reducing the fluctuations in the external circuit of the machine.

An expedient sometimes used instead of laminating the pole pieces is to cut narrow longitudinal slots in the pole pieces, Fig. 111, thus laminating a portion of the pole-pieces only. These slots at the same time serve to increase the length of the path traversed by the lines of force set up by the action of the armature current, and to thus reduce the armature reaction upon the magnetic field, checking the sparking connected therewith.

When the commutator brushes, after having short-circuited an armature coil, break this short circuit, the sudden reversal of the current in the same, produced in passing the neutral line of the field, together with the self-induction set up by the extra current on breaking causes a spark to appear at the brushes, which may be considerable, since in the comparatively low resistance of the short-circuited coil a small electromotive force is sufficient to produce a heavy current. If a dynamo, therefore, is otherwise well designed, that is, if the armature is subdivided into a sufficient number of sections, if the field is strong enough so as not to be overpowered by the armature, and if the thickness of the brushes is so chosen as to not short-circuit more than one or two armature sections each simultaneously, and as not to leave one commutator bar before making connection with the next strip, then the sparking at the commutator can be reduced to a practically unappreciable degree by so shaping the pole surfaces as to give a suitable fringe of magnetic field of graduated intensity, thus not only causing the current in the short-circuited coils to die out by degrees, but also compelling the coils to enter the field of opposite polarity gradually. This is achieved by giving the pole corners an *oblique*, or a *double conical*, or a *hyperbolical* form, as illustrated by top views in Figs. 112, 113 and 114, respectively.

For the purpose of counteracting the magnetic pull due to the armature thrust in bipolar machines, see Chapter 24, the pole pieces are often mounted *eccentrically*, leaving a smaller gap space at the side averted from the field coils than at the side towards the same, Fig. 115; or in case of wrought iron or steel pole pieces, *cast iron pole tips* are used at the side towards the exciting coils and wrought-iron or steel tips at the other, Fig. 116. Both the *eccentricity of the pole faces* and the *cast iron pole tips*, if suitably dimensioned, have the effect of increasing the reluctance of the stronger side of the field in the same proportion as the density rises on account of the dissymmetry of the field, thus making the product of density and permeance the same in both halves.

(To be continued.)

Electrodynamic Machinery.—XXV.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

118. In order to show the application of the foregoing principles to the calculation of the E. M. F. produced in an armature of the Gramme type, we will take the case of a bipolar Gramme wound armature from dimensions given by Messrs. Owen and Skinner in a paper read before the American Institute of Electrical Engineers, May 16, 1894, to which paper the reader is referred for fuller particulars of construction and results.

Fig. 106, reproduced from the paper referred to, shows a vertical and a longitudinal cross-section of the machine, which is a bipolar constant current Gramme-wound generator of the Wood type, intended for the supply of any number of arc lamps in series up to 25, and therefore, capable of supplying a total E. M. F. of approximately 1,200 volts at terminals, with a current strength of approximately 10 amperes and an external activity of about 12 kw.

This machine, when complete, closely resembles the generator shown in Fig. 107. Referring to Fig. 106, the field magnet frame of cast iron is shown at *M*, *M*, *M*, *M*, the field coils being wound on spools and filling the spaces indicated. The shaft of the machine is supported in bearings *B B*, and space is left on the shaft for a commutator at *C*, and a driving pulley at *P''*. The bipolar field poles produced by the M. M. F. of the magnet coils *M*, *M*, *M*, *M*, are shown at *P P*, *P'' P''*. The Gramme-wound ring armature is shown at *A A A*. The dimensions of the machine are indicated in inches on the figures.

119. The field winding consists of 100 lbs. of No. 10 B. & S. gauge, single cotton-covered copper wire, the total resistance of the four coils in series being 15.75 ohms hot. The armature core is composed of soft charcoal iron wire of the cross-section shown. It is wound in 15 layers of No. 10 B. & S. gauge, and contains about 9,450 wires, each having a cross-section of 0.00817 square inches, or a total cross-section of 77.2 square inches = 498.1 square cms. The armature is wound in 100 sections of No. 14 B. & S. gauge, double cotton-covered copper wire, in 57 turns each, or 5,700 turns, making a total of 115 lbs. of wire, with a total resistance of 28.8 ohms hot, but which being connected in two parallel halves, as represented in the figure, has a joint resistance between brushes of 7.2 ohms. Assuming 10 amperes to flow through the machine, the drop in the armature will, therefore, be 72 volts, and the drop in the field magnets 157.5, making the total drop in the machine 229.5. When, therefore, the pressure at the machine terminals is 1,200 volts, the E. M. F. generated by the machine is practically 1,430 volts, or $1,430 \times 10^8 = 1.430 \times 10^{11}$ C. G. S. units of E. M. F.

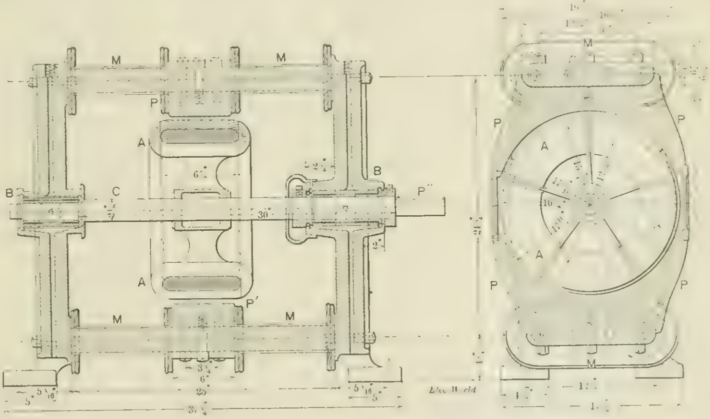


FIG. 106.—GRAMME TYPE ARC MACHINE.

120. The formula for determining the E. M. F. generated by a bipolar armature is

$$E = \Phi\, n\, w \qquad \text{C. G. S. units (Sec. 45).}$$

Consequently, $\phi = \frac{E}{n\, w}$.

The speed of this generator is stated to be 1,000 revolutions per minute, or 16.67 revolutions per second, and w is 5,700, therefore,

$\Phi = \frac{1.43 \times 10^{11}}{16.67 \times 5{,}700} = 1.505 \times 10^6$. The total flux through the armature is, therefore, 1.5 megawebers.

121. Assuming that the M. M. F. required for this machine were not known, it could be calculated in the following way. We first determine the flux density in the various parts of the circuit, and from that the reluctivity and reluctance of the various portions. The cross-section of the armature core, as already stated, is 498 square cms. and if the flux goes through each side or cross-section of the armature, the intensity in the armature is, therefore, $\frac{0.75 \times 10^6}{498} = 15{,}060$ gausses. The arc covered by each pole-piece is approximately 55 cms and the effective breadth 6.5" = 16.5 cms, so that the area of the polar surface is approximately $55 \times 16.5 = 907.5$ square cms. The total flux passes through this surface, and the

mean intensity in the air gap is $\frac{1.5 \times 10^6}{907.5} = 1,658$ gausses.

122. Fig. 108 represents diagramatically the arrangement of magnetic circuits through the machine, where M, M, M, M, represent the field magnet cores, $P\ P'$ the pole-pieces and $A\,A$ the armature. Fig. 109 represents diagramatically the voltaic analogue of the magnetic circuits, where $M_1\ M_2\ M_3\ M_4$ are four batteries, whose E. M. Fs. correspond to the M. M. Fs. of the field magnet coils M^1 and M^3, form one circuit through the field frame, a certain mean length of the pole-pieces and a mean length in the armature a, together with the two resistances $R\ R$ in the air gaps. A similar circuit is provided for the E. M. Fs. M^2 and M^4, through the air-gap resistances R and R, and the mean lengths of armature and pole-pieces. The equivalent arrangement of circuits is represented in Fig. 110, where $M\ \ M$ are E. M. Fs., each equal to M, while the resistance of the double circuit through the field frame is one-half of that of either of the resistances represented in Fig. 109.

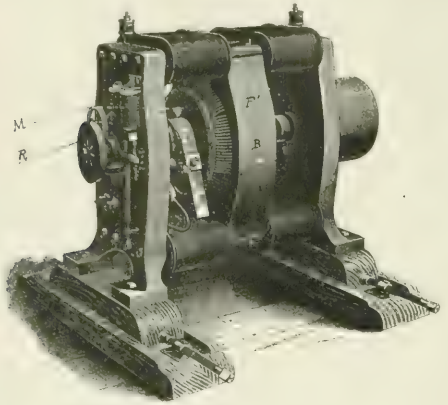
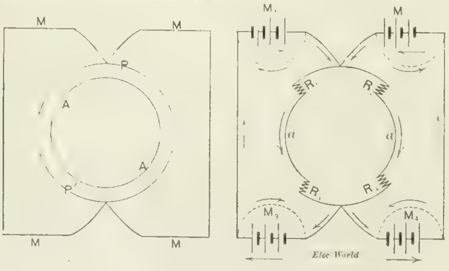


Fig. 107.—Gramme Type Arc Machine.

The flux through the field cores will be greater than the flux through the armature by reason of a certain leakage which occurs over the surface of the magnetic circuit. This leakage is represented diagramatically in Fig. 109 as taking place in a branch circuit or dotted semi-circle around the field coils, but in reality the leakage takes place in an extended system of branched or derived circuits between the polar surfaces and portions of the entire field frame. The calculation of the various reluctances in the air-path offered to leakage is very complex, and it is preferable rather than to attempt such calculation, to refer to experimental data already acquired with machines of similar type. The leakage factor, or the ratio of total flux through the field magnet cores to the total flux passing from them through the armature, for a machine of this type, is approximately 1.7, so that since the useful flux passing through the armature from each circuit $M_1\ M_3$ and $M_2\ \ M_4$, Fig. 109, is 0.75 megaweber, the flux through the field cores may be taken as $0.75 \times 1.7 = 1.275$ megawebers. The cross-section of the cores is found to be 176.8 square cms, so that the intensity in them is approximately $\frac{1.275 \times 10^6}{176.8} = 7,211$ gausses.



Figs. 108 and 109.—Diagram of Magnetic Circuit and Voltaic Analogue.

123. The reluctivity of the armature, consisting of soft wrought iron at a density of 1.5 kilogausses, is approximately 0.0045 (Fig. 47), the mean length of the flux paths through the armature 38 cms. and the cross section 498 square cms. The reluctance of each side of the armature a (Figs. 109 and 110) is, therefore, $\frac{38 \times 0.0045}{498} = 0.000343$ oersted. The joint reluctance of the armature will, therefore, be 0.00017 oersted, but since the armature does not consist of continuous sheets of iron, but of wires, and the flux has to penetrate from wire to wire downward through small air-gaps, the total effective reluctance of the armature will be approximately 0.001 oersted. The length of the air-gap or entrefer is $1.22'' = 3.1$ cms, and the area as already determined, 907.5 square cms, so that the reluctance in each air-gap will be $\frac{3.1}{907.5} = 0.003416$ oersted, the total reluctance in the air as seen in Fig. 110 will be 0.006832 oersted.

The reluctivity of the cast iron in the field frame at a mean intensity of 7,211 gausses may be taken as 0.009 (Fig. 47). The length of the mean path in the field on each side of the machine is approximately 152.4 cms, and its cross-sectional area 176.8 square cms, so that the reluctance in each half of the field will be approximately $\frac{152.4}{176.8} \times 0.009 = 0.00776$ oersted. The total flux being divided between the two sides of the field, the joint reluctance, as represented in Fig. 110, will be 0.00388 oersted.

The drop of magnetic potential in the reluctance of the armature ($\Phi\ R$) will be . . . . . $1.5 \times 10^6 \times 0.001 = 1,500$

The drop of magnetic potential in the reluctance of the air . . $1.5 \times 10^6 \times 0.006832 = 10,248$

The drop of magnetic potential in the reluctance of the field . $2.55 \times 10^6 \times 0.00388 = 9,894$

$\overline{21.642}$

Since one gilbert = 0.7854 ampere-turn, the total M. M. F. in the circuit will have to be 17,000 ampere-turns, or 8,500 ampere-turns on each of the spools $M\ M\ M\ M$.

124. The preceding calculation is open to errors from several sources in the absence of definite experimental data, namely:

(1) The assumed leakage factor may be inaccurate.

(2) The mean lengths of the flux paths in various portions of the circuit may be inaccurate.

(3) The assumed increase in the reluctance of the armature due to its being formed of wires instead of solid sheets may be inaccurate.

(4) The reluctivity of the cast iron employed in the machine may not be that of the sample of cast iron assumed.

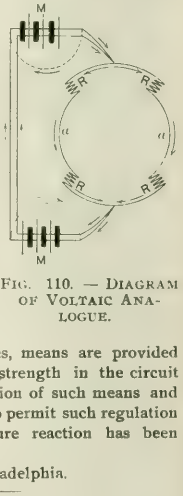


Fig. 110. — Diagram of Voltaic Analogue.

In this, as in all constant-current machines, means are provided for maintaining a nearly constant current-strength in the circuit despite changes in the load, but a consideration of such means and of the requirements of the magnetic circuit to permit such regulation will preferably be postponed until armature reaction has been studied. (To be continued.)

Laboratory of Houston and Kennelly, Philadelphia.

The Elihu Thomson Prize.

To the Editor of The Electrical World:

Sir:—I notice in your issue of Jan. 26, in giving an account of the "Elihu Thomson prize" in France that you have accorded me more credit than is justly my due. The second sum of 5,000 francs awarded to Dr. Oliver Lodge for his paper was the result of a subscription started by Mr. Ernst Thurnauer in Paris, and to which fund others contributed as well as myself. In fact, the credit of having secured the duplication of the original prize is, I believe, due to Mr. Thurnauer, who, before I knew anything of the matter, had gone to work upon it, with the result which has been announced.

I wish publicly to thank not only Mr. Thurnauer, but also the gentlemen who took such a warm interest in the contest and awarded the prizes, as well as the other subscribers to the second fund. I appreciate your kindly remarks in your editorial dealing with this subject. Elihu Thomson,

Lynn, Mass.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE BY CARL HERING COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 922 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

Note.—Owing to the large amount of matter this week some of the abstracts had to be held over until next week.

DYNAMOS, MOTORS AND TRANSFORMERS.

Dynamos Without Commutators.—"L'Eclairage Elec.," Jan. 5, contains a short paper by Mr. Malagoli on the rotating alternating field and its utilization. He discusses alternating revolving vectors and states that "an alternating revolving vector can be considered as the resultant of two constant and equal vectors one revolving to the right and the other to the left and excited besides from another movement of rotation in common to the right or to the left according to the direction of rotation of the revolving alternating vector. One of the vectors being thus excited from two velocities equal and contrary will remain fixed whilst the other turns with a velocity double that of the alternating revolving vector and in the same direction as this one;" a diagram is given to illustrate this. Appyling it to a Gramme ring winding with permanent connections at the end of the diameter and supposing that an alternating field revolves around this ring such that the zero lines coincide with this diameter, he shows that the windings will be the seat of a constant E. M. F. of the same intensity during the whole period; "from that which precedes it easily follows that one could construct a continuous current dynamo having two equal magnetic fields, the one fixed and the other revolving, with separate or with self-excitation, without the use of a Pacinotti commutator but simply with two sliding contacts between which passes the exciting current of a revolving field." He states that it is furthermore possible to apply these results to the construction of a transformer excited by an alternating current which would furnish a continuous current without any revolving part.

Dynamo Without Iron.—Mr. Coerper, in a communication to the "Elek. Zeit.," Jan. 3, states that a number of years ago his company built an 8-hp. dynamo somewhat like that suggested by Mr. Pietzker (see Dig st, Jan. 12), but found that there are no advantages gained.

Design of Large Alternators.—In a brief communication to the Lond. "Elec. Rev.," Jan. 18, Mr. Kennedy in reply to Mr. Armstrong, of Schenectady, states that the London Electrical Supply Company, after many years of experience with coreless disc alternators, have just ordered another one of 1,000 kw, thus confirming his contention that coreless disc dynamos are perfectly successful "and much superior to the horrible designs embodying gigantic rickety masses of laminated iron stampings. * * * We may look forward to an American inventor in a few years discovering the coreless disc armature, and extolling its virtues, in the same way they discovered the constant current dynamos years after they were abandoned here."

Synchronous Motors.—A mathematical paper of some length by Mr. Steinmetz is published in the "Elek. Zeit.," Jan. 10-17. It does not admit of being abstracted; in the conclusion he gives a numerical example.

Theory and Calculation of Non-synchronous Motors.—A mathematical article by Mr. Legrand is begun in "L'Eclairage Elec.," Jan. 5.

Starting Motors.—In the "Elek. Zeit.," Jan. 10, Mr. Menges discusses the subject, with special reference to the recent article of Mr. Egger (see Digest, Jan. 12), giving, however, nothing new.

The "Western Electrician," Jan. 26, was not received.

First Polyphase Motor.—The article by Prof. Thompson abstracted in the Digest, Feb. 2, is reprinted with the illustration in the "Elec. Rev.," Jan. 30.

Dynamo Design.—In Mr. Harrison's serial in the "Elec. Age," Jan. 26, he discusses the choice of the metals for the field magnets.

Dynamo.—The one with hinged pole pieces described in the Digest, Feb. 2, is illustrated in the "Elec. Rev.," Jan. 30.

LIGHTS AND LIGHTING

The Electric Arc.—The Lond., "Elec.," Jan. 18, begins the publication of a paper by Mrs. Ayrton in which she will give a very short abstract of the most important points and deductions of the paper by Prof. Ayrton which he read at the Chicago Congress in 1893, the only copy of which was unfortunately destroyed by fire; it will be followed by some later experiments and investigations which she is conducting in the form of a continuation. The paper does not admit of being abstracted, as some of the most valuable information is contained in the form of numerous diagrams and curves, but the following will give an idea of the treatment of the subject. The experiments to which Prof. Ayrton directed his special attention are briefly: "1. Obtaining curves connecting the steady final values of the potential differences between the carbons with the current for different currents, lengths of arc and sizes of carbons, cored and uncored. 2. Obtaining the time variations of the potential difference between the carbons with various constant currents, various constant lengths of arc, and with the ends of the carbons variously shaped. 3. Obtaining the time variation of the potential difference between the carbons when the current was suddenly changed, and the length of the arc was kept constant. 4. The distribution of potential throughout the arc. 5. The influence of varying the current and the length of the arc on the depth and width of the crater. 6. The candle-power and efficiency of the arc, with various currents, potential differences and lengths of arc." The lamp used was hand regulated, an illustration of which is given; the differences of potentials between the carbons was measured by making contacts by means of two thin carbon rods pressing by means of springs against the large carbons near the arc. By the length of the arc is meant the vertical distance between the point of the negative carbon and the horizontal plane drawn through the edge of the crater of the positive, as measured on an image 10 times full size, formed on a screen. The optical arrangements are shown by diagrams; a set of curves are given for the voltage and the current in arcs of various lengths with various sizes of carbons; the voltages were not measured until after the current had been flowing for a considerable time, the length of the arc being kept constant during the whole of this time giving the carbons an opportunity to acquire their normal shape; the time required varied from about 10 minutes to over an hour. The voltage generally falls with increase of current for a constant length of arc; when the positive carbon is cored this is true only for long arcs but for short silent arcs the voltage rises with increase of current; between these two ranges there is a region in which the voltage is practically independent of the current; this particular length is a little less than 2 mm; when both carbons are cored it diminishes to ¾ mm; when both carbons are solid there is no length of silent arc for which the voltage is independent of the current; for very small currents whether one, both, or neither of the carbons are cored the voltage falls rapidly with increase of current. If the voltage is kept constant and the arc lengthened and maintained at this length the current is larger and not smaller than it was for the shorter length. For a constant voltage the apparent resistance of the silent arc when in the normal condition diminishes rapidly as the arc is lengthened; this will be referred to again in describing her own experiments. For very short silent arcs a given voltage will send two distinct currents through the arc, for instance, with 41 volts it will be either 3 or 21 amperes through a 1 mm arc, which indicates a quadratic equation. In the hissing or unstable state no current between the highest for the silent arc and the lowest for the hissing arc can be sent through the arc at all, however cautiously and slowly the resistance in circuit may be varied. The voltage for hissing arcs increases with the length of the arc but appears to be fairly constant for a given length, that is, the apparent resistance varies inversely as the current for a given length. There are two kinds of hissing, a sound like a kettle just about to boil which belongs to a long arc with a small current but which is not accompanied by a drop in the voltage; the other is a sharp hissing of an arc of any length when the current is too great for a silent arc to be maintained; this is the hissing usually referred to; there is a third and several other sounds which are difficult to classify. The idea that a hissing arc is necessarily a short one is dispelled by the curves; hissing may occur with any length of arc if the current is increased beyond what the silent arc can bear.

Arc Lamp.—A lecture by Prof. S. P. Thompson is abstracted in the Lond. "Elec. Rev.," Jan. 18. Numerous experiments with the arc were shown; among other things he dates its discovery back to 1801 instead of 1809; the difference between it and the discharge from an induction coil is that in the former the light comes chiefly from the solid matter of the electrodes and therefore depends greatly on what matter is used, while in the latter it comes mainly from gaseous volatile particles and not from the solid matter of the electrodes; in a hissing arc there is a large transport of matter but in the silent one it is small; the matter is transported in only one direction, from the positive to the negative carbon.

Projectors.—In the long serial in "L'Eclairage Elec.," Jan. 5 (see Digest, Jan. 12), the authors discuss the influence of the dimensions of the reflector, its focal distance and the intensity of the current, on the lighting power of the reflector.

High Voltage Lamps.—In a communication by Mr. Baynes in the Lond. "Elec. Rev.," Jan. 18, he states that two years ago he recommended the use of 230-volt lamps at the Bradford station; exhaustive tests showed that lamps of two firms ran 3,000 hours without a single breakage, and required an average of 3.2 watts per cp; it was not possible, however, to have any subsequent orders for lamps filled, for which reason the system could not be adopted. In such a system there is a difficulty in dealing with the arc lamps, as no small customer would agree to burn 4 or 5 arcs in series, and it would therefore appear advantageous to use a special circuit for arc lamps in series, metered by a time switch; cheap lamps burning two small arcs in one group might also be used.

Incandescent Lamp Patent.—The Lond. "Elec.," Jan. 18, gives an abstract of the Lane-Fox patent.

Welsbach Light.—The leading editorial in the Lond. "Elec. Rev.," Jan. 18, discusses and criticises very unfavorably the report of the Lancet Commission, which it claims is unsatisfactory and disappointing in many respects and fails to give any support to the expressed admiration; the laudatory terms are somewhat incomprehensible in the face of the figures given. The editorial states that from figures it appears that the Welsbach burner gave the greatest increase of heat per cubic foot of gas burned, the ratio being as 3 to 2; the common burner also gives less carbon dioxide than the Welsbach; "the candle-power estimates and the deductions made from them are hardly worth consideration;" attention is called to the difference between high luminosity and high diffusive power, the latter being what is wanted and the former being of no value; the claims that the quantity of light is greater and the gas bill less cannot both be substantiated, for if one obtains the great increase in light, which is usually the reason for its introduction, the gas bill will remain the same; as the 50-cp is the smallest practicable lamp, there will be an increase of light instead of a reduction of gas; in a fog the Welsbach lights become invisible long before the common gas light is obscured, thus proving their low diffusing power; it believes that a "complete, thorough and unbiased test would reveal very different facts and figures from those given by the rough, brief and unsound investigation made by the Lancet Commissioners."

In the same journal the Welsbach light is defended by Mr. Welch, whose statements are criticised in the above mentioned editorial.

———

Continuous Current from an Alternating Arc.—Mr. Peirce in the "Elec. Eng.," Jan. 23, offers an explanation for the phenomenon described in the Digest, Jan. 19. The path of a current crossing a magnetic field at an angle will be displaced laterally; if either be reversed the displacement will be reversed; this accounts for the appearance of the flame in both directions. He thinks the unidirectional current is due to the position of the electrodes in the extension of the arc; he believes that if they are very small and placed at the centre of the arc no current would flow through the galvanometer if they are in a plane at right angle to the carbons.

Lantern Projection.—A brief abstract of a recent lecture by Mr. Hopkins is given with illustrations of the lanterns in the "Elec. Eng.," Jan. 30; he showed various applications, among others the projecting microscope magnifying 2,000 to 3,000 diameters with very good lighting.

Electric Lighting in England.—The "Elec. Eng.," Jan. 30, reprints some of the statistics and the map mentioned in the Digest, Jan. 26.

Welsbach Burner.—A paper by Mr. Goetz read at the meeting of the North Western Electrical Association on the "Incandescent Lamp vs. Welsbach Burner" is reprinted in the "Elec. Rev.," Jan. 30, and "West El.," Feb. 2.

Atlanta Exposition.—Some other lighting effects are briefly described in the "Elec. Rev.," Jan. 30.

POWER AND HEAT.

Elastic Couplings for Gas Engines.—In a long communication by Mr. Bablon in "L'Ind. Elec.," Jan. 10, he discusses the subject from a purely practical point of view and argues that if the coupling is sufficiently elastic the irregularities in the speed of the gas engine may always be greatly reduced; he cites the case in which this was done successfully and believes the result would have been even better if the spring coupling had been still more elastic, that is longer; the ideal coupling is one in which the tension does not vary with the length or extension; he believes the irregularities may certainly be reduced to 1-10; with a coupling which is too short the irregularities may be increased as was found by Mr. Picou (see Digest, Sept. 8, see also Oct. 20, Dec. 22 and Feb. 2), but it is theoretically and practically possible to give the coupling sufficient length that the irregularities may be reduced to a small fraction.

Designing Transmission Plants.—A paper by Mr. Mountain on the design and efficiency of plants for the transmission of power by electricity is published with illustrations in the Lond. "Elec. Eng.," Jan. 18; it is elementary in character and appears to be chiefly for non-electrical engineers.

Driving Tools.—See also Crompton's presidential address.

Rock Drills.—In his long serial on mechanical applications Mr. Richard in "L'Eclairage Elec.," Jan. 5, gives well illustrated descriptions of the Siemens & Halske and the Thomson & Houston drills besides other mechanical applications.

Agricultural Applications.—Some estimates showing the advantages of electric power over animal power are given in the "Elek. Zeit.," Jan. 10.

Electric Furnace.—"L'Elec.," Jan. 19, abstracted from the "Chem. News" a description by Mr. Warren of a simple electrical furnace for demonstration purposes for reducing refractory earths, which is used in many large institutions in England; the description is somewhat meagre but it appears to consist of an arc in which the materials are either placed directly or by means of a tube of graphite heated by it. The materials are pulverized and reduced to a paste with a solution of pyroxyline, then moulded into a small rod which is introduced into the arc.

Electric Heating of a Theatre.—According to the Lond. "Elec. Eng.," Jan. 18, the Vaudeville Theatre in London was recently heated electrically and an order has now been given for the permanent warming of the theatre in this way; the cost is not expected to exceed that of other systems.

Electric Heating and Cooling.—See Crompton's presidential address.

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Electric Furnace for Heating Iron Strip.—The "Elec. Eng.," Jan. 30, gives a brief illustrated description of the Siemens process (described in the Digest, March 11, 1893) as used in an installation in Montreal for making horseshoe nails. The furnace consists of a carbon tube 24 inches long with a bore of 1 inch and walls ½ in. thick, the outside being enclosed in sand; a current of 500 amperes at 12.5 to 15 volts brings it to a white heat; it is intended for continuous feed and will heat 5 feet of strip per minute; a 1,040-volt alternating current is used and transformed down to the proper amount.

Travelling Shears.—The "West. El.," Feb. 2, publishes an illustration with a brief description of the shears described in the Digest, Oct. 6.

TRACTION.

Accumulator Traction.—The "Elek. Zeit.," Jan. 19, contains a paper by Mr. Feldman describing the Waddell-Entz copper-zinc accumulators which are used on the line which has just been started in Hagen, Germany; the first test was very successful; the line has numerous curves and grades; it is 1.9 miles long; the sharpest curve has a radius of about 50 feet; the steepest grade is 4 per cent., the gauge is 3.28 feet; there are five cars for carrying 26 passengers each having one motor of a maximum of 15 hp; it contains 88 accumulators under the seats, each having 7 negative and 6 positive plates, is 12.6 inches high and 8x4; the weight of the empty cell is 15.4 lbs. and of the field cell 30.8 lbs.; the negative plates are made of a new work of fine iron wire on which the zinc is deposited; the insulators are glass tubes; the plates are placed in sheet steel receptacles; the positive plates are made of copper wire gauze surrounded by finely divided copper and enclosed in cotton bags; they differ from the older form of Comellin and Desmazures in that the dropping of the voltage with strong currents is not so great; the E. M. F. is 0.85 to 0.88 volt, their normal capacity 250 and their maximum 300 ampere-hours, the efficiency being claimed to be independent of the rate of discharge (the ampere-hour and not the watt-hour efficiency is doubtless meant); 3 cells in series were short circuited and gave 400 amperes during 40 minutes, the voltage being still 0.5 and the E. M. F. immediately after opening the circuit 0.85; one charge is intended to run about 20 miles; the weight is about 1.4 tons, the total weight of the loaded car being 70 tons. The field of the motor is excited by a separate set of 12 accumulators which also run the lights, the remaining 76 are either connected in 4 parallel groups or in 2x2 or all in series, there being 8 points on the controller, for the last of which resistances are inserted in the field while at the first one the motors act as a brake charging the accumulators; a car was stopped within one-half to one times its length by means of this brake (the previous speed, however, is not given); on a down grade the charging current is 200 to 300 amperes, but whether this can be used is a question, as the cells must be heated during charge. The charging installation is only briefly described; the cells are in groups of 44 and are placed on steam heat radiators while charging; the charge begins with 0.9 volt and ceases at 1 volt, during which the cells must be heated to about 122 degrees F. It is claimed that for equal output the weight of these as compared with lead accumulators is as 0.55 to 1 and that the life of the plates is not effected by the rate of discharge. Some further information about this type of accumulator will be found under Accumulators.

Wearing Away of the Trolley Wire.—According to the "Elek. Zeit.," Jan. 10, Mr. V. Hefner-Altneck claims that it is not due to electrolysis but to the sparks caused by poor contacts, the sparks carrying particles from the wire to the wheel.

Working of Electric Railways in France.—A translation of the short article mentioned in the Digest, Jan. 5, is published in the Lond. "Elec.," Jan. 18.

Electric Traction System.—"L'Ind. Elec.," Jan 10, extracts from a large work published by the General Electric Company, of Berlin, describing their traction system; 8 large illustrations are reproduced.

Electrolysis of Pipes.—The "St. Ry. Gaz.," Jan. 26, reprints the report of Prof. Barrett (but without the accompanying map) on his investigation of the electrolysis of pipes by escaping railway currents in Brooklyn. Much of it is chiefly of local interest. Extensive measurements were made at 660 street hydrants covering 100 miles of streets, in which the difference of potential between the hydrants and the rail was measured as was also between the hydrant and at least three earth points and between these same earth points and the rail, also in some cases between hydrants and gas pipes and the elevated road structure; he states facts which are now well understood and discusses at some length the distribution of the earth currents as found from his measurements; the dangerous currents are generally near the power station but there are also such points in districts not in the vicinity of the power station. The remedies which he suggests are to keep the currents from the pipes in all those regions where they tend to flow from the rails to the pipes (the trolley wire being positive), by providing a more liberal system of return conductors, to a limit fixed only by considerations of reasonable cost; "after everything that is reasonable has been done in this direction there will still be a large overflow of current from the rails;" the points where the unavoidable residue leaves the pipes should be carefully located and at those points special return wires should be connected to them; this should not be done until an adequate system of outlying returns has been provided for; he thinks that the pipes would then be virtually safe; danger spots will remain to be hunted out and remedies applied to each specific instance, consisting chiefly in electrically connecting different lines of pipes at suitable points and also with the rails. He describes in detail a clamp for making connections with pipes, consisting of a collar, clamping the pipe through a lead gasket. In conclusion he states that at present it is indisputable that the earth currents are causing extensive corrosion in Brooklyn at an indeterminate but serious rate and that there are practical means at command which are being neglected and which if properly applied would largely abate if not altogether arrest the destruction.

Storage Railway and Lighting Plant.—A short paper by Mr. Condict read before the North Western Electrical Association is reprinted in the "St. Ry. Gaz.," Jan. 26. He describes a small plant at Merrill, Wis. in which the combined railway and lighting station was running very unsatisfactorily until after the introduction of a storage battery plant consisting of 240 chloride accumulators with a capacity of 500 ampere-hours at a 50-ampere rate; the batteries are divided into 4 series of sixty cells which can be connected either all in series for the railway, or 2 in parallel for the two sides of the three-wire lighting system; it is charged by means of an independent feeder; it does away entirely with a supplemental steam plant, by the addition of another turbine.

New York Rapid Transit System..—The "Elec. Age," Jan. 26, describes briefly, with an illustration, the Leschziner plans, one of which is to construct a three-deck elevated road through the middle of the blocks and another a depressed road running under private property in the middle of the blocks; he thinks that the cost of the road would not be half that estimated for the proposed roads.

New York Rapid Transit System.—In the "Eng. News," Jan. 31, Mr. Reno gives a more detailed description of his plan including several good illustrations.

Tasmania.—An illustrated description of the Siemens line at Hobart is published in the "Elec. Eng.," Jan. 30.

Series Traction System.—The article by Mr. Perry mentioned in the Digest, Jan. 26, is reprinted in full in the "Elec. Rev.," Jan. 23.

Switch Locomotive.—The "West. El.," Feb. 2, extracts from the Lond. "Railway World" a description of a switch locomotive of 3 tons weight.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Central Stations in Germany.—In a review of the past year, the "Elek. Zeit.," Jan. 3, states among other things that the introduction of the accumulators in central stations in Germany has developed very much in the past year, the application of alternating currents in municipal lighting has also developed and the four following fundamental principles have found almost universal application in the German central stations: moderately low frequency, large units, slow speed, and direct coupling. It is interesting to note that the three-phase current is likely to replace the alternating current in the newer stations, among the reasons being the better utilization of the material in the generators, motors and circuits, and as it is now possible to regulate such systems as easily as the alternating current systems, there is no longer anything standing in the way of its adoption. The application of current for motor purposes has made great progress during the past year; progress in electrical railways has been very promising.

Development of Municipal Stations.—The "Elek. Zeit.," Jan. 10, contains a paper by Mr. Meyer, a brief abstract of which is given in the Lond. "Elec. Eng.," Jan. 18, in which he gives tables showing the lamps connected, the capital, income, expenses and profit of a number of large stations in Germany; the excess of income over expenses, in per cent. of capital invested, varies from a little over 7 in most of them to 15 and even 18. An indirect proof that such stations pay is shown by the willingness of parties to run them at their own expense.

Chemnitz.—The "Elek. Zeit.," Jan. 3, publishes a long and well illustrated description by Mr. Weinhold of this station, in which the three-phase system is used; the machines are coupled in parallel without any difficulty; the apparatus is that of the firm of Siemens & Halske; he gives the curves of the current; the energy is sold for 18c. per kw-hour for lighting and 4.5c. for power purposes.

Cologne.—Detailed data regarding the operation of this station are published in the "Elek. Zeit.," Jan. 10.

London Central Stations.—The Lond. "Elec.," Jan. 18, publishes its annual supplement in the form of a map of London giving in different colors the mains of the various companies up to the beginning of this year.

Cost of Working at the Portsmouth Station.—The Lond. "Elec. Rev.," Jan. 18, gives the results of some examinations regarding the cost of working which it considers are phenomenally good; no meters exist at the works and the curernt is therefore partially estimated; it believes that the results are without a parallel in corporation lighting; it claims that the cost of generating and distributing is the most startling feature and is as good as anything that has been done in any alternating current station; in the first half of the year of its existence it produced and distributed a kw-hour for 4.6c.

Lighting of Trains.—A brief description of the system used in Denmark (described in the Digest, Sept. 1) is given in "L'Elec.," Jan. 19.

Load Factor.—See Crompton's presidential address.

Chicago.—The "Elec. Eng.," Jan. 23, contains a long and profusely illustrated description of the installation of the Chicago Edison Company by Mr. Martin, including a large double-page plan of the Harrison street station.

Electrical Equipment of the "Priscilla."—The "Elec. Rev.," Jan. 30, gives an illustrated description of the installation on this Fall River Line steamer.

Yarmouth.—The "Elec. Eng.," Jan. 30, reprints the description of the station mentioned in the Digest, Feb. 2.

South Norwalk.—The "Elec. Eng.," Jan. 30, published a short description of this municipal lighting plant, including a table of results giving the consumption of coal, oil, etc., for the past year.

WIRES, WIRING AND CONDUITS.

Explosions in Conduits.—Mr. Gilbert, in the Lond. "Elec. Rev.," Jan. 18, gives his views regarding conduits; he condemns bare conductors; no matter how well made conduits will admit gas and water but they should be constructed as perfectly water tight as possible; it is essential to have side chambers to admit gas and water and that compressed air be sent through the entire system into the manholes once a day; every manhole should be ventilated at the curbstone; the conduits should be made with a cover and the cables laid into them; he gives an illustration of a proposed system in which the positive and negative mains are in independent chambers. The English journals, Jan. 18, speak of a gas leak detector in which the hydrogen flame is used.

Explosion in Conduits.—Mr. Higgins in the Lond. "Elec.," Jan. 18, suggests that hydrogen gas is generated in great quantities in the soil due to the oxidation in iron pipes, which if not protected oxidize very rapidly, and being inodorous the gas cannot be detected by its smell.

Explosion in St. Pancras.—A report of the Board of Trade inquiry is published in the Lond. "Elec. Rev.," Jan. 18.

Underground Mains.—The Lond. "Elec." and "Elec. Eng.," Jan. 18, give an illustrated description of the Spenc-Doulton system, which is claimed to be the first attempt to successfully combine the advantages of the drawing-in system with those of bare copper strips; it consists of tubes of vitrified stoneware supported on insulating bridges of the same material, in a trough of earthenware, concrete or iron; the joints of the tubes are bored and turned and require no cement; there is practically no depreciation, as the materials are all imperishable; the first cost is not as low as that of bare strips on insulators, but it is small in comparison with the advantages.

Carrying Capacity of Conductors.—An article on this subject by Mr. Talbot is published in the "Elec. Rev.," Jan. 30, he gives a brief summary of a number of the published rules.

ELECTRO-PHYSICS AND MAGNETISM.

Discharge Through Gases.—A royal institution paper (read April 13) by Prof. J. J. Thomson is reprinted in full with illustrations in the Lond. "Elec. Rev.," Jan. 18; it was mentioned in the Digest, Sept. 15; it is well worth reading by those interested. He believes that the discharge through gases elucidates the connection between mechanical and electrical effects and therefore throws light on the connection between electricity and matter; he describes a phenomenon connected with the passage of electricity from the gas to the electrode and from the electrode to the gas; also some properties of the discharge when its course lies entirely in the gas; in a tube 50 feet long the discharge may be observed through a rotating mirror and the luminosity will be found to follow the direction of the positive current through the tube with an enormous velocity, but it is checked at the negative electrode where it lingers some time before entering it; there is an accumulation of the positive electricity in this neighborhood until the potential fall is 200 to 300 volts; there is difficulty in getting from the gas to the metal but in the gas alone the discharge meets with "a ridicuously small amount of resistance." He describes several phenomena in one of which the discharge prefers to go through a plate of mica rather than through a pellet of mercury; alternating discharge between long electrodes in a vacuum tube does not pass across the nearest ends but goes from the tip of one electrode to the place where the other passes through the glass, thus preferring to pass through the gas rather than the metal; the difficulty in passing from the gas to the electrode depends largely on the gas as also on the electrode and on their relative positions in the electrochemical series; he explained some experiments illustrating this point and believes that there is a temporary formation of a chemical compound between the gas and the metal. He describes experiments in which the discharge passes entirely through the gas, by means of a tube in a coil which induces the charges; he shows in this way that gases are exceedingly good conductors, which statement he proves by experiment; he finds that the conductivity of the gas estimated per molecule is about 10,000,000 times that of dilute sulphuric acid and is greater than the molecular conductivity of even the best conductive materials; if the pressure is diminished below a certain point the conductivity again diminishes. He describes another experiment in which he shows the effect produced by a magnetic field on the discharge; when the latter flows across the magnetic lines it is retarded but when it flows along the magnetic lines it is aided by the magnetic field.

Modern Theories of Electricity.—The Lond. "Elec.," Jan. 18, contains a paper by Mr. Lodge in which he discusses and criticises the recent article of Prof. Rowland (see Digest, Jan. 12); it is partly in the nature of a criticism and partly an expression of approval. Regarding the statement that electricity no longer exists he states that he would not have expressed himself quite as unreservedly; the expression only means that it is the ether which is now claiming the lion's share of attention, but this is hardly a helpful statement; the explanation of how bodies can be charged, he does not consider very luminous, but that to explain electrification by friction he considers better; the phrase that the lines of force cannot pass through a vacuum should be interpreted that they cannot move through it, as the vacuum has dielectric properties; he considers the statement regarding the earth's magnetism as "full of more than doubtful hypotheses;" he states that it has never been proved that magnetism is certainly due to rotation of something nor that rotating ether is the necessary and sufficient whirling material, all that is known is that rotating electrification is sufficient; a large number of experiments having negative results can be shown in reply to the statement that the spinning of matter on its axis magnetizes it; he approves of the statement that it is air which causes disruptive discharges.

Electrostatic Capacity of a Line Carrying a Current.—An Academy paper by Mr. Vaschy is abstracted in "L'Ind. Elec.," Jan. 10. In a recent note Mr. Potier remarked that the capacity per unit of length is well defined while the electricity is in equilibrium at the surface of the wire, but not so when a current passes; the present writer investigates this subject mathematically when a continuous current passes and finds that the capacity per unit of length of a cable traversed by a continuous ("permanent") current has the same significance as in electrostatics; but when the variations of the current are very rapid one can no longer suppose that the electric field admits of a potential and the idea of a capacity, defined as above, disappears.

Potential in Liquid Moving Conductors.—In an Academy paper by Mr. Villemontée published in "L'Ind. Elec.," Jan. 10, he describes experiments to determine if the circulating of a liquid in large glass tubes having the same cross section throughout can produce a difference of potential between two points of the liquid; his conclusions are that it cannot, at least within the limits between which he experimented.

Retardation of Polarization in Dielectrics.—A paper from the Italian by Mr. Arno is translated in the Lond. "Elec.," Jan. 18. He refers to the experiments of Ewing and Klaassen regarding magnetic hysteresis and points out an analogy with dielectric bodies which suggest certain predictions which he makes; he then describes briefly a series of new experiments the results of which confirm these predictions.

Conductivity of Organic Salts.—The Lond. "Elec. Eng.," Jan. 18, abstracts very briefly a paper by Mr. Bartoli from the "Gazzetta."

Passage of an Oscillator Wave-train Through a Plate of Conducting Dielectric.—A Physical Society paper by Mr. Yule is abstracted briefly in the Lond. "Elec. Eng.," Jan. 18.

Diffraction and Dispersion of Electric Rays.—A paper by Messrs. Garbasso & Aschkinass from the "Weid. Ann.," Vol. 53, page 534, is abstracted in the "Elek. Zeit.," Jan. 3.

Mercury Switch for Electric Use.—A switch is described by Mr. Maycock in the Lond. "Elec. Rev.," Jan. 18, which, however, appears to contain nothing new; the terminals of groups of batteries end in mercury cups by means of which they may be variously combined. The "West. El.," Feb. 2, reprints the article with the illustration.

Physical Papers.—The Lond. "Elec.," Jan. 18, states that the first number of the "Proceedings of the Physical Society" of London contains abstracts of physical papers from foreign sources compiled under the editorship of Mr. Swinburne; this first set is said to contain many very interesting subjects. (As most of the more important physical papers on electrical subjects appear in full or in abstract in the leading foreign electrical journals, abstracts and references of most of them may probably be found in the files of the Digest.)

Influence of Temperature on Magnetization.—A paper by Mr. Wilde is reprinted in the Lond. "Elec. Rev.," Jan. 18. He discusses the subject and states that the general law for the diminution of magnetization with increasing temperatures is now completely established; he describes and illustrates a magnetometer for demonstrating it; it consists of a suspended needle, one end of which is near the magnetic body which can be heated.

Example of Viscous Hysteresis.—Messrs. Gaze and Johnston in the Lond. "Elec.," Jan. 18, give the results of experiments to determine the time effect of the magnetic lag, by the use of Thompson's permeameter; when the values of H were 192, 48 and 24 the time required for maximum pull was 5, 10 and 20 seconds and the increase over the initial pull was 1.2, 1.6 and 0.9 per cent, the second value being at the bend of the permeability curve.

Magnetization of Nickel Wire Under Stress and Torsion.—A paper by Mr. Nagaoka from the "Weid. Ann.," Vol. 53, page 481, is abstracted in the "Elek. Zeit.," Jan. 3; he finds that a reversal of the magnetization takes place under combined stress and torsion; that the torsion alone is the condition, he believes has not yet been proved.

Distribution of Energy in the Spectrum of the Glow Lamp.—The article by Dr. Nichols abstracted in the Digest last week is being reprinted in "El'ty," beginning with the issue of Jan. 30.

Degree of Incandescence of Lamps.—A reprint of Mr. Crova's paper abstracted in the Digest, Nov. 17, is published in the "Elec. Age," Jan. 26.

Curious Magnetic Phenomenon.—In the "Elec Rev.," Jan. 30, Mr. Stone describes the observations of Mr. Burnie, a description of which was given in the Digest, Dec. 29.

Alternating Current.—The 31st "Leaflet" by Messrs. Houston and Kennelly is published in the "Elec. Eng.," Jan. 30; it treats of impedance, reactance, the combination of alternating currents, etc.

ELECTRO-CHEMISTRY AND BATTERIES.

Walker-Wilkins Battery.—The Lond. "Elec. Rev.," Jan. 18, abstracts at some length, including curves, data and an illustration of the battery, from the report made by Prof. Jamieson. The atmosphere is used as the depolarizing agent, the nascent hydrogen meets with the condensed air in the pores of the carbon and combines with it; the hydrogen therefore "never assumes a gaseous form and polarization is prevented;" the life of the electrolyte is said to be remarkable; the battery is composed of an amalgamated cylinder of zinc immersed in a solution of caustic potash contained in a porous cup placed in a large perforated outer vessel, the space between them being packed with carbon, that in contact with the porous cup being powdered; the current is collected by means of a perforated nickel cylinder embedded in the carbon; the claims are freedom from fumes, simplicity of cells and solutions and absence of local action; these claims are corroborated by the report; the results are given in tables and curves which show an efficiency of the zinc of 97 per cent., which he says is better than that of any primary cell that he has tested and he believes the cell to be the best of its kind that he has ever tested. Editorially it is stated that the E. M. F. is low (1.457 on opening circuit) droping 8 per cent. at once, and that it is not non-polarizing; it will doubtless do for a small output but the slow depolarizing action is not sufficient for heavy work. The complete report is published in the Lond. "Elec. Eng.," in which it is stated that the cost of the electrolyte is 16c. per gallon; also that the electrolyte would yield 768 ampere-hours (but whether this is for one gallon or for 3 quarts is not clear from the way it is stated).

Electrical Energy Direct from Coal.—Mr. Tatlow writes to the Lond. "Elec.," Jan. 18, stating that he tried the same experiment (see Digest, Nov. 10, Dec. 8, 15, 29, Feb. 2) using carbon electrodes, one of which was in cupric chloride and the other in cuprous chloride in hydrochloric acid, using a porous partition; cupric chloride was used because the air oxidizes the cuprous chloride; the E. M. F. was found to be about 0.2 and when coal gas was used it rose to 0.36; a similar result was obtained by churning the cuprous chloride with petroleum oil; by using chromic acid as an oxidizing agent in place of cupric chloride the E. M. F. was 0.79 volts; as the theoretical voltage for the oxidation of either hydrogen or carbon monoxide is nearly 1.5 volts, a large balance remains unaccounted for.

In a communication of Mr. Winand to the "Elek. Zeit.," Jan. 10, he states that he made tests in 1887 and came to the same conclusion as Dr. Borcher that coal cannot be used directly but should first be converted into generator gas. He states that there is very little literature on the subject and mentions a patent of Mr. Bernstein. He fears that the results of Dr. Borcher are of interest only theoretically, and that the problem will be solved in a way not yet discovered.

Copper Zinc Accumulators.—In a paper by Dr. Schmidt abstracted briefly in the "Elek. Zeit.," Jan. 3, he gives a brief description of this cell. Among other things he states that they should be heated to about 86 degrees F. while charging, to prevent dissolving of the copper oxide, care should also be taken that the charging voltage does not exceed one volt; but if some copper has been deposited on the negative electrode it can be removed by reversing the accumulator; he gives the voltage as 0.75; the weight per stored kw-hour is about 132 pounds which he says is about half that of the lead accumulator; the efficiency in watt-hours is about 60 per cent.; he believes there is a great future for this accumulator for traction purposes as it shows an exceedingly small amount of wear and can be discharged without injury at any desired current. Some further information about this type of accumulation is given under "Accumulator Traction."

Secondary Battery Patents.—The Lond. "Elec.," Jan. 18, gives some illustrated abstracts of the five remaining patents which will expire during the year in England.

Testing for Poisonous Minerals.—According to "L'Elec.," Jan. 19, Dr. Kohn at the Hygienic Congress at Liverpool stated that electrolytic analysis can be employed to great advantage in testing for mineral poisons in the body, such as antimony, lead, copper, mercury and cadmium; it will serve to detect a one-tenth of a milligram of these metals; it is much more sensitive than the other processes, all the more so because it can be applied in the presence of organic substances.

Electrometallurgy of Gold.—In "L'Elec.," Jan. 19, Mr. Andreoli gives a brief summary, including data, of the electrolytic methods used chiefly in the Transvaal Republic.

Theory of Electrometallurgy.—The first part of a paper by Prof. Crocker is published in "El. Power," for January, and will be concluded in the next issue; it will also appear in the "Sc. of Mines Quart." He gives the physical and chemical principles upon which electrometallurgy is based and the relation between the various quantities involved. It applies to electrolytic metallurgy, including electrotyping and plating as well as electrolytic reduction and refining of metals; also to electrical smelting and electrical working of metals—welding, forging, etc. The relation between the electrical quantities—current, direct E. M. F., counter E. M. F. and the resistances of generator, leads and cell—is discussed and methods of predetermining each are given. The formula for the counter E. M. F. of an electrolytic cell (covering also the direct E. M. F. of voltaic cell) is deduced and explained, including the equation of Helmholtz. The latter is usually ignored entirely by other writers or is merely stated without explanation. The fact that the E. M. F. of an electrolytic cell may have any value from about +3 to —3 volts is shown, and the common fallacy of supposing that it must be a *counter* E. M. F. between 1 and 2 volts is pointed out. The distinction between the counter E. M. F. and resistance and the use of aqueous and non-aqueous solutions as well as fused electrolytes are considered. Various formulas are deduced for the weight of metal deposit and the relation between this weight and the chemical composition of the electrolyte is explained, the latter being sometimes a puzzling matter to electrical engineers. The leakage of current which occurs when the counter E. M. F. is greater than the direct E. M. F. is accounted for. The important process of "selective electrolysis" or picking out of a particular metal or metals from mixed electrolytes, also the converse process of depositing alloys and the chemical and physical nature of deposits are all treated. The article closes with a discussion of the principles of electrical heating as applied to smelting and working of metals. The article is devoted chiefly to the fundamental principles.

Cold Galvanizing Process.—The importance of the successful application of this electrolytic process is discussed favorably in a recent paper by Mr. Wood abstracted in the "Eng. News," Jan. 31.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measurement of Self-Potential of Straight Wires.—A paper by Mr Prerauer from the "Weid. Ann.," Vol. 53, page 772, is abstracted in the "Elek. Zeit.," Jan. 3. He used Maxwell's bridge method for comparing self (induction) potentials and considers that the results show that the method is sufficiently sensitive and exact to measure such potentials up to 500 cm with an accuracy of 1 per cent., in wires whose time constant lies beween 10 to the minus 3d power and 3.10 to the minus 5th power, seconds.

Determining the Form of Waves.—A Physical Society paper by Mr. Janet is abstracted in "L'Ind Elec.," Jan. 10. He refers to his previous paper on the determination of the form of the periodic currents as a function of time and describes a modification consisting of a series of styles equidistant from the others by which one obtains a series of blue lines the extremities of which represent the desired curve; the description is not as clear as might be desired.

Differential Meter.—The Aron type of 1893 is briefly described and illustrated in "L'Eclairage Elec.," Jan. 5.

Instruments and Measurements.—See Crompton's presidential address.

Electrostatic Voltmeter.—Some additional information regarding the Rowland voltmeter (see Digest, Jan. 26) is given in the "Elec. Eng.," Jan. 23. The form which he finds best is vertical with only the quadrants and the equivalent of the needle immersed in the oil in the bottom of the instrument while the pointer is free in the air; the constant of the instrument remains unaltered with time provided the fluid is not changed; with ordinary oil the spaces can be so much smaller than in air that the forces are immensely greater while good insulation is maintained. In one case in which 1,000 volts were used a contact occurred under the liquid but the instrument was not injured in any way although about a yard of wire outside of the instrument was deflagrated with a loud report.

Units of Light and Radiation.—Prof. Macfarlane's Institute paper abstracted in THE ELECTRICAL WORLD, Jan. 26, page 95, is published in full in "El'ty," "Elec. Rev.," Jan. 30, and "Elec. Age," Jan. 26.

Electrical Standards.—The "Elec. Age," Jan. 26, reprints from the English journals Aug. 31 the new standards of electrical measurements for use for trade in England (mentioned in the Digest, Sept. 22).

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephonic Disturbances.—The "Bull. l'Ass. Ing. El. Montefiore," Dec. 15, contains a paper by Mr. Pierard in which he describes tests made to determine the disturbing effects produced by aerial lines such as those of railway circuits. The disturbances began to be great when the wires were 30 feet apart and the length exceeded 1,500 to 2,000 feet in the paper, he seeks to determine the causes; his conclusions from a number of experiments are as follows: that the electrostatic effects are those which make themselves felt first even at relatively great distances of 150 to 1,000 feet according to the length of the circuits; that these effects alone can cause serious disturbances; that when one of the earths of the telephone circuit is too near the rails the derived currents may be more or less disturbing; that they are very great when both earths are near the railway earths, the telephone circuit then forms a shunt circuit to the rails; that the electromagnetic effects appear to be negligible in all cases or at least far inferior to the others.

Telephone Loops Without Induction.—In the "Elek. Zeit.," Jan. 3, Mr. Rodewaldt referring to a recent article (abstracted in the Digest, Dec. 29) disagrees with the statements made; he believes the reason for the good results is an entirely different one, namely, that the supports for the insulators of each separate loop are connected metallically; he believes that this is the only reliable method for preventing cross-talk and that in addition, these supports should be insulated from the pole. In an editorial reply it is stated that while the latter is probable it cannot be considered to have been proved.

Telephony.—In a review of the progress of the past year in the "Elek. Zeit.," Jan. 3, are mentioned the improvements in the switchboard of the Western Electric Company (1893 model) the introduction of platinum contacts on the switchboard, also that the practical solution of the automatic switchboard appears to have been solved by the Nissl apparatus.

Telephone Switchboard.—An improvement is described and illustrated by Mr. Engelman in the "Elek. Zeit.," Jan. 10.

Telegraphy.—In a review of the past year in the "Elek. Zeit.," Jan 5, it is stated that a direct cable from Germany to America has been under consideration and there are hopes that it may be realized in the not very distant future. An important improvement in the Hughes apparatus is the replacing of the brake regulator by one of symmetrical construction; another improvement is the introduction of sounders on many lines; the Rathenau researches for telegraphing without a wire are also mentioned (see Digest, Dec. 1.)

Muirhead vs. Commercial Cable Co.—The "Elec. Rev.," Jan. 18, contains a communication by Mr. Bailey in which he criticises a recent statement regarding the delusion of supposing that an accurate balance can be obtained by the rheostat. The subject is also discussed in a short communication in the same issue.

Railway Signals.—An automatic system for ringing alarms at crossings is illustrated and described by Mr. Kohlfuerst in the "Elek. Zeit.," Jan. 3.

Motor for Railway Signals.—A weight motor started and stopped from a distance by means of a current is described at some length and fully illustrated in "L'Elec," Jan. 19.

Telephone.—A correspondent to the "Elec. Rev.," Jan. 23, calls attention to the importance of renewing the contact surface in microphones and gives a short description with sketch of the Mercadier and Anizan microphone described in the Digest last week.

Carbonnelle Microphone.—A brief description of this apparatus which was described in the Digest Jan. 12, is given in the "Elec. Rev.," Jan. 23.

Mexican Central Railway Telegraph System.—The "Elec. Eng.," Jan. 30, contains a short article on this subject by Mr. Guy.

MISCELLANEOUS.

Unconsciousness Produced by an Electric Shock.—"L'Elec.," Jan. 19, reprints from the "Medical News" a description of a case in which a man was rendered insensible by a shock from a 1,000-volt current; at first he was blind, then became delirious; after recovering consciousness he could remember absolutely nothing from the time he received the shock; he subsequently recovered completely. It is claimed that it is an argument in favor of electrocution that unconsciousness is produced the moment the current is applied.

Methods of Resuscitation.—Those recommended by the French Academy mentioned in the Digest, Feb. 2, are reprinted in the Lond. "Elec. Rev.," Jan. 18.

Electricity and Plant-Growing.—The Lond. "Elec. Eng.," Jan. 11, abstracts a paper by Mr. Baily, of Cornell, from the "Transactions of the Mass. Horticultural Soc." The paper does not admit of being abstracted. Among other things he states that the arc light exerts a powerful influence on plants, which, however, varies, due to the effort of the plant to adapt itself to the new conditions; lettuce can be profitably aided, and probably many flowers also. He discusses experiments to determine the effects of electric currents on growing plants, stating that it has not been proved that the effects which have been noticed were due to the mere electrification of the soil, as they may have been due to some chemical or mechanical effect which the current exerted upon the soil or the interstitial air; he is convinced, however, that marked effects may be produced by the application of electricity to the soil; atmospheric electricity probably exerts a powerful influence upon vegetation. He describes some experiments by Prof. Lemstroem, the conclusions from which are that simultaneous action of electricity and high temperature is injurious to plants, although if the weather is not too hot, atmospheric electricity influences plants profoundly and usually beneficially; it is probably due to some chemical change in the atmosphere; Prof. Baily expects to supplement these experiments in this country.

Lightning Effects.—The "L'Elec.," Jan. 19, relates a case in which 23 telegraph poles were struck by lightning probably at the same instant; the effect was different on all of them, some were splintered throughout while some were destroyed only at the top, in others the discharge was distinctly marked by a regular spiral encircling the pole.

Artificial Rubber.– According to "L'Elec.," Jan. 19, a more or less resisting rubber can be made by dissolving 4 parts of nitrocellulose with 7 parts of bromonitrotoluol; by varying the proportion of the former it has elastic properties greatly resembling that of rubber and even of that of gutta percha; according to the "Rev. de Chime. Ind.," the latter constituent can be replaced by nitrocumol and its analogous compounds.

Review of the Past Year.—In a brief review by E. H. in "L'Ind. Elec.," Jan. 10, he states that there has been no important discovery during the year, and that progress was slow but continuous; he considers the Welsbach gas burner a most important competitor to the electric light; he reviews the progress in several directions and states among other things that "in several years, transmissions by belts will be an encumbered and superannuated system, an old process which one will look at as a historical curiosity." He refers to the Heilmann locomotive the first trials of which do not seem to have met the expectations of the parties involved, although two new models are being constructed. In conclusion he says "it has been a good and honest year which will have no electric history."

Progress in Germany.—The "Elek. Zeit.," beginning with the issue Jan. 3, publishes the replies of a large number of firms in Germany to the questions regarding the work of those firms during the past year, including recent improvements, and an expression of opinion on the present and the future of the industry in Germany; they are chiefly of local interest.

The Monocyclic System.

Among the United States patents issued Jan. 29 are no less than nine granted to Mr. C. P. Steinmetz. Of these six relate to systems of alternating current distribution and two to monocyclic motors, of which an account is given below, and one to a new method of winding armatures.

The first patent in date of application on alternating current distribution is of April 2, 1894 (533,244), and describes what is termed a monocyclic system of distribution, whereby lamps or other simple alternating current translating devices, as well as multiphased motors, may be supplied with current from a single source of power and a common system of circuits. By means of this system generators may be installed for an ordinary lighting system, and wherever it is desired to operate motors as well as lamps, it is only necessary to run an additional main to the points where the motors are located and to maintain upon this main an E. M. F. of displaced phase so that between it and the simple alternating motors polyphased E. M. Fs. will exist. This end is attained by means of supplementary or phase modifying sources of E. M. F., arranged so as to act jointly with the main source of E.M.F., but having a different phase relation, so that by the combined action of the main and supplementary sources an E. M. F. of displaced phase is maintained upon the third or intermediate main of the polyphased circuit.

The general method consists in the use of a phase modifying-coil on the main generator of the ordinary simple alternating type, this supplementary coil having a displaced position from the main winding in the field of force so as to generate an E. M. F. of different phase from that generated in the main winding. This coil is connected at one end to an intermediate point in the main winding and at the other end to the intermediate main of the polyphased circuit, the outside mains of the circuit being connected to the terminals of the main winding.

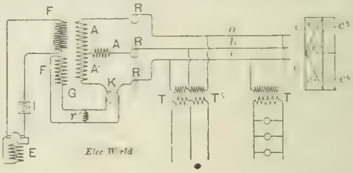
In Fig. 1 such a distributing system is shown diagramatically. The generator comprises an armature winding A A^2, whose terminals are connected to collector rings R' R^2 and which is arranged in a manner similar to ordinary simple alternating dynamos. The winding A A^2 constitutes the main source of E. M. F. and maintains alternating E. M. F. waves in the mains a c connected respectively to the collector rings, and which constitute either a simple alternating circuit or the outside mains of a polyphase circuit. The field of the generator is wound with a coil F in circuit with a separate shunt-wound exciting dynamo E, and a resistance I is provided for regulating the exciter. For compounding or over-compounding the main dynamo, its field may also be provided with a series coil F', the current in which is rectified by a commutator K; a resistance r' is shown shunting the commutator brushes to prevent sparking, though this forms no part of the invention.

The intermediate main b of the multiphase circuit is connected to a third collector ring R^3, and the phase-modifying coil A', which occupies a displaced position in the field of force, has one terminal connected to this collector ring and its other terminal to a point at or near the electrical centre of the main winding as shown in the diagram.

When simple alternating current translating devices alone are used, the phase-modifying coil will be open circuited, and at such times the system will operate in all respects as any ordinary alternating system, the translating devices, such as lamps, being connected electrically or inductively with the outside mains a c, and the intermediate main being dead. When polyphase currents are desired the phase-modifying coil is connected to the intermediate main, and E. M. Fs. are then maintained between this main and the mains a c, respectively, due to the resultant action of the coil A' and the halves of the main winding A A^2, which are out of phase with one another and with that maintained by the unmodified action of the main winding between the mains a c. When now translating devices are connected with the three mains, polyphase currents are obtainable having a phase relation determined by the resultant action of the main and supplementary sources of electromotive force.

In the diagram, Fig. 1, a circuit of lamps which require only simple alternating currents is shown connected inductively through the transformer T with the mains a c. At the right of the figure a system of transformers is shown, suitable for transforming multiphase currents derived from the three mains. Two transformers, T^5 and T^6 are used whose primaries are connected in series and whose free terminals are connected to the mains a c, while the intermediate main b is connected to a point between the primaries. The secondaries are similarly connected. Such an arrangement will transform the primary currents into secondary currents of different potential but having the same phase relation. Another figure in the same specification shows in addition a simple alternating generator connected between the mains a c.

Fig. 2 shows how the angle of displacement of phase maintained in the main b depends upon the relative phases of the component E. M. Fs. due to the phase-modifying coil and main coil. e represents the E. M. F. of one-half the main winding A, e' representing the E. M. F. due to the other half, A^2, of the winding and e^2 that due to the phase modifying coil. The resultant E. M. Fs. maintained between the main b and the mains a c will then be represented by e^3 e^4. If now the relative value of the components is changed, as, for example, by increasing the value of e^2 while maintaining e e' the same as indicated in dotted lines, the resultant E. M. Fs. will assume a different angular position, and consequently the difference of phase will be correspondingly changed. To enable the adjustment of the phase relation a simple method will be to wind the phase modifying coil in sections and provide a switch for cutting more or less of them in circuit.



FIGS. 1 AND 2.

In this specification the phase-modifying source of E. M. F. is described as consisting of a supplementary coil on the generator. It is, however, not necessary that the modifying source of electromotive force be connected with the main source directly, and in a following application this source is located at a distant point of the line.

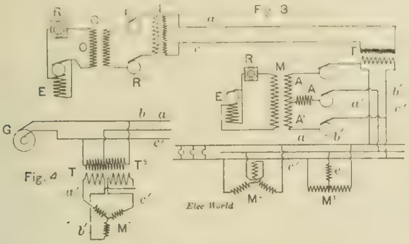
In another patent (No. 533,378), for which application was filed April 5, 1894, a different method from that above described is given for attaining the same ends, and which does not necessitate any change in the construction of the type of simple alternating current generator commonly installed.

This method consists in generating by any suitable form of alternator simple alternating currents which may be transmitted over a simple alternating circuit to a district where polyphased translating devices are installed. At such a point the displaced phase E. M. F. is generated and maintained upon a separate main, which with the mains of the simple alternating circuit constitute a polyphased circuit from which polyphased currents are derived. By this means it is not necessary to run the additional main all the way from the main generating station, but only over such parts of the system as demand polyphased currents.

The displaced E. M. F. may be derived at the desired point from a phase converter or machine resembling a synchronous or induction motor, having a main winding such as ordinarily used in machines of this type and a phase-modifying coil, in which, when rotated in the magnetic field, the desired displaced E. M. F. is generated. Fig. 3 illustrates diagramatically a distribution system embodying one form of this invention in which G is a simple alternating generator whose armature winding is connected through rings R' R^2 and a step-up transformer T^7 to the mains a c constituting a simple alternating circuit. O is the field winding of the alternator, supplied by a continuous current from an exciter E, which is regulated by a resistance R; T^7 and T are step-up and step-down transformers, and beyond T is a sub-circuit a' c' on which are shown incandescent lamps L L.

For the purpose of obtaining polyphase currents for operating polyphase motors installed on this sub-circuit, there is provided a phase converter M^5 which has an armature winding A, A^2, whose terminals are connected to the mains a' c', and which therefore receives simple alternating currents from such mains. This machine is of the synchronous type, having its field supplied with continuous currents from an exciter E, and regulated by a resistance R in the exciting circuit. The main armature winding A A^2 is the same as that used in simple alternating machines. A phase modifying coil A', connected at one end to the central point of the main winding, leads through a collector ring to an additional or middle main b' which with the single phase circuit mains a' c' constitute for all practical purposes an interconnected polyphase circuit. The coil A' occupies a displaced position relatively to the main coil in the magnetic field.

When so constructed the armature of the machine M^5 will rotate, as in the case of an ordinary synchronous motor, and the modifying coil A' gives rise to and maintains on the middle main b' a displaced E. M. F. such that polyphase currents will be delivered to translating devices whose terminals are joined to the three mains. Such translating devices are shown at M', M^2. M' represents a motor constructed in a manner similar to machine M^5. It has a main winding connected across the mains a' c' and a supplementary winding e coupled between the middle main b' and the central point of the main winding. This last coil occupies a displaced position in the field of force corresponding to the displacement of phase existing between the middle main and the outside mains. M^2 represents a three-phase motor either of the synchronous or induction type, provided with a so-called Y winding and with its different coils connected to the mains a' b' c'. One of its coils, namely, that joined to main b', is reversed, so that it may operate as a three-phase motor with currents flowing in the coils 120 degrees apart in phase, though in the diagram it is assumed that there is only 60 degrees difference of phase between the middle main b^1 and the outside mains.



FIGS. 3 AND 4.

A second illustration to the same specification represents transformers interposed between the motors and the line.

Still another modification is shown in which no change in the construction of the machines now in common use is required. Referring to Fig. 4, G is a simple alternator. Two transformers T^1 T^3 have their primaries connected in series with the mains a c, while from the central point between them is run a third main b. M^1 represents a three-phase motor having a Y^2 winding. The terminals of two of the motor coils are connected by mains a' c', with the secondaries of the transformers, while the third coil is connected to main b'. The secondary of the transformer T^3 is reversed so as to alter the phase relation of the transformed current from 60 degrees on the primary side to 120 degrees on the secondary side. With this arrangement the machine M^1 will maintain a displaced E. M. F. on the main b', which is reflected back through the transformers and the phase relation of the primary and secondary currents altered in the transformers as well as the potential. In this way it is possible to deal with currents at high voltage by a three-phase machine wound as is customary for comparatively low potential.

Another specification, for which application was filed April 11, 1894 (No. 533,379), describes a system of electrical distribution for polyphased currents whose principal novel feature consists in an arrangement whereby motors of the three-phased type may be operated from line circuits in which currents flow 60 degrees apart in phase, only slight changes being required in the construction of the motors from that of the ordinary well-known induction machines of this class. This change consists in reversing one of the three coils of the motor so that the current flows through this reversed coil in an opposite direction from that in ordinary motors, and therefore produces the same effect, so far as the action of the motor, as that which has heretofore been secured by currents differing in phase by 120 degrees.

Fig. 5 shows diagramatically a system of distribution embodying the invention, in which G is an ordinary alternator except that there is added a phase-modifying coil, as in the other cases described. F are the field coils and E a shunt-wound direct-current exciter controlled by the rheostat R. The phase-modifying coil C' occupies a position in the magnetic field relatively to the main coil of 90 degrees, thus creating an E. M. F. differing 60 degrees from that of the main coils. This phasal relation is secured by properly proportioning the windings of the main and supplementary coils, so that the resultant E. M. Fs. generated by the coil C' and the respective halves of the main winding differ in phase by the desired amount.

For transforming the currents flowing on the mains to a lower potential, two transformers T, T', are used, whose primary windings are connected in series and which are coupled at their free terminals and at the central point c, with the three mains a b c. The secondary windings of the transformers are joined in series and connected in an exactly similar manner to secondary mains a' b' c'. A three-phase motor, M, is provided with the three usual coils e e' e^2, two of which, e and e' have corresponding terminals connected at a common joint t, while the third coil has its opposite terminal connected to the same joint. The winding, it will be observed, is of the usual Y pattern and differs from the ordinary construction only in the reversal of the coil e^2. The free terminals of the coils are connected respectively to the mains a' b' c'. With this arrangement currents flow between the mains a' c' and b' c', which differ by 60 degrees in phase, but by reversing the direction of the current in the coil e^2, the relation of the currents, so far as the operation of the motor is concerned, is changed so that the motor operates in a similar manner to any ordinary three-phase motor when its terminals are connected to mains carrying currents 120 degrees apart in phase.

Another figure accompanying the same specification illustrates a system similar to the above except that the monocyclic currents are not generated directly at the power station, but supplied by a phase converter (motor-generator) taking current from a simple alternating circuit.

Another patent (No. 533,245) for which the application was filed April 13, 1894, describes a system of electrical distribution for multiphased currents by which currents 60 degrees apart may be converted into currents 120 degrees apart in phase, or the reverse, thus rendering possible the generation and distribution of currents 60 degrees apart in phase and their conversion into currents differing 120 degrees in phase and suitable for operating three-phased motors of the ordinary type or other three-phased apparatus. By this method monocyclic currents may also be converted into three-phased currents.

The conversion of one system into the other is effected by two transformers in which the primary and secondary windings occupy relatively a reversed relation, so that in a 60-degree system the phase of one of the currents will be changed through the angle of 180 degrees, thus occupying a phasal relation with reference to the other two currents such that all the three are 120 degrees apart.

Fig. 6 represents diagramatically the system of distribution in which 60-degree or monocyclic currents are converted into 120-degree or three-phased currents, G being, as in Fig. 5, a monocyclic generator.

For converting their currents into three-phase currents, two transformers, T, T' are employed whose primary coils are joined in series at the point e. Their free terminals are connected to two of the mains a c, and their connected terminals at the point e are joined to the third main b. The secondary windings of the transformers are coupled in a similar manner to mains a' b' c', but one of the secondary coils, as, for example, that of transformer T, is reversed, as shown in the diagram.

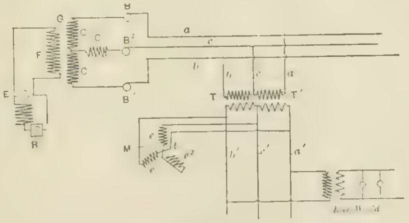
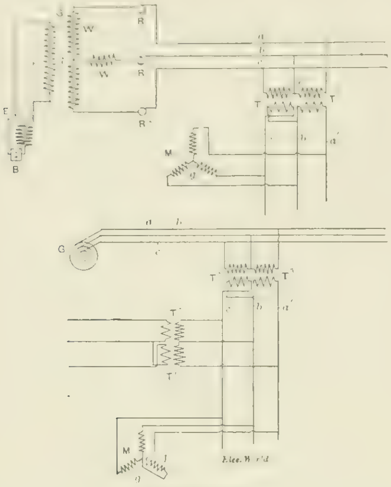


FIG. 5.

This will result in shifting the E. M. F. maintained between the middle main b' and one of the outside mains through an angle of 180 degrees, so that the phasal relation of the E. M. Fs. on the secondary side of the transformers will be 120 degrees apart instead of 60 degrees apart, as they are on the primary side. Instead of reversing one of the secondary coils, the same change of phase may be secured by reversing one of the primary coils. The three-phase currents thus procured may be used with motors, lamps, etc., as desired.

In Fig. 7 the generator G' is of the three-phase type, and the E. M. Fs. maintained between the mains a b c are 120 degrees apart in phase. These currents may be converted into a monocyclic system by two transformers, T^2, T^3, connected in series to the mains a b c, in a manner similar to the transformers T, T', shown in Fig. 6, and already described. The secondaries of the transformers are connected to mains a' b', c', but the secondary of transformer T^2 is reversed, so that the two E. M. Fs. between the main c' and the mains a' b' are 60 degrees apart in phase, instead of 120 degrees, as is the case on the primary side. The secondary currents may be utilized for operating translating devices in any desired manner.

Motors may be run from all three mains by using a system of transformers, T^6, T^6, in all respects similar to T, T' as described in connection with Fig. 6, or, by modifying somewhat the construction of the ordinary three-phase motor, they may be connected directly with the mains a', b', c'. This modification consists in reversing one of the coils of the motor, as shown at M'. Here the motor has three windings, having one set of terminals connected to a common joint g, and their free terminals to the mains, but instead of the arrangement shown at M, one of the coils, f, is reversed. This illustrates how motors of this type may be operated from the mains a', b', c' without reconverting the 60-degree currents into true three-phase currents.



FIGS. 6 AND 7.

In another patent (No. 533,247), the application for which was filed Sept. 24, 1894, is described a system in which two or more multiphased motors having some of their coils connected across a simple alternating circuit and other coils occupying a displaced position in the magnetic field relatively to the first named, are connected by balance wire; the operation, then, of any one of the motors will produce on this balance wire an E. M. F. of displaced phase which will enable any one of the other motors to be started. Of the two figures which accompany this specification one relates to three-phased motors (Fig. 8), and the other to two-phased motors. G is a simple alternator, E its exciter, and F G a transformer. In one of the branch circuits, a', b', are indicated three multiphased motors, M, M', M^2, with Y-connected coils. Each of these motors has two of its coils connected in series across the simple alternating mains, and the third coil connected to the corresponding coil of the other motors by a balance wire d.

If we suppose that all but one of the motors are disconnected from the supply lines a', b' and the motor M, which is connected, to have been started and to be running, then there will be generated in the coil A', which is connected to the balance wire, an alternating E. M. F. out of phase with the E. M. Fs. on the simple alternating lines a' b'. This displaced E. M. F. is communicated to the balance wire, and if any other motor is then thrown into connection with the simple alternating lines a' b' and the balance wire d it will receive in its coil A' a displaced E. M. F., which, co-operating with the simple alternating E. M. F. on the lines a' b' will serve to start the motor in operation.

It will thus be seen that the operation of any one of the motors will generate on wire d a displaced E. M. F. which enables any one of the other motors to be self-starting. When all of the other motors are in operation the balance wire d may be, and preferably is, practically idle, but in case of abnormally heavy or light load on part of the motors it will serve to transfer energy from the lightly loaded parts of the system to the overloaded parts. In case a motor is put in connection with the supply lines and no other motor has previously been so connected it may be started into operation in any convenient manner. There is shown for this purpose a small switch s, shunting one of the inducing coils of the motor, which, with the proper proportioning of the various parts will cause the motor to start, even when under load.

In another portion of the figure are shown three branch circuits a^2 b^2, a^3 b^3, a^4 b^4, which supply motors M^5, M^4, M^3, through sets of transformers T^2 T'^2, T^3 T^3, T^4 T^4, which reduce the potential on the motors. The balance wire d is connected to a point between the primary coils of each set of transformers T^2 T, T^3T^3, T^4 T^4. The motor M^5 is shown as an induction motor with -connection, and has two of its coils connected in series with the secondaries of the transformers T^2T^2, its third coil being connected between the secondaries of transformers T^2 T^2. A synchronous motor M^4 is shown having armature coils relatively displaced and connected in Y-connection. These coils are connected to collector rings r^1, r^2, r^3, on which bear brushes c', c^3, connected to outer terminals of the secondaries of transformers T^3 T^3, and brush c^2 connected to the junction of said secondaries.

A field coil f in circuit with a separate exciter E' is provided for this synchronous motor. M^3 represents a three-phase induction motor having a delta winding, one of its coils being connected in series with the secondaries of the transformers T^4 T^4 and the junction of the other two coils being connected to the junction of the secondaries of transformers T^4 T^4. The operation of these devices is the same as that above described except that transfer of the displaced E. M. F. and of energy on the balance wire d is effected with an intermediate transformation by transformers T^2 T^2, T^3 T^3, T^4 T^4. This arrangement is applicable to cases wherein the motors are all in reasonable proximity to the mains a, b, but distant from one another, while the arrangement shown for the motors M, M^1, M^2 is more especially applicable to the case of motors in proximity to one another. At a^5, b^5 is shown a branch circuit containing devices such as lamps L, supplied through a transformer T, from the mains a, b. It is also clear that simple alternating translating devices whether inductive or non-inductive may be supplied from any one of the branch lines a' b', a^2 b^2, etc.

The motors shown in Fig. 8 are all three-phase motors, and it must be understood that ordinary three-phase motors may be employed as here shown without any modification whatever. Such motors in general as heretofore constructed have their three coils similarly wound, so as to be equal in effect—so that the E. M. Fs. generated on the balance wire d would naturally be balanced in the normal operation of the motors; but this equality of action is not necessary. The coils may have unequal relative values in the different motors—so that this balance does not exist, though the balanced system is preferred. For this purpose, however, it is not necessary that the relation between the coils of each motor should be one of equality. It is only necessary that this relation should be the same in the several motors—that is, if one of the coils is stronger in effect than the other coils in one of the motors, the corresponding coil in the other motors should be stronger than the other coils in the said motors. It will also be clear that any other phase relation may be used, and the same system may carry three-phase apparatus in one part and quarter-phase in another part, the balance wires being separate, that is, the three-phase apparatus having one balance wire, and the quarter-phase apparatus another balance wire, or such apparatus of different phase relation may even be connected to the same balance wire by the interposition of appropriate phase-changing apparatus, such as transformers. Such an arrangement is shown in another diagram in the specification.

The final patent in this series (No. 533,248), application for which was filed September 24, 1894, comprises a set of mains connected to and supplied by a source of simple alternating currents, and associated with this set of mains and one or more balance wires on which is maintained an E. M. F. out of phase with the E. M. Fs. on the simple alternating mains. At various parts of the system this third wire is connected with the translating devices which require a displaced E. M. F. for their operation, as, for example, certain forms of alternating current motors. These motors have some of their coils connected across the simple alternating mains, and from these mains in the normal operation of the motors is derived the energy which actuates them. Other coils of the motors are connected to a balance wire and are supplied thereby with a displaced E. M. F.

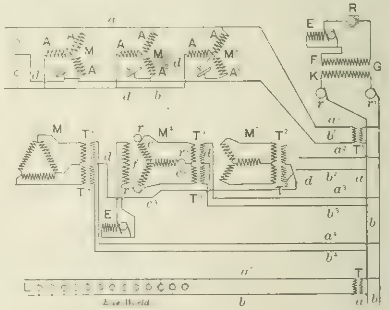


FIG. 8.

In the normal operation of the system, that is, when the load throughout the system is normal, including the load on the motors, then the motors will derive substantially all their operating energy from the simple alternating mains, and the balance wire, while maintaining a displaced E. M. F. on the coil to which it is connected, does not supply any substantial part of the energy which is converted into work by the rotation of the motor. Under these circumstances the system becomes substantially a simple alternating system and is capable of being regulated and of operating simple alternating devices with the same facility as the ordinary alternating current system. This is termed in the patent the monocyclic system.

Comparing this system with an ordinary multiphase system it is to be noted that in the multiphase system there are three or more mains carrying two or more alternating currents of different phase, each of which supplies a substantial part of the energy required for the normal operation of the multiphase translating devices, and in general the energy transmitted is about equally divided between the several currents. In the case of the monocyclic system, however, as herein described, only two of the mains and the simple alternating current carried thereby are instrumental in the distribution or transmission of energy in the normal operation of the system. The other main or mains in such normal operation supply simply a displaced E. M. F., but do not have any substantial part in the actual transfer of energy. This result is accomplished by adjusting the relation between the impressed E. M. Fs., counter E. M. Fs. and resistances, both inductive and non-inductive, of the several circuits.

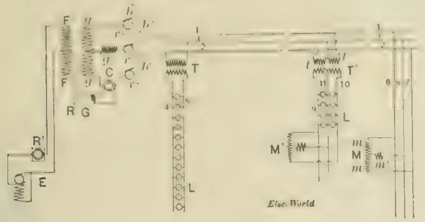


FIG. 9.

In an ordinary multiphase system this relation is such that in the normal operation of the multiphase translating devices the counter E.M.F. developed in each branch or circuit in such devices is considerably less than the impressed E. M. F. existing in such branch or circuit. The consequence of this is that in each of such circuits a current will flow, consuming energy, and this energy is drawn from all the mains. In the monocyclic system, however, as herein described, the impressed E. M. F. in one or more of the branches or circuits of the translating devices is made substantially equal to the counter E. M. F. which is generated in such branch or circuit in the normal operation of the devices, consequently practically no current will flow in such branches or circuits, the E. M. Fs. therein being practically balanced. Under variations of load above or below the normal, this balance will no longer exist and the balance wire will then be traversed by a current. Thus in the case of an over-load on the device in question, the counter E. M. F. will fall below the impressed E. M. F. in the branch connected to the balance wire so that a current will result in the direction of the impressed E. M. F., that is, the device will absorb energy from the balance wire.

On the other hand, in the case of an abnormally light load on the translating device the counter E. M. F. in such device will rise above the impressed electromotive force and current will flow in the direction of the E. M. F., thus supplying energy to the balance wire. The balance wire thus acts as a possible means for transferring and equalizing the load throughout the system.

The displaced E. M. F. on the balance wire may be derived from the same machine that supplies the alternating current to the simple alternating mains, or it may be derived from a separate machine. It is, in fact, immaterial what means are employed to maintain the displaced E. M. F.—whether it is by the action of a source associated with the main source of simple alternating current—or of a source entirely distinct therefrom, or by the action of one or more of the translating devices themselves. Thus certain classes of translating devices, such as motors having displaced coils, are capable of supplying the displaced E. M. F. by their normal operation while deriving their operating energy from the simple alternating mains.

The invention lies not so much in the type or arrangement of apparatus employed as in the proportioning of the forces acting therein, and of the resistances opposed to such forces, so as to bring about a normal condition of static equilibrium or balance, as regards the balance wire and the parts immediately connected therewith.

Fig. 9 represents diagramatically a system of distribution to which this method is applicable and which includes many of the details described and illustrated above. Other illustrations accompanying the specification show a system similar to the above but in which the displaced E. M. F. is derived directly from the main source of simple alternating current, a system in which the displaced E. M. F. is obtained by the action of the translating devices themselves; a system in which the displaced E. M. F. is supplied by a motor generator and one employing a three-phase generator.

Referring to Fig. 9, G is an alternating current generator having a main armature coil g and as in the preceding illustrations, an additional coil, g', angularly displaced (preferably 90 degrees, with reference to the main coil, and connected at one end to the intermediate portion of the main coil and at its other end to a third collector ring. The generator shown is compound wound, having one field coil F included directly in the simple alternating circuit through a rectifying commutator C, a resistance, R, shunting the break of the commutator to prevent sparking; the other field coil F' has a separate exciter E.

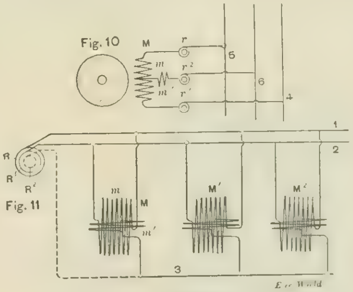
The circuit 4-5 indicates a simple alternating transformer and branch circuit, the energy for which is derived altogether from the main generating coil g of the generator; 6-7 is a connection to an induction motor M having an inducing winding with main and supplementary coils similarly arranged to those of the generator G, the simple alternating lines 6 and 7 leading to the main coil m of the motor and the balance wire 8 leading to the supplementary coil m'. These coils may be supposed to act upon a closed coil armature in the usual manner, and when the motor is started from rest the displaced E. M. Fs. supplied to its angularly displaced coils will furnish the torque required for starting. When the motor is running a counter E. M. F. is developed in all of its coils, and the counter E. M. F. between the lines 6 and 8 and between the lines 7 and 8 will be the resultant of the counter E. M. Fs. generated in the supplementary coils m m'.

The direction and magnitude of the current flowing in the several branches of the circuits of the motor depends upon the relation between the impressed and the counter E. M. Fs. in the respective branches or circuits. By properly proportioning the windings of the generator or of the motor by properly adjusting the impedance of the several circuits, the effective impressed and counter E. M. Fs. in any one of the branches can be made substantially equal when the motor is running at normal speed and load. The motor M is shown directly connected to the main and the third wire, but transformers may be included in the connections if desired, as shown in the circuit 9-10-11.

Patents Nos. 533,249 and 533,250, of which the applications were filed November 20 and 24, 1894, respectively, relate to a monocyclic motor.

The motor is represented diagramatically in Fig. 10. Its primary member is provided with mains and "teaser" windings m and m', the collector ring r^2 being connected with a line making connection, say, at the generator with a coil displaced in phase from that of the simple alternating current flowing in the two outside lines represented.

Fig. 11 represents three monocyclic motors connected to a simple alternating circuit and with their teaser coils connected to a balance wire 3. When the motors are in normal operation the balance wire will carry substantially no current. Currents, however, may be conveyed over this wire from one motor to another when one is loaded unequally, or when one or more of the motors are starting or running at other than the normal speed. In starting a motor of this character the field of the machine should be left unexcited until the armature has been brought to speed, as is now the common practice with different forms of polyphased motors.



FIGS. 10 AND 11.

Common Sense Oil Filter.

The oil filter we illustrate, made by F. H. Alling, New Haven, Conn., has the unique advantage of the entire operation of filtering being plainly visible.

The filtering medium is all submerged in water, and occupies the upper portion of two bell-shaped glasses. The oil to be filtered is put into the tank on top of the filter, and is fed down through the side pipe, entering the filter at the bottom near the centre. Oil, being lighter than water, immediately rises through the water and accumulates beneath the filtering material, being enclosed by the bell. By capillary attraction and its gentle pressure upward from its lighter gravity, it gradually goes up through the filtering material in the lower glass bell, and is caught and required to pass through the upper one in the same manner, the clean oil accumulating on top of the water, and is drawn off at the front faucet, which communicates with the central pipe. The side faucet is to draw off the water.

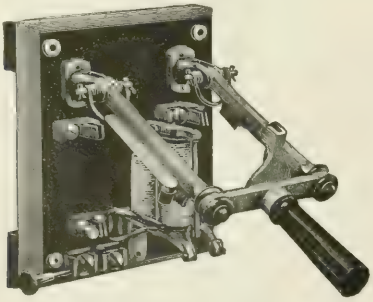
Through the difference of specific gravity of water and oil, the latter rises, while the iron and babbitt and most other impurities found in the oil, being heavier than water, have a tendency to fall; this tendency, however, is greatly diminished by the water, whose specific gravity subtracts from that of these substances, and thus they have a very moderate inclination to drop. As a result of these two modifications there is a very gentle, but sure, tendency to separate, and this condition permits oil being filtered successfully for any length of time. The filtering material used is such as has been proven by most thorough experiment and constant use to be the best, not only for some kinds of oil, but for all kinds. The filter is made of glass, so that the operation is visible.

Common Sense Oil Filter.

Automatic Motor Switch.

In order to prevent the burning out of armatures and other accidents which not infrequently occur to electric motors through accidents or carelessness of the attendants, the Brodie Electric Company, of Manchester, N. H., has brought out an automatic motor switch shown in the accompanying illustration.

The switch is designed to open the circuit, not only when an abnormal current passes through the armature and thus to prevent danger from overloading, but also to disconnect the motor whenever the field current ceases from any cause, as through the circuit being thrown off at the central station or any other reason. It thus prevents damage which is likely to result if the current should suddenly be thrown on again.


Automatic Motor Switch.

To accomplish the above named objects an ordinary double-pole jackknife switch of approved design is employed which is supplied with special springs tending to hold it in an open position. Between the blades of the switch is mounted an electromagnetic controlling device consisting of a differential electromagnet controlling the position of a detent, which detent is capable of engaging with the switch and holding it closed, but if the current increases above a certain amount the detent releases and the switch is thrown open. One of the spools on the electromagnet is in series with the motor armature, while the other is traversed by the field current of the machine.

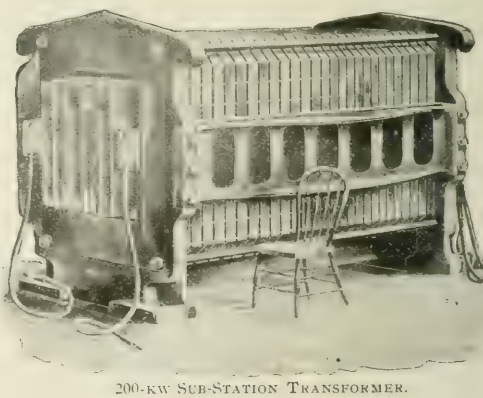
The operation of the device is as follows: Upon closing the switch the detent through the influence of the field current holds the switch in a closed position and the motor may be started by the rheostat in the usual way; if, however, at any time through overloading the armature current exceeds the proper amount, the magnetism due to it preponderates over that due to the field current and the detent releases, allowing the switch to open and disconnect the motor; or, if the current supplied to the motor fails from any cause, the magnet immediately loses its power, the switch is instantly released, and the motor is protected from the damage that might otherwise occur from the sudden resumption of the current before the rheostat had been thrown back. In order to shut down the motor it is only necessary to press the button on the left hand side of the switch. Wires may be led from the short circuiting contacts to any part of the building where the motor is used, and the buttons may be arranged to shut down the motor from distant points in case of accident. Auxiliary arcing contacts are provided to prevent the fusing of the switch contacts when heavy currents are broken.

Air-Blast Transformer.

The development of transformers of very large capacity for sub-station and large power transmission has been the subject of much careful study and research on the part of the General Electric Company, with the result, it is claimed, of overcoming the difficulties which for some time were considered almost prohibitive of the use of very large transformer units.

The principal difficulty met with in transformer work is the matter of temperature. All large transformers to be efficient and economical must be provided with artificial means of cooling. Many methods have been from time to time proposed for the artificial cooling of large transformers; such, for example, as the circulation of oil through the transformer and a cooling tank or the passage of water or other cooling fluid through pipes within the transformer, all of which have shown themselves to be complicated and inconvenient. The General Electric Company has, however, devised a simple and efficient air-blast system, which consists of a transformer having numerous air ducts through which cool air is constantly forced by means of a blower, the temperature being sufficiently reduced by radiation from the walls of the ducts. This system is practically the same as that by which all large dynamos are kept cool, differing only in that we are so fortunate as to have in the dynamo a rotating armature to create the necessary draft, while in the transformer a separate fan has to be used.

By means of the air-blast the rise in temperature may be readily kept below 60 per cent., or even lower if required, the 200 kw transformers recently manufactured for the Cataract Construction Company having a maximum rise of but 35 per cent. The power required to supply the necessary air-blast, of course, varies with the transformer capacity installed, and also with the distance that it is necessary to convey the air from the blower to the transformer. Under ordinary conditions, however, it will not exceed one-half of 1 per cent. of the total capacity of the transformers cooled, and in large sub-stations it may generally be reduced to one-fourth of 1 per cent.


200-kw Sub-Station Transformer.

A simple method of installing one or more large sub-station transformers is to place them over a duct beneath the floor having suitable openings beneath each transformer for the air-blast, which is maintained in the duct by means of a blower driven from any convenient source of power, the duct at the same time serving as a convenient place to locate all wires coming to the transformers. The air passes through the duct upward through the transformer and may either escape into the surrounding room or may be led away through other ducts as may be found most convenient.

Transformers of the air-blast type are built in the following standard sizes: 40, 65, 75, 100, and 150 kw. Special transformers of intermediate or larger sizes can, however, be furnished almost as promptly as standard apparatus.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Feb. 2, 1895.

GENERAL ELECTRIC has not seen fit to participate in the bettered feeling of most electrical stocks this week. The selling of this stock has at all times during the week been more conspicuous than the buying, and the stock has been weak when the rest of the active list has manifested a distinct tendency to advance. On one day it broke four points on sales of 26,670 shares. There is no doubt that a good deal of long stock has come out, but most of the decline was brought as the result of a well-directed bear campaign engineered by all the old leaders on the down tack. This bear campaign has been long in contemplation, and people on the inside have had definite and precise information in regard to the time and extent of fall in General Electric's quotations. The opportunity came this week and quick advantage was taken of some small sales of long stock following upon the repeated bear stories of last week as retailed in these columns. Liquidation was hurried along by well-circulated reports that the annual report soon to be made public would show large gross earnings but very small net profits. The liquidation was aggravated by the persistent hammering, and quotations finding no support, fairly tumbled over each other. It seems as if insiders have not been averse to the decline, for no effort at all was made to check the slump, no contradictions being made of the current unfavorable rumors, nor any buying for their account. In the last two days quotations have bettered a little, more out of sympathy, however, with the advancing market than through a genuine appreciation of value, and the stock closes for the week in a comparatively bad way, speculatively speaking.

WESTINGHOUSE ELECTRIC issues are practically unchanged, though a slight stiffening in the price of the common is noticed. Reports of current business continue good, and the work of removal to the new Brinton shops is progressing at a rate entirely satisfactory to the company's officials.

POSTAL TELEGRAPH has been strong of late. Its business has recently been increasing by leaps and bounds, the efficiency and despatch of the service having been demonstrated of late on several noteworthy occasions to a degree to invite the most favorable criticism. President Chandler's policy of doing a thing well is apparently receiving its due rewards. Very promising things are told of the company's increasing earnings.

AMERICAN BELL TELEPHONE is still sick. It has been depressed this week more than anything else by reports of ever-increasing competition, which is said to be making great inroads on the company's revenues, especially in Indiana, Ohio and the other middle Western States. The officials have determined to push along the contemplated long-distance extensions, and these new lines will eventually prove a source of profitable revenue that will assure big Bell Telephone dividends for years to come. Nothing has as yet been decided, however, about the auction sale of stock left over from subscription or regarding the issue of the remaining $25,000,000 capital stock authorized last year.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	128	130
Edison Electric Ill., New York	100	98	100
" " " Brooklyn	100	108	110
" " " Boston	100	123	126
" " " Philadelphia	100	120	125
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	35	40
General Electric	100	30	30⅛
General Electric, pref	100	65	70
Westinghouse Consolidated, com.	50	32	32¼
" " pref	50	49⅛	50

BONDS.

	Par.	Bid.	Asked
Edison Electric Ill., New York	1,000	108	109
Edison Electric Light of Europe	190	75	85
General Electric Co. deb. 5's	1,000	90	90⅛

TELEGRAPH AND TELEPHONE.

	Par.	Bid.	Asked
American Bell Telephone	100	190	192
American District Telegraph	100	45	49
American Telegraph & Cable	100	92	93
Central & South American Telegraph	100	117	120
Commercial Cables	100	140	145
Erie Telephone	100	47	48
Gold & Stock Telegraph	100	106	110
Mexican Telegraph	100	180	190
Mexican Telephone	100	75	80
New England Telephone	100	67	69
New York & New Jersey Telephone	100	97½	99
Postal Telegraph-Cable	100	53	58
Western Union Telegraph	100	88	88⅛

THE ERIE TELEGRAPH AND TELEPHONE COMPANY, Lowell, Mass., has declared a dividend of 1 per cent. for the quarter ended Dec. 31, 1894, and reports a surplus of $159,523.57.

THE UNITED STATES ELECTRIC SECURITIES COMPANY has declared a semi-annual dividend of $3.50 per share on the preferred stock; checks are being delivered to stockholders to-day.

THE NEW YORK AND NEW JERSEY TELEPHONE COMPANY will, on and after March 2, redeem its first mortgage 6 per cent. bonds. In order to pay off its maturing firsts it offers for sale $375,000 5 per cent. 30-year gold bonds at 103 and interest.

ELECTRIC TRACTION stocks have again been lively. Long Island traction remains weak. Added to the depressing effect created by the strike's occurrences comes the report that it is very doubtful whether the company can meet its coming interest and rental obligations and a forfeiture of important leases is thereby threatened. Brooklyn traction, too, continues to sag, and the muddle of litigation following on the strike is not calculated to cheer depressed stockholders. In Philadelphia there have been savage attacks on the Tractions, but there has been a rally, the most violent fluctuations being in Metropolitan, People's and Philadelphia. Consolidated Traction of New Jersey is also down, but Director B. M. Chanley says "there is nothing in the company's affairs to cause a moment's alarm; earnings now exceed fixed charges, and beginning with spring they will equal $2,500 a day above all charges." This means something earned for stockholders.

BOSTON TRADING has been confined to West End. Nothing has come as yet of the threatened labor troubles, the company having, it is reported, made concessions, but the stock naturally is not inclined to rise on such reports.

DUQUESNE TRACTION—A Pittsburgh stock much thought of in the East—has redeemed the promise told of last week by declaring a dividend of 2 per cent. ($1 per share); checks will be mailed on Monday. At present market prices, 28 and 29, Duquesne Traction, with dividends on a 4 per cent. basis, nets the investor 7.15 per cent., which is the largest sum yielded on any Pittsburgh traction stock. Citizens' Traction yields at current prices, 5.10 per cent, Pittsburgh, Allegheny and Manchester 6.4 per cent; Pleasant Valley, 5 per cent.; West End Traction 4 per cent., and Pittsburgh Traction 5 per cent.

BUFFALO STREET RAILWAY—another "foreign" road dealt in here—makes a fine report for the year ending Dec. 31, 1894. Net earnings were $679,652, an increase of $105,943 over the figures for 1893, and there is a surplus applicable to dividends of $210,735, which is nearly 4 per cent on the stock.

ELECTRIC TRACTION STOCKS.

	Bid.	Asked
Union Ry. Co. (Huckleberry)	115	125
Brooklyn Traction, com	11	13
" " pref	58	62
Long Island Traction	10¼	10¾
Rochester St. Ry	36	38
Columbus St. Ry	45	50
Louisville St. Ry. com	37	39
" " " pref	87	88
Cleveland Electric Ry.	59	60
Cleveland City Ry.	68	70
North Shore Traction	23	25
New Orleans Traction	14½	16½
New Orleans Traction pref	56½	59½
Worcester Traction com.	12½	14
" " pref	79	81
Metropolitan Traction, Philadelphia	94¾	96¼
Philadelphia Traction	87	89
People's Traction	49½	49¾
Binghamton R. R. common	100	—

BONDS.

	Bid.	Asked
*Union Ry. 1st. mtge 6s.	105	108
*Westchester Electric 1st. mtge. 5s.	98	101
Rochester St. Ry. 1st. 5s.	95	97
*Columbus St. Ry. 1st 5s.	95	97
Columbus Crosstown 1st. 5s.	95	97
*Binghamton Railroad Co. 5s	99	100

*With accrued interest

Special Correspondence.

PITTSBURGH NOTES.

PITTSBURGH, Feb. 2, 1895.

PREPARATIONS ARE BEING MADE by local electric light men for a large attendance at the Cleveland convention. Owing to the short ride between here and Cleveland the Pittsburgh delegation will be exceptionally large.

THE PROCESS OF MOVING the Westinghouse electric works from Garrison Alley, this city, to Brinton, is rapidly progressing. The company is expected to extend a general invitation to the guests at the Cleveland convention for a visit to Pittsburgh to the new works. If this should be done those who will take advantage of that invitation will have an opportunity of seeing many interesting sights. The arrangements and equipment of machinery in the new shops are said to surpass anything in the world in a similar establishment, and the Westinghouse Company has facilities there for turning out apparatus that have never been equalled.

A NUMBER OF PROMINENT CITIZENS have inaugurated a move against the local street car companies, which, if it should be successful, will bring lots of new business to car manfacturers. A bill was introduced into the Pennsylvania legislature yesterday compelling street car companies to charge a reduced fare to their patrons when the latter are obliged to ride in the cars and cannot get a seat, in other words, have to stand up. It is said the bill has powerful backing and is being vigorously pushed. The street railway business is now conducted in this city as near perfection as possible. During all the varieties of recent weathers, heavy snow storms, sleet, rain, frost, etc., etc., the operation of all the roads was never impaired, and the street car traveling public were never inconvenienced by undue waiting because cars were not running.

WESTERN NOTES.

Branch Office of The Electrical World,
936 Monadnock Building, Chicago,
February 2, 1895.

THE NASHOLD CLEAT is now being manufactured to the number of 100,000 a month, and still unfilled orders on hand Feb. 2 amounted to 120,000 cleats.

MR. J. P. B. FISKE has severed his connection with the Morgan Engineering Company, Alliance, O. Mr. Fiske was formerly in the motor department of the General Electric Company.

FRED. W. RICHART, Carbondale, Ill., has just completed the installation of a 500-light A. C. incandescent lighting plant, for Wright Bros., Vienna, Ill., using Bain electrical apparatus and Watertown steam machinery.

THE McEWEN MANUFACTURING COMPANY, through Agent Sharp, has captured the order placed by the great retail house that is to occupy the block between Jackson and Van Buren streets on State street. The McEwen Company will supply both engines and direct-connected generators of their own make.

THE CARD ELECTRIC COMPANY, Mansfield, O., reports the following sales of electrical machinery. Citizens' Street Railway Company, Mansfield, O., two single 35-hp equipments and one double 35-hp equipment; Elkhart and Goshen, Ind., five single 35-hp equipments, two double 25-hp equipments, and two double 35-hp equipments; Bloomington, Ill., Street Railway Company, one double 25-hp equipment; Lincoln, Ill., Street Railway Company, one double 25-hp equipment; J. E. Tomlinson, Centerville, S. D., one 35-kw multipolar dynamo; E. C. Hargrave & Company, Hinckley, N. Y., one 30-kw multipolar dynamo; Mansfield Machine Works, Mansfield, O., one 30-kw generator with multipolar motor equipment; The Aultman & Taylor Machinery Company, Mansfield, O., one 30-kw multipolar dynamo; Fulton Truck and Foundry Company, Mansfield, O., one 30-kw dynamo; J. Holt Gates, St. Louis, one 30-kw multipolar dynamo; J. Holt Gates, Chicago, one 30-kw multipolar dynamo; United States Baking Company, Louisville and Indianapolis, two 25-kw multipolar dynamos; Geo. P. Nicolls, Chicago, one 15-hp multipolar generator; Niagara Engineering Company, Buffalo, N. Y., one 12-kw machine, besides numerous other multipolar motors and dynamos of small sizes. For the Niles Tool Works, Hamilton, O., a large special iron-clad reversible motor for working boiler-plate rolls. This motor will be controlled by special reversible controller with long lever handle. The Card Company is making a specialty of this class of work. The factory is now well equipped for work and orders are coming in fast.

General News.

NEW INCORPORATIONS.

THE ST. LOUIS AND JEFFERSON BARRACKS RAILWAY COMPANY, St. Louis, Mo., capital stock $50,000, has been incorporated.

THE CHICAGO BELT LINE STREET RAILROAD COMPANY, Chicago, Ill., capital stock $500,000, has been incorporated by F. J. Phillips, G. P. Loehr, and Andrew Matson.

THE CHARDON TELEPHONE COMPANY, Chardon, O., capital stock $2,000, has been incorporated by Orange Pomeroy and others to build and operate an exchange.

THE MUTUAL AUTOMATIC TELEPHONE COMPANY, Chicago, Ill., capital stock $1,000,000, has been incorporated by Athel E. Mackin, Joseph Kelley and James F. Duhig.

THE FISHERVILLE, BARTERBROOK AND STUART'S DRAFT TELEPHONE COMPANY, Fisherville, Va., has been incorporated by J. W. Paul, P. T. Burkholder, W. F. Gilkeson and others.

THE PEOPLE'S TRACTION COMPANY, New York, capital stock $1,500,000 has been incorporated to operate a street surface road 20½ miles long. F. A. Wilcox, E. H. Hibbs and J. A. Bensel, New York, are the promoters.

THE FULTON ELECTRIC LIGHT AND POWER COMPANY, Fulton, Ill., capital stock $20,000, has been formed to operate an electric light and power plant. C. C. McMahon, Ed. Wyatt and H. S. Remer are the promoters.

THE YORK LIGHT AND POWER COMPANY, York, Neb., capital stock $12,000, has been incorporated to furnish light and power by gas or electricity. H. C. Page, Geo. W. Shuck, S. H. Sedgwick and Geo. R. Reed are the promoters.

THE WESTCHESTER COUNTY CENTRAL ELECTRIC COMPANY, White Plains, N. Y., capital stock $75,000, has been formed to build and operate a street surface road. F. H. Reed, C. A. Johnson, and C. M. Nichols, New York, are interested.

THE MASSACHUSETTS CAR COMPANY, Saco, Me., capital stock $500,000, has been incorporated with G. A. Hilton, Milton, Mass., and W. G. Wheildon, Stoneham, Mass., as treasurer, for the purpose of manufacturing and dealing in cars and railway supplies.

THE RUSHVILLE ELECTRIC LIGHT COMPANY, Rushville, Ill., capital stock $12,500, has been incorporated to supply electric light and power. C. W. Waimnan, John Foote, Chas B. Griffith, J. P. Clarke, Chas. H. Wells and John D. Little are the promoters.

THE METROPOLITAN REGISTER COMPANY, New York, capital stock $10,000, has been formed to make and sell electrical registers and indicators. J. H. Carson, New York; J. B. Benton, Elizabeth, N. J., and J. M. Stoughton, Yonkers, N. Y., are the organizers.

THE GRAND ISLAND LIGHT AND POWER COMPANY, Grand Island, Neb., capital stock $50,000, has been formed to erect, operate and maintain an electric light and power plant. The promoters are H. T. Julius Fuethman, Henry C. Joehuk and W. H. Thompson.

THE MOLYNEUX ELECTRIC MANUFACTURING COMPANY, Buffalo, N. Y, capital stock $30,000, has been incorporated to make and sell articles covered by the Barton S. Molyneux patents. The promoters are H. Walter Webb, Edgar Van Etten and A. C. Leonard, New York.

THE BOYNTON MULTIVOLT BATTERY COMPANY, Brooklyn, N. Y., capital stock $10,000, has been incorporated to make and sell electric apparatus, batteries, etc., etc. E. S. Boynton, Brooklyn, Abraham Strauss and Peter Kemble, New York, N. Y., are the promoters.

THE CLINTONVILLE ELECTRIC LIGHT AND POWER COMPANY, Clintonville, Wis., capital stock $8,000, has been formed to operate an electric light and power plant at Clintonville. D. S. Stewart; L. M. Stewart, Clintonville, and P. A. Stewart, Morris, Wis., are interested.

THE BALLSTON ELECTRIC RAILROAD COMPANY, Ballston Spa, N. Y., capital stock $200,000, has been formed to build and operate a street surface road 10 miles long. Thos. Craig, Trenton, N. J. E. W. Smith, New York and F. R. Barnes, Ballston Spa, N. Y., are interested.

THE CENTRAL WISCONSIN ELECTRIC RAILWAY COMPANY, Oshkosh, Wis., capital stock $1,000,000, has been incorporated to build an electric road from Oshkosh to Kaukauna. W. F. Gruenewald, Oshkosh; M. L. Campbell, Neenah; T. E. Ryan, Waukesha, Wis., are interested.

THE JACKSON, WELLSTON AND McARTHUR RAILWAY COMPANY, Wellston, O., capital stock $10,000, has been incorporated by Isaac E. Adams, Daniel J. Ryan, Edwin R. Sharp and others for the purpose of building and operating an electric railroad through Wellston to McArthur.

THE KING SOLOMON MINING AND POWER COMPANY, Chicago, Ill., capital stock $1,000,000, has been formed to develop and locate mining property, and to furnish light, heat and power, electric or otherwise; also to construct railways, etc. The promoters are John Casselman, Arthur B. Lewis and Harry C. Igel.

THE COMPTON ELECTRIC SERVICE COMPANY, New York, maximum capital stock $300,000, has been formed to manufacture and sell electrical and mechanical devices, appliances, apparatus, etc. Geo. L. Thomas, Baltimore, Md., Melvin Compton, Newark, N. J., and J. Fred Clasby, Elizabeth, N. J., are interested parties.

THE ELECTRIC PURIFIER COMPANY, Chicago, Ill., capital stock $300,000, has been formed to manufacture and sell electric and other purifiers and also to buy and operate patents for the above purposes. Geo. H. Reynolds, A. B. Jenkins, Julius Kessler, Wm. T. Rankin, Wm. M. Cully, and Henry L. Williams, are the promoters.

THE JACKSON, WELLSTON AND McARTHUR RAILWAY COMPANY, Wellston, O., capital stock $10,000, has been formed to build, acquire, or operate a railroad to be operated by steam, electric, horse, or other motive power. Isaac E. Adams, Dan. J. Ryan, Edwin R. Sharpe, Chas. Kinney and Edw. B. McCarter are interested.

THE FORT MADISON WATER COMPANY, Jersey City, N. J, capital stock $275,000, has been formed to construct, maintain and operate water works, gas works, and electric light works. Alfred S. Brown, Louis Hallock, Jr., Robt. H. Dillingham, Herbert F. Hatch, East Orange, and Chas. B. Brown, Jersey City N. J., are the promoters.

THE UNIVERSAL ENGINEERING COMPANY, Baltimore, Md., capital stock $10,000, has been incorporated by Geo. W. F. Vernon, Theodore F. Wilcox, Wm. J. King, Julius Stern and Leopold Stern, to carry on a mechanical manufacturing and industrial business for the sale and manufacture of electrical instruments, machinery and supplies.

THE LORAIN AND WELLINGTON RAILWAY COMPANY, Lorain, O., capital stock $100,000, has been formed to construct and operate a street railroad to be operated by electricity or other motive power; also to furnish electric light and power. H. C. Reddington, E. H. Pierce, John Stang, Q. Gillmore, J. W. Steele, O. F. Carter and Jas. Nicholl, Jr., are the promoters.

THE FREDERICK-McCABE CONSTRUCTION COMPANY, Baltimore, Md., capital stock $50,000, has been incorporated by James F. McCabe, Lawrence N. Frederick, Frank H. Sloan, Lawrence P. McCabe, Francis E. Yewell, Wm. G. Stocksdale and Frank Slingluff to carry on a general constructing and electrical engineering business, make and sell dynamos, accumulators, etc.

THE GUEST-BATES MARINE LIFE-SAVING APPLIANCE COMPANY, Hoboken, N. J., capital stock $100,000, has been formed to manufacture and sell all kinds of marine life-saving apparatus and especially the electric lighting thereof, etc. The promotors are James A. Guest, 1,620 Nineteenth street, N. W., Washington, D. C.; Jas. H. Bates, 321 Hudson street, Hoboken, N. J.; Chas. J. Bates, Englewood, N. J., and Edw. C. Chew, 2,033 P Street, N. W., Washington, D. C.

TELEGRAPH AND TELEPHONE.

MARSEILLES, ILL.—A telephone franchise has been granted to a home company.

BOULDER, COL.—A new telephone line to connect Boulder with the mountain camps is to be built.

DUBUQUE, IA.—C. M. Palmer, representing the National Telephone Company, is seeking to organize a new telephone company.

HENDERSON, N. C.—Steps are being taken to secure a telephone exchange

MORRISTOWN, TENN.—J. B. Cox, of Knoxville, will establish a telephone exchange.

COLCHESTER, ILL.—John E. Hall has been granted a franchise to put in a telephone system at this place and is in the market for telephones and supplies

NORTHPORT, L. I.—A scheme is being agitated by Justice Wm A Strawson to construct a telephone line connecting all the nearby villages with Huntington.

UNION, S. C.—A telephone line and exchange is to be established by W. D. Arthur, who desires prices on a complete telephone equipment for 50 to 100 subscribers.

NEWARK, O.—The Western Telephone Company, of Chicago, has accepted a contract to build a new telephone exchange, which already has over 200 subscribers.

SPRINGFIELD, MO.—A telephone line will probably be established to connect Springfield, Bolivar, Fair Play, Humansville, Hermitage, Pittsburgh, Urbana, Buffalo and Conway.

SANDUSKY, O.—Upper Sandusky is to have an independent telephone exchange. It will be constructed at once by Geo. W. Hale & Co., who represent the Phoenix Telephone Company, of Indianapolis.

MARSHFIELD, WIS.—A communication from the business men of Grand Rapids has been received by Mayor Eicho, asking for co-operation in the establishment of a telephone line between the two cities.

RICHMOND, IND.—At the regular meeting of the city Council, the Harrison Telephone Company will ask for a franchise, and it is thought the same will be granted. The intention of the company is to put in a $40,000 plant.

ELIZABETH, N. J.—The City Council of Elizabeth granted a franchise to the Elizabeth Mutual Telephone Company to erect poles, establish an exchange, etc., in the city. The company will furnish the city with police call boxes.

CHICAGO, ILL.—The present telephone system in the stockyards which is run in connection with the Stock Yards patrol, is likely to give way to a new telephone system. It is reported that packers are arranging to put in a new system.

UPPER SANDUSKY, O.—The Phœnix Telephone Company has been granted a franchise to erect and operate a telephone system The rates are to be $2 for business places and $1 per month for residences. The rate now paid by the town is $3 per month. It is expected that the new system will be in operation in six months.

HAMILTON, O.—The franchise recently granted to a corporation giving it the privilege to string wires erect poles for telephones and telegraph purposes through the city, has been sold to another company. The new company was organized by the election of Jos. B. Hughes, president; F. W. Witaker, vice-president, and Thos. M. Boyd, treasurer.

ELECTRIC LIGHT AND POWER.

PHENIXVILLE, PA.—Phenixville streets are to be lighted by electricity.

STRATFORD, CONN.—The town of Stratford is to have street electric lights.

WAKEFIELD, NEB.—Wakefield is talking of putting in an electric light plant.

FLORENCE, ALA.—The Cypress Creek water power is to operate a large electric plant. Address Mayor G. W. Swartz.

PORT ARTHUR, ONT.—W. P. Cooke will put in a 750-light incandescent plant in connection with the present railway plant.

CLINTON, N. J.—Robert Thirkell has purchased the Clinton electric light plant and will make a number of improvements.

FRENCHTOWN, N. J.—It is rumored that an electric light plant will be one of Frenchtown's improvements in the near future.

JANESVILLE, WIS.—The H. A. Doty Light and Power Company has been succeeded by the Bower City Light and Power Company.

CLINTON, N. J.—R. Thirkell has purchased the Clinton electric light plant for $3,640 50, and a number of improvements will be made.

UTICA, N. Y.—Wm. S. Doolittle, Chas. I. Williams and Thos. N. Mooney will organize a company to furnish light and power to the city of Utica.

BROCKTON, MASS.—There is a big scheme afoot in Brockton for the organization of a new electric light company on the co-operative principle

CHESTER, PA.—The stockholders of the Chester Electric Light and Power Company contemplate some extensive improvements it is understood.

BALTIMORE, MD.—The Mt. Washington Electric Light and Power Company has purchased a site at Mt. Washington upon which they will erect a power house.

ERIE, PA.—The city has awarded the street lighting contract to the Edison Electric Light and Power Company. The price is 17 cents per 2,000-cp lamp per night.

FOX LAKE, WIS.—Fox Lake is commencing to agitate the question of electric lights. The village has exceptionally favorable conditions for the location of a plant.

JACKSON, TENN.—The Electric Car Company has been granted permission to construct an electric plant for lighting the city with both arc and incandescent lights.

CHELSEA, MICH.—Address the Mayor concerning the establishment of 20 arc lights at $1,680 per year, the lights to be 2,000 cp, and the contractors to furnish all the accessories.

NORRISTOWN, PA.—A bill was introduced by Hon B Witman Dambly asking an appropriation for the Norristown Hospital for the Insane of $12,000 for an electric plant.

MENDON, MICH.—W. P. Custard, Alex. Custard, M. Flewelin, H. C. Clapp and Geo. Avis have organized a stock company with a capital of $12,000 to put in an electric light plant.

NORMAL, ILL.—It is contemplated by the management of the Normal electric light plant to remodel the entire plant next summer and put in a new dynamo, engine and boiler.

HARTFORD, CONN.—Both Boards of the Common Council have voted for action that will result in placing under ground all electric wires in the centre of this city except the trolley wires.

DENVER, COL.—The Gilman electric plant has been purchased by the Tip Top Mining Company for $20,000. It is operated by water power, and is equipped so as to supply both light and power.

BALLSTON, SPA, N. Y.—The Ballston Spa Electric Light and Power Company has added a new 125-hp engine and a new dynamo. This gives 225 hp and a capacity of 3,000 incandescent lights.

NEW CASTLE, PA.—The New Castle and Tin Plate Company has awarded a contract to the Morgan Engineering Company, of Alliance, O., for a large electrical plant, comprising electric cranes, etc.

NEVADA, MO.—The associated water, gas and electric light companies have effected an organization. F. J. Tygard, of Butler, is president, and C. F. Strohm, of Nevada, secretary and treasurer.

DALLAS, TEX.—C. L. Wakefield and his associates are seeking a franchise to put in a modern plant to cost $40,000, the object being to furnish light and power in competition with the present company.

LAMPASAS, TEX.—The Lampasas Electric Light, Water and Power Company is in the market for electric light machinery, including lamps, storage battery, Nos. 8 and 11 wire, insulator, switches, etc., etc.

SANDY HILL, N. Y.—W. B. Baldwin has disposed of his interest in the Electric Light and Power Company, the Power Company, and the Spring Brook Water Company to G. F. Underwood, of Fort Edward.

IOWA FALLS, IA.—The company to which has been given the franchise to construct and operate an electric plant in Iowa Falls has notified the city officials that it will not be able to carry out the contract.

HILLSBOROUGH BRIDGE, N. H.—A syndicate of gentlemen have purchased land and water power on the Contocook River, about two miles below this village, on the Henniker road, where an electric plant will be erected

CANANDAIGUA, N. Y.—The Board of Water Commissioners has decided to erect a power house somewhere near the lake and to transmit the power from there to the pump house on Sutherland's Point by electricity. Bids to be called shortly.

READSBORO, VT.—Mr. W. S. Kelley, of Boston, formerly a Lowell resident, has purchased Howe's Pond in Readsboro, Vt., and proposes to put in a plant for the generation of electrical power to be transmitted to North Adams which is nearby.

CARROLLTON, ILL.—Conrad E. Hensen, of Virden, has submitted to the Carrollton City Council a proposition to establish and operate an electric light plant. The matter was referred to a special committee to investigate and report at next meeting.

MARSEILLES, ILL.—At the meeting of the Council, the electric light question was informally discussed and the committee instructed to get figures from the Water Power Company on the same number and location of arc lights as were formerly furnished.

NORTH ADAMS, MASS.—P. G. Carpenter, of this town, has sold to W. S. Kelley, of the Boston General Electric Company, Howes Pond and over 500 acres of land in Readsboro, Vt. It is believed that the electric company will build a large electric plant there.

LE ROY, N. Y.—The Le Roy Hydraulic Electric Company is circulating a petition to the village board of trustees asking permission to erect poles on the streets in order to furnish light, fuel and power to those wishing same. The petition is being well signed.

REDLANDS, COL.—At the annual meeting of the Electric Light and Power Company, it was voted to issue bonds in the sum of $100,000. The old issue of bonds will be taken up with one-half of this amount, the balance being used to improve and make additions to the plant.

MT. STERLING, KY.—Address the Mayor regarding an electric light plant to be established.. A trolley system is also contemplated the power for which is to be generated by means of water works eight months of the year, and by steam the remaining four. Machinery is wanted.

SAGINAW, MICH.—A plan is under consideration by the members of the Council to establish an electric light plant at the east side water works, and light the streets, city hall, police station, parks and other city property, thus saving the taxpayers the profits which the other electric light companies made of city contracts.

MARBLEHEAD, MASS.—The new municipal plant was started up Jan. 22. The plant has a capacity of 200 arc lights and 1,000 incandescents. There are two boilers of 250 hp each, and two cross-compound condensing Corliss engines of 200 hp each, with all the necessary appurtenances. The appropriation for the plant was $60,000.

MILWAUKEE, WIS.—At the meeting of the Council the following resolution was adopted: That the engineer be, and the same is hereby requested, to prepare plans and specifications for the construction and erection of a municipal lighting plant or plants, suitable for lighting the streets of Milwaukee by electricity, and to submit the same, with an estimate of cost, to the Common Council.

BLACKSTONE, MASS.—As a result of the recent agitation in this town and Woodsocket, the Selectmen of Blackstone have received an offer from R. Schefbaner, of Paterson, N. J., to put in a plant in this place He offers to put in a plant and furnish 29 lights per night, all night and every night, at 40 cents per night on a contract for five years, the town to have an option of buying the plant at any time after one year to ten years.

BUFFALO, N. Y.—A 10-story office building will be erected on Ellicott square bounded by Main, Swan, Washington and South Division streets. John N. Scatcherd is president of the Ellicott Square Company. Sixteen quick-running elevators will convey passengers in the building, to be run by electricity, if the transmission of Niagara power is completed by the time the building is finished. The building will have its own electric equipment.

SYCAMORE, ILL.—The Frank C. Patton Mfg. Co. was granted a franchise by the City Council to erect another electric light and power plant in this city. The business of the Sycamore Electric Light Co has increased so largely that they will erect a new plant and put in larger engines and dynamos on the land recently purchased for that purpose. The old electric power house will be utilized to heat stores by steam conveyed by pipes underground. A stock company is being formed for that purpose.

WEYAUWEGA, WIS.—A special village election will decide whether this village will have electric lights or not. A few weeks ago the Wood & Gumaer Manufacturing Company and the Badger Manufacturing Company, of this place, made an offer to the Village Board, whereby they agree to supply the village with 10 arc lights for $450 per year, with the privilege of 15 lights at the same rate in consideration of a 20-year franchise being granted by the Board. The Village Board decided to submit the question to the people.

THE ELECTRIC RAILWAY.

CORSICANA, TEX.—The city is considering a proposition made through J. A. Townsend to build an electric railway.

OGONTZ, PA.—A new electric power house is to be built to supply the People's Traction Company's trolley extension to Jenkintown.

SIOUX CITY, IA.—The Traction Company has let the contract for a power generator to the Sioux City Electrical Supply Company.

ALBION, N. Y.—The Waterport Electric Light, Power and Railroad Company has adopted the Beecher storage battery railway system.

ANDERSON, IND.—The work of surveying right of way, etc., for Chas. L. Henry's Gas Belt Electric Railway has been commenced.

COLUMBUS, GA.—The Drake & Stratton Company has been granted a charter for the construction of an electric railroad in Phoenix City.

GRAFTON, W. VA.—Baltimore parties, it is reported, are considering a project to build about 50 miles of electric line to connect about 10 towns.

STROUDSBURG, PA.—The Delaware Valley Electric Railway is in the hands of M. F. Coolbaugh and Edward H. Peters, of Bushkill, as receivers.

BALTIMORE, MD.—The City and Suburban Company may build a trolley line along Eager street in Northwest Baltimore. Nelson Perin, president.

CHARLOTTESVILLE, VA.—The Electric Street Railway Company has purchased the only horse car line in the city, and will rebuild it for electric motors.

MEMPHIS, TENN.—The Raleigh Spring Electric Railway Company will extend its electric line to Raleigh Inn. General Manager Jones may be addressed.

LONDON, ONT.—The London and Springbank Electric Railway Company is applying for a charter to construct an electric railway from London west to Springbank.

HAMILTON, ONT.—The Hamilton Iron and Steel Company is applying to the legislature for power to construct an electric tram railway in connection with their works.

MONTICELLO, KY.—Business men are trying to organize an electric railway company to build a trolley line to Burnside, Ky. F. H. Bagby or J. W. Tuttle may be addressed.

ANNISTON, ALA.—It is stated that a company is being organized to build an electric line from Anniston to the St. Clair coal field and the Coosa River. The distance is 20 miles.

HENDERSON, KY.—The Henderson City Council decided not to act on the proposition to erect an electric light plant until a vote of the people could be taken on the question.

MECHANICSBURG, PA.—The Cumberland Valley Traction Company is pushing the construction of its line to Mechanicsburg, and expects to have it completed by Sept. 1, 1895.

BIRMINGHAM, ALA.—C. A. Avery, of the company which has bought the Highland Avenue and Belt steam dummy line, states that eventually it is to be rebuilt for electric traction.

ROME, GA.—Eastern parties have become interested in the City Electric Railway Company and will construct several switches and add two motor cars to its equipment. J. B. Marvin is manager.

WATERLOO, ONT.—The Grand Valley Railway Company is applying for power to construct a steam or electric railway, to run from the town of Berlin to Brantford, Lestowell, Stratford and Elora.

NEW LONDON, CONN.—There does not seem to be much show for the construction of the proposed electric road between this city and Norwich as far as can be learned. The cost of the road would be $350,000.

GETTYSBURG, Pa.—General E. M. Hoffer, of the Gettysburg Electric Railway Company, which was sold to Chicago and Philadelphia parties, has consented to remain this year in the capacity of president of the road.

PORT TAMPA, FLA.—Edward R. Gunby and A. H. Hayden are among the incorporators of the Port Tampa Street Railway Company, which intends building twelve miles of electric line in Tampa and Port Tampa.

SARATOGA, CAL.—A new electric road is to be built to connect Saratoga with San Jose and Santa Clara. Work is to be commenced at once, and it will probably be completed early in July. Its total length will be 12 miles.

EAST WEYMOUTH, MASS.—An enthusiastic meeting was held in G. A. R. Hall, East Weymouth, in the interest of the future extension of the franchise of the Quincy and Boston Street Railway Company. W. C. Earle may be addressed.

NEW BRITAIN, CONN.—John Crilly, of Hartford, purchased 1½ acres of land on North street in this city for, it is thought, a power house for an electric railway company in Hartford which proposes to extend its lines to New Britain.

COXSACKIE, N. Y.—There is much talk in favor of an electric railway to run from Coxsackie to Greenville, a distance of 13 miles. Public meetings have been called and it is believed that sufficient capital will be subscribed to build the road.

PORTLAND, ME.—A petition signed by President William R. Wood, of the Portland Railroad Company, asking for right to equip its lines in the city with electricity was received and a public hearing directed at 2.30 p. m., February 13, on the subject.

WESTCHESTER, PA.—It is proposed to build an electric railway up the Westchester and Wilmington pike. The Wilmington folks are willing to do their share, and they have asked Burgess Way if the people here would come forward to help the matter.

SPRINGFIELD, O.—A 25-year franchise was granted by the County Commissioners to E. S. Corson and others for an electric railway line from Springfield to Clifton. Mr. Corson is backed by Philadelphia capitalists and says the road will be built next spring.

GREENFIELD, MASS.—A syndicate of capitalists in the eastern part of the State, headed by H. T. Prince, of Leominster, proposes building an electric road from Greenfield to Turner's Falls, via Cheapside and Montague City, at an estimated cost of $100,000.

WASHINGTON, D. C.—The Washington and Maryland Railway Company is endeavoring to secure a franchise for a line in the District to connect with a Baltimore road. W. Welsey Schoepf is interested. He is manager of the Eckington and Soldiers' Home line.

LITTLE ROCK, ARK.—It is stated that the General Electric Company of Chicago will endeavor to secure the Capital and City Electric road and spend about $75,000 in improvements and extensions. B. E. Sunny is local representative of the Chicago company.

SOUTH BRAINTREE, MASS.—The Braintree Street Railway Company intends building a new road between Braintree and Randolph, and also making some extensive changes in the line between Quincy and Holbrooke. Chas. J. Beattey, superintendent, may be addressed.

ELLICOTT CITY, MD.—It is stated that arrangements are being made to extend the Edsondson avenue, Cattonsville and Ellicott City line to Ellicott City. The line is contracted for to a point within two miles of Ellicott City. Hon. John Hubner, of Baltimore, is interested.

WASHINGTON, D. C.—The projectors of the East Washington Belt Line Railway Company were given a hearing by the sub-committee of the House District Committee upon the bill authorizing the construction of that road. They promise to have the road running within six months.

DELAVAN, WIS.—Chicago and Minneapolis capitalists are interesting themselves in a scheme for the construction of an electric line from Harvard to Delavan via Walworth, Fountana and Geneva Lake, to connect with the Chicago Milwaukee and St. Paul Railway at Delavan.

QUEENSTOWN, MD.—It is now proposed to extend the electric railroad projected from Queenstown to Denton and Chestertown across the Eastern Shore of Maryland to Lewes and Rehoboth, Del. Wm. H. Bosley, of Baltimore, and Wilmer Emory, of Centreville, are interested.

SCOTTDALE, PA.—The borough Council of Scottdale has granted the right of way over Broadway, Market, Pittsburgh and Mulberry streets to the Scottdale, Evenson and Bradford Electric Street Railway, and the company proposes to commence the construction of the road at an early date.

VICTORIA, B. C.—The Victoria Electric Railway and Lighting Company contemplates building a water power plant of about 1,000 hp to supplement its present steam plant. It also intends to increase the present electrical equipment in the way of alternators and street railway apparatus.

OSHKOSH, WIS.—The Central Wisconsin Electric Railway Company was formed in this city for the purpose of building an electric street line and intersuburban road between Oshkosh and Kaukauna. G. F. Kedham, G. J. Kobusch and Otto von Schrader are directors. The capital is $1,000,000.

TACOMA, WASH.—The Point Defiance Railway has been sold to S. Z. Mitchell, of Portland, who represents the General Electric Company, and is likely to be connected with the Tacoma Railway and Motor Company's lines, the latter company being controlled by the General Electric Company.

READING, PA.—At a meeting of Council a report was received from the highway committee recommending the passage of the bill to permit the Reading and Southwestern Electric Railway to extend its tracks on Franklin street and elsewhere, providing an edging of granite blocks is placed on both sides of the rails.

OXFORD, PA.—Two capitalists of New York were in Oxford looking after the interests of a proposed electric railway between Oxford and Newark, Del., to be known as the Oxford and Newark Electric Railroad. They were guests of the Oxford Board of Trade. It is thought that the road will be built if the right of way can be secured.

GETTYSBURG, PA.—The Gettysburg Electric Railway has been sold to J. Luttrell Murphy, of Chicago, and Walter B. Kendall and John A. Connelly, of Philadelphia. The purchasers will complete the road to the Maryland line, there to connect with the Maryland system of trolley roads. They are to obtain possession of the franchise March 1.

HACKENSACK, N. J.—At a meeting of the Board of Road Commissioners of the township of Richmond an application was made by the Bergen County Traction Company for a franchise for a trolley road. The road is to run from the Bergen County line to Englewood. Nothing was done by the commissioners on the application and the matter was laid over.

GREENSBURG, PA.—The ordinance passed by the town Council of Jeannette granting the franchise for the right of way through that borough to the Greensburg, Jeannette and Pittsburgh Street Railway has been returned to the Council by Chief Burgess A. J. Case unsigned, with a number of exceptions noted. It is thought the Council will amend the ordinance.

BELLEVILLE, N. J.—A meeting will be held in Passaic Hall at which the Passaic and Newark Electric Railway Company will make public application for a franchise enabling them to operate a double-track overhead trolley line upon Washington avenue from Franklin township line to Jeroleman street. Their application is viewed with favor by the township committee and the citizens at large.

HARRISBURG, PA.—General Manager Lincoln Nissley, of the Citizens' Passenger Railway Company, of Harrisburg, has resigned. In the recent election for president of the East Harrisburg Passenger Railway Company, John Q. Denny, the present incumbent, was declared re-elected. His opponent, Mr. T D. Greenawalt, has contested the election, and the matter will be settled in the Dauphin county courts.

KENNEBUNKPORT, ME.—Among the bills introduced in the Maine legislature is one to incorporate the York County Electric Railway Company with authority to operate an electric road through Kennebunkport, Lyman, Alfred, Waterboro, Limerick, Parsonfields, Cornish, Limington, Holis, Buxton, Saco and Biddeford. The capital is $1,000,000. W. A. Roberts, Edgar A. Hubbard and others are the incorporators.

NEWBURYPORT, MASS.—A meeting of the incorporators and others interested in the building of the Essex County street railway under the legislative act of 1893 will be held at Ipswich the coming week. The incorporators represent the business interests of Newbury, Rowley and Ipswich, the three towns through which the new road will pass. It is anticipated that work will be commenced early in the spring.

WASHINGTON, D. C.—Representative Childs, of Illinois, introduced in the House a bill to incorporate the National Central Railway Company. It creates Wm. Dollin, J. C. Caldwell and others, of Chicago; John Bell, of Benton Harbor, Mich., and others, a corporation, and authorizes it to construct and maintain a continuous electric railroad from the Hudson River in or near Jersey City, or from some point in New York City to San Francisco.

PRINCETON, N. J.—The managers of the Trenton Passenger Railway Company had a conference with the Princeton borough authorities in regard to right of way through the borough. The company is planning to extend its line both to Princeton and Bordentown at as early a date as possible. John L. Kuser, the secretary and treasurer of the company, stated that nothing definite resulted from the conference, but that they felt sure they would get the franchises desired eventually.

MISCELLANEOUS NOTES.

THE MONTREAL ELECTRIC CLUB, at its recent annual meeting, elected the following officers: W. B. Shaw, president; Mr. Edwards, vice-president; C. Dantor, secretary.

ROBERT LAIDLAW, president of the Laidlaw-Dunn-Gordon Pump Company, of Cincinnati, was elected treasurer of the National Association of Manufacturers, which convened at Cincinnati the third week in January. Mr. Laidlaw was one of the leading spirits in organizing the association, and much of the success of the convention was due to his superior executive skill and untiring energy. The delegation was banqueted at the new plant of the Laidlaw-Dunn-Gordon Pump Company.

LAWYER SIMON STERNE, of New York, has obtained from Judge O'Brien a temporary injunction restraining the Metropolitan Telephone and Telegraph Company from removing, or interfering with his use of the telephone in his office. The Metropolitan Company, Mr. Sterne claims, had notified him of its intention to remove the instrument on Feb. 1, because he declined to submit to what he considered an arbitrary increase in rental. The company claims that the expense of putting its wires underground and the furnishing of a metallic circuit necessitated an increase in rates. Mr. Sterne says the rental, as compared with the rates charged in European cities, are entirely too high and he asks the courts to interfere.

Trade and Industrial Notes.

F. H. ALLING, New Haven, Conn., is meeting with success in introducing in electric plants the Common Sense Oil Filter, formerly manufactured by W. E. Crane, of Hartford.

THE COLBURN ELECTRIC MANUFACTURING COMPANY is building on Winter street, Fitchburg, Mass., a brick machine shop 155x43 feet and two stories high, with boiler and engine house 42x40 feet.

THE CENTRAL ELECTRIC HEATING COMPANY, Havemeyer Building, New York, is placing on the market an electric glue pot, in which the vessel containing the glue sets in an electrically heated water bath. The advantages claimed are steady temperature and minimum attention.

THE VIADUCT MANUFACTURING COMPANY, Baltimore, reports the list of some of the telephone exchanges which are using its magneto telephone exclusively with great satisfaction: West Winsted, Conn.; Great Barrington, Mass.; Emporium, Pa.; Vineland, N. J.; Liberty, N.Y.; Reidsville, N. C.; Vinton, Tenn.; Suffolk, Va., and Gaffney, S. C.

THE OHIO VALLEY ELECTRICAL ENGINEERING COMPANY, of Cincinnati, O., has been retained by the Kings Powder Company and the Peters Cartridge Company as consulting engineers in charge of the work of installing two 300-kw General Electric generators and is 200-kw Shawhan-Thresher generators, together with a number of motors.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is making a specialty of theatrical electrical devices and has secured control of a number of lighting specialties particularly adpated for theatre work. In fact, this has become so important a department of its business that it is found necessary to issue a special catalogue of this material under the name of "Catalogue of Theatrical Lighting Devices," which is now being extensively distributed.

H. E. COLLINS & COMPANY, sole agents for the Caball vertical water tube boiler, manufactured by the Aultman & Taylor Machinery Company, of Mansfield, O., have contracted for a 250-hp boiler, using blast furnace gas as fuel, for the Seneca furnace, and for a 500-hp for the Philadelphia Gas Company, at Kelly Station, Pa., and for two boilers for the Solvay Process Company, at Syracuse, N. Y. They are also building the boilers for the new sugar refinery at Havana, Cuba.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., held its annual stockholders' meeting on Jan. 29. The following Board of Directors was elected: Chas. M. Jarvis, Geo. H. Sage, F. L. Wilcox and Burr K. Field, of Berlin, Conn.; S. Howard Wilcox, of Brooklyn, N. Y.; Julius Burr, of East Berlin, Conn., and H. Peck, of Waterbury, Conn. By vote of the stockholders the capital stock of the company was increased from $300,000 to $500,000. The new issue of stock has all been taken by the old stockholders.

THE BALL ENGINE COMPANY, Erie, Pa., continues to keep its shops well filled with work and has recently taken some good-sized orders. Among recent shipments of electric light engines are the following: Oskaloosa Edison Light Company, Oskaloosa, Ia., two 175-hp direct-connected engines; Chesapeake Light and Power Company, Hampton, Va., one 300-hp cross compound engine; Peninsular Electric Light Company, Detroit, Mich., one 150-hp cross compound engine; Dunkirk, Ind., Electric Light Company, one 100-hp tandem compound engine; Barnesville, O., Gas and Electric Light Company, one 80-hp single cylinder engine; Washington, Mo., Electric Light Company, one 50-hp single cylinder engine; Norfolk Navy Yard, one 80-hp single cylinder engine; Yngo Soledad Plantation, Guantanamo, Cuba, one 35-hp single cylinder engine; Canon City, Col., Electric Light and Power Company, one 100-hp single cylinder engine; Sweetwater, Tenn., Mill Company, one 25-hp single cylinder engine; Crook, Horner & Company, Baltimore, Md., one 125-hp single cylinder engine; L. M. Rumsey Manufacturing Company, St. Louis, Mo., one 60-hp single cylinder engine.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, on account of conflicting dates with the convention of the National Electric Light Association, at Cleveland, Feb. 19, 20 and 21, will postpone its regular monthly meeting at New York and Chicago from Feb. 20 to Wednesday, Feb. 27, 1895. The paper to be presented on the latter date is by Mr. H. Ward Leonard, entitled "Notes on Recent Electrical Engineering Developments in France and England," being the results of the author's recent personal observation in electric light, railway, central station and underground practice.

Business Notices.

WOVEN WIRE BRUSHES.—The Belknap Motor Company, of Portland, Me. are the patentees and manufacturers of the best woven wire commutator brush on the market.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention, Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JANUARY 22, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

533,078. PRIMARY BATTERY; R. O'Toole, Mechanicstown, Md. App. filed April 3, 1893. In a battery containing oxide of copper as depolarizing material caustic soda solution and zinc, the combination of a perforated jar containing the depolarizing material, covered at top and bottom, and a suspensory rod passing through the top and bottom and secured to a cover or bridge across the jar.

533,083. SYSTEM OF AND APPARATUS FOR CONTROLLING ELECTRIC CURRENTS; W. B. Potter, Lynn, Mass. App. filed Jan. 24, 1893. A plurality of dynamo electric machines each provided with a circuit controller and a series of electromagnetic resetting devices for such circui controllers actuated by a common circuit.

533,084. RECTIFYING COMMUTATOR AND METHOD OF MAKING SAME; H. G. Reist, Schenectady, N. Y. App. filed Oct. 19, 1894. A commutator composed of registering portions cut from a flanged ring having an internal groove and having suitable insulation between the registering portions.

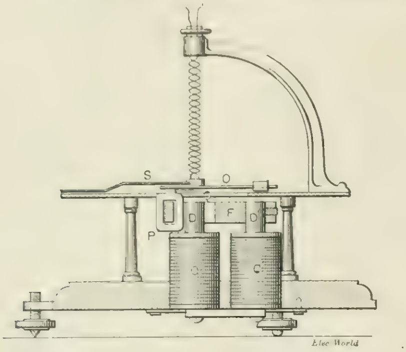
533,100. ELECTRIC ARC LAMP; H. O. Swoboda, New York, N. Y. App. filed March 2, 1894. This comprises a movable carbon support, device for controlling the movement of the same, a tilting frame, a solenoid core controlling the movement of the frame, the solenoid including a spool having a body portion and removable end flanges, the body portion being so formed as to permit notched flanges to be slipped on and locked on a partial rotation of the same.

533,107. ELECTRICAL MEASURING INSTRUMENT; E. Weston, Newark, N. J. App. filed March 11, 1891. This comprises electromagnets, a ring pole piece formed on one of the cores of the magnet and surrounding the other core, a coil surrounding the ring pole, a bar supporting the coil and a suspension device carrying the bar, and an index needle with means for passing a current through the coil and returning the latter to starting point after a deflective impulse has ceased. (See illustration.)

533,108. ELECTRIC MOTOR; C. Wirt, Chicago, Ill. App. filed April 23, 1894. A chrono-electric motor having a pendulum, a contact moved thereby, an electric actuating device, and a contact having a retarded movement toward the pendulum contact, and a free movement in the opposite direction. (See illustration.)

533,130. COMBINED CURB, GUTTER AND CONDUIT FOR ELECTRICAL CONDUCTORS; W. Kingsley, St. Paul, Minn. App. filed Feb. 1, 1893. A combined hollow curb and gutter having its front wall flush with the surface of the paving, and with its rear wall flush with the sidewalk, and a curved removable cover forming the top and also the face or gutter surface of the hollow curb.

533,142. TELEPHONE SYSTEM; J. I. Sabin and W. Hampton, San Francisco, Cal. App. filed April 14, 1894. This comprises a double strand cord connector, a calling generator, a key adapted when depressed to bridge the generator between the strands, and a second key adapted when depressed to connect the generator between one of the strands and ground.



No. 533,107.—Electrical Measuring Machine.

533,146. APPARATUS FOR SMOOTHING CURRENTS OF DYNAMO ELECTRIC MACHINES; C. E. Scribner, Chicago, Ill. App. filed Jan. 16, 1892. This comprises a source of electricity, several parallel branches between the poles of the source, a telephone transmitter and the primary helix of an induction coil in each branch, and a source of counter electromotive force connected in shunt with the working circuit.

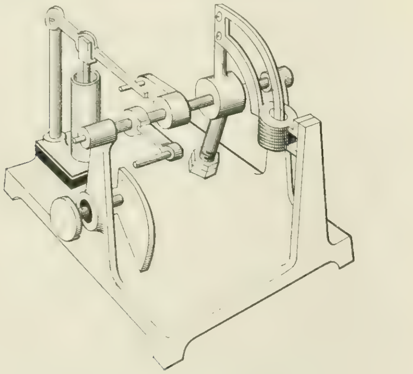
533,147. TELEPHONE SWITCHBOARD APPARATUS; C. E. Scribner, Chicago, Ill. App. filed May 13, 1892. The combination with the connecting plug of a tip and a shank electrically connected together and a sleeve or contact piece insulated from the shank or tip.

533,148. SPRING JACK FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed May 23, 1892. The combination with a tube or thimble of a narrow test ring in front of the thimble and insulated therefrom, the opening of the test ring being larger than the opening in the tube.

533,154. CIRCUIT CLOSER FOR RAILWAY RAILS; E. C. Wiley, Bristol, Tenn. App. filed May 29, 1894. This comprises the main rail and circuit breaking devices; a rigid supplemental rail anchored to the main rail at its ends, and having about its middle a downwardly projecting arm extending under the main rail, and supporting a portion of the circuit closing devices.

533,183. AUTOMATIC ELECTRIC SIGNAL; H. C. Storrs, Hartford, Conn. App. filed April 20, 1894. This consists of two metallic holding and heat conveying members having spirally formed adjacent ends embedded in a mass of non-metallic sealing material of a fusible or soluble nature.

533,196. COMBINED PORTABLE STAND AND WALL BRACKET FOR INCANDESCENT ELECTRIC LAMPS; H. Horn, Philadelphia, Pa. App. filed Feb. 15, 1892. The combination of a swinging lamp, a shell having its tube screwed into a portion of the lamp socket, a cap between the shell and socket, and a weight in the shell.



No. 533,108.—Electric Motor.

533,211. ELECTIC ARC LAMP; E. Conrady, Keighley, England. App. filed Dec. 16, 1893. A feed mechanism comprising a resilient strip, elastic connection between the same and the movable carbon, compound gripping levers to act on the strip, and means for controlling the levers.

533,221. BONDING COLLAR, M. M. Jacobs, New York, N. Y. App. filed Sept. 12, 1894. A bonding collar provided with a coating of tin or similar substance, grooved or slotted longitudinally and threaded or roughened interiorly.

533,223. INCANDESCENT ELECTRIC LAMP; G. R. Lean, Cleveland, O. App. filed Nov. 29, 1893. This comprises the bulb, tubular metallic guides sealed therein, leading in wires extending through the guides, and insulating material interposed between the wires and guides.

533,241. GAGE ALARM; W. A. Stafford, Meadville, Pa. App. filed April 17, 1894. A gage having a dial face with a curved slot therein, a segment having a stud and screw working in the slot, a pointer and electric connections for the segment and pointer.

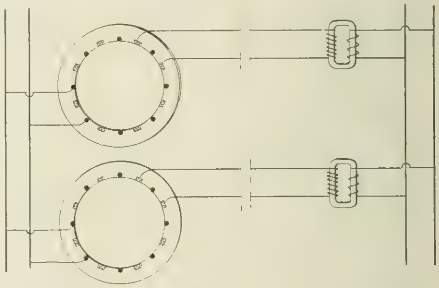
533,244, 533,245, 533,247, 533,248, 533,249, 533,250, 533,378 and 533,379 are patents by Mr. Charles P. Steinmetz on the monocyclic alternating system, and are digested on pages 182-185.

533,254. SIGNALLING TELEGRAPH; F. A. Turner, Chelsea, Mass. App. filed July 27, 1893. This consists of a strip, a punch adapted to act continuously during a break in the main line and a drop adapted to enter the perforation in the strip caused by continuous punching, and a stop for the punching controlled by the falling of the drop to interrupt the operation of the punch.

533,246. WINDING FOR DYNAMO ELECTRIC MACHINES; Charles P. Steinmetz, Schenectady, N. Y. A method of winding dynamo armatures, and more particularly those of machines in which the cross or end connections overlap at the end of the armature or fields. Such overlappings exist in direct current, alternating and polyphased machines in which there is more than one tooth per pair of poles. The invention consists in arranging the coils in separate sets or sections, whose combined effect is the same as that of the continuously overlapping coils now used, but whose end-bars or cross-sections, while overlapping in each set, do not overlap those of other sets. This enables each set to be removed independent of and without disturbing the others, and also enables the magnetic structure to be divided into two or more separate parts.

533,259. ELECTRIC LOCOMOTIVE; S. L. Wiegand, Philadelphia, Pa. App. filed Oct. 23, 1890. This comprises a shaft, helical pinions turning therewith and engaging toothed wheels, turning in planes diagonal to the shaft and pinions, combined with and located upon the axles of the car wheels.

533,261. BONDING DEVICE FOR ELECTRIC RAILWAYS; J. J. Zimmlee and A. Bournonville, Philadelphia, Pa. App. filed Nov. 30, 1894. A bond for an electric conductor having limbs on the end thereof, the same being adapted to be tightened in position.



No. 533,323.—System of Electrical Distribution.

533,269. RECORDING AMPERE METER; W. H. Bristol, Hoboken, N. J. App filed July 26, 1894. This comprises a stationary coil, a movable coil, two flexible conducting supports for the coil and connecting with the terminals thereof, a recording arm, a flexible support for same, and a knife-edge connection between the movable coil and the support.

533,270. ELECTRICAL MEASURING INSTRUMENT; W. H. Bristol, Hoboken, N. J. App. filed Sept. 24, 1894. An armature composed of a thin disc of iron and a reinforcing plate of non-magnetic material.

533,309. APPARATUS FOR STOPPING ENGINES; L. C. E. Meyer, Paris, France. App. filed Aug. 22, 1894. This comprises a stop valve, a brake consisting of a flywheel roller path eccentric thereto, and rollers of yielding material actuated by compression in the gradually contracting space between the roller path and the flywheel, and electromagnetic mechanism for closing the stop valve and discharging the roller into the roller path.

533,318. CONTROLLER OR SWITCH FOR ELECTRIC MOTORS; W. J. Pohlman, Woodbrook, Md. App. filed Nov 17, 1894. This comprises a series of contact arms, a rotatable circuit breaker, escapement mechanism for intermittently rotating the circuit breaker, a dental instrument provided with a rotatable spring-impelled finger piece, a flexible shaft connecting a dental instrument with a motor, and a cord passing through eyes on the flexible shaft and connected at its ends with the escapement mechanism, and a rotatable spring-impelled finger piece or drum.

533,323. SYSTEM FOR AND METHOD OF ELECTRICAL DISTRIBUTION OF ENERGY; W. Stanley, Pittsfield, Mass. App. filed Nov. 3, 1894. This consists in running alternators so as to generate currents of like phase, transforming the separate currents into currents of a different potential, and combining such transformed currents so as to produce in the working circuit a combined current of potential like to that of the transformed currents. (See illustration).

533,398. AUTOMATIC ELECTRIC SAFETY SYSTEM FOR RAILROADS; R. R. Snowden and A. C. Ives, Ocala, Fla. App. filed Jan. 26, 1894. A traveling car carrying a circuit and having short circuit connections, one portion of which is made movable and yielding to the force of the air pressure when the car is in motion to open the shunt.

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SHOCKS FROM SECONDARY ALTERNATING CIRCUITS.

In commenting several weeks ago on a letter from a Demerara correspondent describing a fatal accident from electric shock, we remarked that it could not have been due to the primary voltage as asserted, this opinion being based upon the assumption that the only leakage in the system, as stated, was that from points of defective insulation found in the transformer. In this issue several correspondents point out that shocks from the primary voltage of an alternating system through contact with the secondary circuit are not unusual, and are due to the fact that in addition to a contact between the primary and secondary in the transformer there is also present a ground connection with the primary at some point or points of the system. It is very reasonably shown that in an alternating system numerous opportunities for leaks to ground from the primary are provided by the many transformers and their connections and by contacts with trees and otherwise. As a consequence, if the insulation between the primary and secondary is defective, or both are grounded on the iron of the transformer, a circuit containing the primary voltage may be completed by contact with the secondary, and without the latter being affected or the fuses blown if the resistance interposed in the ground connection is that of the human body. Several methods have been proposed to obviate this danger. One consists in so winding the transformer coils as to reduce the amount of primary voltage that may be introduced into the secondary circuit through a contact between the coils. Another method provides for grounding of the secondary momentarily at short intervals of time by means of clockwork. Still another consists in grounding the iron of the transformer, though this does not provide for a direct contact between the primary and secondary when both are free of grounds on the transformer. In one instance of which we know, the superintendent of a large alternating plant grounded the secondary in his house through a relay of considerable resistance, so arranged as to break the house circuit in case of the secondary being subjected to the primary voltage.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The catalogue of members in the January number of the *Transactions* of the American Institute of Electrical Engineers shows a most gratifying growth of the membership, which numbered 913 on February 1, an addition of 79 names since September 1 of last year. Referring to previous catalogues, we find that the membership has more than doubled since May 1, 1890, at which time it was 427. On January 1, 1892, the membership had increased to 583, on June 1, 1893, to 690, and on September 1, 1894, to 834. The average monthly increase in the periods above given has been 7.8, 6.3, 7.2, and 16, respectively, so that the last five months, by this comparison, show the largest rate of increase. Since June 1, 1893, the increase in the entire membersip has been 32 per cent., while that of Chicago is 70 per cent., and of Philadelphia and San Francisco, 157 per cent. each; the membership of Boston remains the same, that of Brooklyn has increased 50 per cent., and of New York only 22 per cent., or at less than the average rate. While the great increase in Philadelphia is to be ascribed to the influence of the annual meeting held there last spring and the election of Prof. Houston to the presidency, that of Chicago is undoubtedly due to the institution of its local meeting, and of San Francisco to the effort made to obtain a sufficient membership to follow in Chicago's footsteps. At present Washington, Baltimore, Schenectady, Philadelphia and Pittsburgh also have a sufficient membership to hold local meetings, and as the value of the *Transactions* and the vigor of the Institute would be notably increased if these places were to take advantage of the opportunity thus afforded, it is to be hoped that, at least in the three latter places, the members will soon take the matter under consideration. Were this done and the meetings instituted, we feel that the increased interest in the Institute and its work would not be confined to these localities alone, and that the result would be to very soon carry the membership beyond the one thousand mark.

THE LATEST SENSATION.

Quite a little excitement seems to have been caused by the recently published statements regarding the possible introduction of a very serious rival to the electric light. We refer to the recent accidental discovery that coal dust and lime can be chemically combined, forming a substance resembling coal and called "calcic carbide" which possesses the very peculiar property that if placed in water it changes into slacked lime or "whitewash" and acetylene gas, the richest illuminating gas known, having an illuminating power of 15 times that of ordinary gas. If this gas can thus be produced so that in illuminating power it will be equal to ordinary gas at 30 cents per thousand, as is claimed in a recent estimate, it certainly will become a very serious rival, but fortunately these figures are mere estimates, and until they are substantiated they need not worry the managers of central stations, or those who install and manufacture electric lighting apparatus. The published statements, all of which have been abstracted at some length in our Digest, come from enthusiasts and may therefore be taken with a few grains of salt. For example, in one of the estimates the cost of an electrical horse-power per hour is assumed at the absurd figure of .28 cent It is satisfying to the electrical engineer to know that this curious compound can be produced only in the electric arc, and that if its production on a large scale is undertaken there will be a large demand for electrical machinery. While it has yet by no means been demonstrated that the gas thus produced will be a serious rival to the electric light, yet it will be well to watch the developments. Should it turn out that central stations are affected by it, then why not take the bull by the horns and erect, in connection with each central station, a few good sized electric furnaces for producing this material; this will form an excellent and flexible substitute for the much desired day load, enabling the engines to be used to their full power during the whole twenty-four hours. Although the machinery in continuous-current stations is not as well adapted for an electric furnace as it might be, yet it does not seem that there would be any insurmountable difficulties. Until the manufacture of this material has been undertaken on a large scale, however, it is too early and quite needless to make any estimates of whether it would pay central stations to go into the business of making it.

ELECTROCUTION.

The unwarranted assertion made some months ago by D'Arsonval to the effect that execution by electricity as practiced in New York State does not produce true death, reopened a discussion far from agreeable to the electrical public, and offered an opportunity for sensationalism of which due advantage was taken by the newspaper press in general and by one P. J. Gibbons in particular—the latter, we regret to note, being encouraged by several of our electrical contemporaries, who apparently did not recognize the absurdity of his claims. In order to definitely settle this distressing subject the New York State authorities very wisely concluded to request the attendance at an execution of a committee whose conclusions in the matter would be accepted as authoritative, not only in this country, but abroad among those influenced by D'Arsonval's authority. To this end Dr. Augustin H. Goelet, the eminent therapeutist, and Mr. A. E. Kennelly were invited to witness, on January 28, the execution of a negro murderer at Sing Sing, and in this issue we publish the result of the observations made by these gentlemen and the general conclusions founded upon them. It will be seen that the verdict is open to no misconstruction, and emphatically pronounces that death in the case witnessed was instantaneous and painless, with absolutely no possibility of resuscitation. There should have been no question of this, and it is difficult to see how one with the standing in the scientific world of D'Arsonval could have been led into the gross error of asserting otherwise. That over 18 horse-power of energy, racking and rending such a delicate organism as the human frame for almost a minute and disintegrating its fluids, could do otherwise than produce a fatal effect is beyond belief. How destructive is the effect of this energy was shown by the post-mortem examination, when it was found that the blood circulatory system was destroyed, numerous blood vessels of the brain ruptured and the blood itself changed so as to be no longer capable of supporting life. As the method of electrocution practiced at Sing Sing is the same as in other prisons in New York State, the general conclusion as to its absolute efficiency may be accepted as final in all cases, and should definitely put to rest a harrowing subject. It will be noted that the report disclaims any inference that may be drawn from it as to the fatal effect of ordinary electric shocks. Through the short duration or high resistance of a contact under these circumstances, the energy expended may be very small, and the effect merely to suspend animation, which may be again restored through the application of the necessary treatment, a knowledge of which should be acquired by all electricians.

First Annual Convention of the Indiana Electric Light and Power Association.

The first convention of the Indiana Electric Light Companies, which met on Jan. 30, 1895, in the club room of the Hotel English, Indianapolis, was a success in every respect, and reflected much credit on the gentlemen in charge of its organization and conduct.

The meeting was called to order at 2 p. m., by Chairman H. W. Frund, who, in an opening address, said that the object of the Indiana Electric Light Association was not to further the interests of its members in a mercenary sense, but to secure the mutual benefit resulting from an interchange of ideas born of practical experience, to the end that they may not alone cheapen the production of electric light, heat and power, and protect themselves from imposition from whatever source, but also to render better service in all branches of their business, thus benefiting their patrons while furthering their own interests in a legitimate business way.

J. D. Edwards was chosen secretary *pro tem.* A committee of ten on organization reported a constitution and rules similar to those of the National Electric Light Association, excluding, however, supply men and manufacturers of apparatus and confining active membership in the association to those who are owners of electric light and power plants or representative managers. After the report of the committee and adoption of a constitution, the supply men and others not interested in lighting companies left the room, and at an election of officers then held, the following named gentlemen were unanimously elected without ballot:

President, J. W. Roney, Richmond; vice-president, W. K. Smith, Union City; secretary, James Boyce, Muncie; executive committee, H. W. Frund, Vincennes; H. A. Smock, Martinsville; C. C. Perry, Indianapolis; J. W. Morrison, Frankfort, and J. D. Edwards, Decatur.

The night session was called to order by President Roney, at which various committees were appointed and a discussion held in reference to lighting interests. The secretary was directed to forward blank applications to all Indiana electric lighting companies not represented, and the membership fee was fixed at $5.00 per annum. The next meeting will be held in August, in Indianapolis, if called by the president and executive committee. The annual meetings are thereafter to be held on the first Wednesday in February of each year. The following gentlemen were in attendance at the meetings: E. W. Boden, C. H. Kerlin, Cambridge City; J. W. Cole, Greencastle; L. Wohlgemuth, Rochester; L. F. Putnam, Attica; T. W. McNamee, Wabash; O. C. Irwin, Greenfield; Z. F. Graham, Washington; W. K. Smith, Union City; Jas. A. Halstead, Jos. S. C. Sarver and E. W. Smith, Brazil; H. A. Smock, Martinsville; O. L. Moorman, Winchester; J. D. Edwards, Decatur; Victor E. Seiter, Logansport; J. W. Morrison, Frankfort; J. W. Roney, Richmond; James Boyce, Muncie; C. E. Latta, Goshen; W. Wilkemeyer, Evansville; J. W. Draper, Ligonier; H. A. Root, Michigan City; C. C. Perry, Indianapolis; H. W. Frund, Vincennes.

Cold Light.

In a recent Royal Institution lecture a piece of photographic paper moistened with liquid air was held within a few feet of an arc lamp and it was found that it was not acted upon by the light,

The National Electric Light Association.

The next annual meeting of the National Electric Light Association, to take place at Cleveland next week, bids fair to be exceedingly interesting, both in the scope and the character of the work laid out, as will be seen from the complete programme of the convention given below

A meeting of the Executive Committee will be held in Parlor 138, Hollenden Hotel, at 9 a. m. on Tuesday, Feb. 19, and the morning session will commence at 10:30 o'clock in Army and Navy Hall. Following an address of welcome by the Mayor of Cleveland, President M. J. Francisco will open the convention with the usual presidential address, and the following programme will then be taken up:

Paper, by N. W. Perry, "The Storage of Energy Essential to Central Station Economy: How It May Be Accomplished, and the Economies Resulting." Discussion by John W. Langley, W. M. Stine and M. J. Perry.

Report of Committee on Relations between Manufacturing and Central Station Companies; Frederic Nicholls, chairman.

Afternoon Session, 2 o'clock.

Paper, by E. J. Houston and A. E. Kennelly, on "A New Method of Measuring Illumination." Discussion by W. A. Anthony, C. D. Haskins, W. S. Howell, Edward Weston and L. Stieringer.

Report of Committee on Data; H. M. Swetland, chairman. Discussion by W. R. Gardener, E. L. Powers and H. W. Sexton.

Paper, by Walter E. Harrington, on "Correct Method of Protecting Electric Circuits."

Questions and Answers. What Is It You Wish to Know?

WEDNESDAY, FEB. 20.

Morning Session, 10 o'clock.

Paper, by Edward Weston, on "Some Economies in Electric Light and Power Stations."

Paper, by C. N. Black, on "Large Arc Dynamos." Discussion by S. M. Hamill, J. J. Wood, F. W. Rollins and E. R. Weeks.

Topic, "How to Light Large Cities." Discussion by Frederic Nicholls, Geo. A. Redman, Jas. I. Ayer, E. F. Peck, C. R. Huntley, Robert Lindsay, F. H. Clark, T. C. Smith and J. F. Morrison.

Report of Committee on Finance; John A. Seely, chairman.

Questions and Answers. What Is It You Wish to Know?

Afternoon Session, 2.30 o'clock.

Paper, by E. A. Leslie, on "The Operation of High Tension Currents Underground from a Physical and Financial Standpoint." Discussion by H. J. Smith, W. H. Browne, C. H. Wilmerding, John A. Seely and C. L. Edgar.

Paper, by L. B. Marks, on "Arc Carbons and the Rating of Arc Lamps."

Topic, "Incandescent Lighting vs. Other Methods." Discussion by H. T. Edgar, E. F. Phillips, W. S. Barstow, E. A. Armstrong, J. Gwynn and B. P. Holmes.

Questions and Answers. What Is It You Wish to Know?

Evening Session, 8 o'clock.

Topic, by A. J. Wurtz, "Practical Demonstrations of Protecting Lines from Lightning."

THURSDAY, FEB. 21.

Morning Session, 10 o'clock.

Paper, by Dr. Louis Bell, on "The Monocyclic System." Discussion by A. E. Kennelly, L. B. Stillwell and J. F. Kelly.

Report of Commitee on Rules for Safe Wiring; Wm. J. Hammer, chairman.

Topic, "Underwriters' Rules vs. National Electric Light Association Rules." Discussion by Wm. Brophy, C. H. J. Woodbury, J. J. Burleigh and A. W. Field.

Afternoon Session, 2.30 o'clock.

Election of officers.

Special rate railroad tickets will be good from three days before the convention until three days after.

The following is a list of those who have engaged seats on the Electrical Special, leaving New York on Monday, the 18th inst., at 9:30 a. m., via New York Central road:

Jas. P. McQuaide.
C. O. Baker, Jr.,
Mrs. C. O. Baker, Jr.,
A. J. Belden,
Mrs. A. J. Belden,
H. J. Smith,
Mrs. H. J. Smith,
M. J. Francisco,
Mrs. M. J. Francisco,
I. H. Francisco,
Don Francisco,
C. H. McIntire,
Mrs. C. H. McIntire,
E. F. Peck.
Mrs. E. F. Peck,
A. J. Purinton,
Cecil P. Poole,
Chas. D. Shain,
E. H. Johnson,
A. J. Martin,
Jos. Sachs,
P. L. McLaren,
F. W. Harrington,
F. S. De Ronde,
Mrs. F. S. De Ronde.
W. J. Johnston,
Mrs. W. J. Johnston,
R. O. Heinrich,
E. W. Little,
T. C. Martin,
F. A. Scheffler,
Mrs. F. A. Scheffler,
John A Seely,
S. L. Coles,
Edward Weston,
A. E. Bakewell,
Geo. M. Phelps.

The Western contingent of the convention delegates will go by special car on the Lake Shore Railroad, leaving Chicago at 8:30 p. m. Monday, Feb. 18. The railroad officials have made particular arrangements for the comfort and convenience of the party, and the prospect is good for a pleasant time en route.

On Magnetic Potential.*

BY FREDERICK BEDELL.

Introduction

In 1882 Prof. Clausius discussed at length the dimensional formulæ of the electrostatic and electromagnetic systems and derived the dimensions for magnetic pole (m) from a consideration of the equivalence of a magnetic shell and a circuit carrying a current of electricity, as first pointed out by Ampere; thus,

$$\text{Area} \times \text{current} = \text{magnetic moment} = ml. \qquad (1)$$

In the electromagnetic system this gives a magnetic pole the dimensions $M^{\frac{1}{2}} L^{\frac{3}{2}} T^{-1}$, which accords with Maxwell and subsequent writers. In the electrostatic system, however, this gives to magnetic pole the dimensions $M^{\frac{1}{2}} L^{\frac{5}{2}} T^{-2}$, for which Maxwell gives $M^{\frac{1}{2}} L^{\frac{1}{2}}$. The reasoning of Clausius was apparently correct, and he concluded Maxwell was in error. This conclusion was indorsed by Prof. Everett. The discussion which followed, "On the Dimensions of a Magnetic Pole in the Electrostatic System of Units," needs merely a mention here.

Prof. J. J. Thomson pointed out that the equivalence of a circuit and a magnetic shell, as given by Ampere, is correct only in a medium with permeability equal to unity. The factor μ, denoting the permeability of the medium, should be introduced into the general statement, and (1) should be written—

$$\mu \times \text{current} \times \text{area} = \text{magnetic moment}. \qquad (2)$$

In the electrostatic system μ has the dimensions $M^0 L^{-2} T^2$; hence m has the dimensions $M^{\frac{1}{2}} L^{\frac{1}{2}}$, as given by Maxwell. In the electromagnetic system permeability is a number without dimensions, and the presence of μ as a factor in (2) does not affect the dimensions of m. Prof. Thomson derived these same dimensions from the expression for the work done in carrying a pole around a circuit. He also pointed out that the factor μ should enter into the expression for the attraction between magnetic poles; thus,

$$f = \frac{mm'}{\mu r^2}. \qquad (3)$$

Prof. Clausius, however, still considered that he was correct, maintaining that, if a circuit and magnetic shell are equivalent, they must be mutually replaceable, and that a change in the medium would affect one as the other. Prof. Everett subsequently concluded that Maxwell was correct, obtaining the dimensions of Maxwell from the galvanometer law and the law of Faraday, although he did not see wherein Clausius was wrong in obtaining his results from the equivalence of a circuit and a magnetic shell. Helmholtz, too, showed lack of confidence in the equivalence of the magnetic shell, and stated that the Ampere-Weber hypothesis must be looked upon as neither verified nor even completely worked out. He gave no consideration to the nature of the medium, which, as Prof. Thomson pointed out, has a most important bearing on the question. It was left for Dr. Lodge to point out that a distinction should be made between the permeabilities of the medium of the space corresponding to the space of the equivalent shell and of the exterior medium. It was he who pointed out that the magnetic moment of a circuit is equal to the product of the current, the effective area, and the permeability of the *interior* space; the magnetic moment is entirely independent of the permeability of the surrounding space. The failure to recognize this fact was the cause of the erroneous views which had been set forth by such distinguished scientists.

It is the purpose of this paper to consider the effect of permeability upon the magnetic potential due to a magnet or a current of electricity, and to show more definitely the bearing of some of the above relations.

The expressions for the magnetic potential at a point, as ordinarily given, are

$$\text{magnetic potential due to a magnet} = V = \Sigma \frac{m}{r}; \qquad (4)$$

$$\text{magnetic potential due to a current} = V = I\Omega. \qquad (5)$$

In (5) I denotes the current, and Ω denotes the solid angle subtended by the circuit at the point, the potential of which is under consideration.

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* From the *Physical Review.*

In the electromagnetic system these equations lead to the following dimensions for magnetic potentials:

$$V = \frac{m}{r} = \frac{M^{\frac{1}{2}} L^{\frac{3}{2}} T^{-1}}{L} = M^{\frac{1}{2}} L^{\frac{1}{2}} T^{-1}; \quad (6) \quad [\text{from } (4)]$$

$$V = I\Omega = M^{\frac{1}{2}} L^{\frac{1}{2}} T^{-1}; \quad (7) \quad [\text{from } (5)]$$

These equations (6 and 7) agree with each other and with the dimensions for magnetic potential in the electromagnetic system as usually given, and will be found correct.

In the electrostatic system, equations (4) and (5) give the dimensions:

$$V = \frac{m}{r} = \frac{M^{\frac{1}{2}} L^{\frac{1}{2}}}{L} = M^{\frac{1}{2}} L^{-\frac{1}{2}}; \quad (8) \quad [\text{from } (4)]$$

$$V = I\Omega = M^{\frac{1}{2}} L^{\frac{3}{2}} T^{-2}; \quad (9) \quad [\text{from } (5)]$$

These equations (8) and (9) are not concordant, although derived from (4) and (5), which gave correct results in the electromagnetic system. Equation (9) will be found to be correct; equations (8) and (4) are not.

If we denote the permeability of the space *exterior* to the magnet by μ_ε

$$V = \Sigma \frac{m}{\mu_\varepsilon r} \quad (10)$$

which accords with (3), and is true in any system of units.

In the electromagnetic system the dimensions of μ are $M^0 L^0 T^0$; hence μ does not affect the dimensions in this system, and (6) and (7) are correct.

In the electrostatic system the dimensions of $\mu L^{-2} T^{2}$. Hence the dimensions of magnetic potential derived from (10) are:

$$V = \frac{m}{\mu_\varepsilon r} = \frac{M^{\frac{1}{2}} L^{\frac{1}{2}}}{L^{-2} T^{2} L} = M^{\frac{1}{2}} L^{\frac{3}{2}} T^{-2}, \quad (11)$$

which agrees with (9), and is correct.

In a Uniform Medium the Magnetic Potential Due to a Current is Independent of Permeability.

The introduction of μ in the expression for the magnetic potential due to a magnet (4) gives the same dimensions to magnetic potential (see 11) as derived from (5), the expression for the magnetic potential due to a current. That the permeability of the medium should be taken into consideration, as above, in the expression for the magnetic potential due a magnet is clear; but should we not expect the permeability to enter into a similar manner in the corresponding expression for the magnetic potential due to a current (see 5)? The equivalence of a current and a magnetic shell as stated by Ampere would lead to this conclusion. Such, however, is not the case; equation (5) holds true as it is written. The magnetic potential at a point due to a current is independent of the permeability—a fact the explanation of which merits attention.

In *air* the magnetic potential at a point due to a current may be obtained from the principle of the magnetic shell as follows. Consider the circuit replaced by a shell consisting of elementary magnets, with axes in the direction of the thickness of shell. If r and r' are distances of the point P from the two poles of one of these elementary magnets, of length l and pole strength dm, the magnetic potential at the point P, due to this magnet, is

$$dV = \frac{dm}{r} - \frac{dm}{r'}. \quad (12)$$

Inasmuch as the length of the magnet is small compared with its distance from the point P, for r' we may write $r + l\cos a$, where a is the angle between the axis of the magnet and a line connecting it with the point P. Hence

$$dV = dm\left(\frac{1}{r} - \frac{1}{r + l\cos a}\right) = \frac{l\,dm\cos a}{r^2}, \quad (13)$$

the last term being obtained by approximation. But from the equivalence of a magnetic shell in air (see 1) we have

$$l\,dm = I\,dA; \quad (14)$$

where dA represents the polar area of an elementary magnet. Making this substitution in (13), and remembering that

$$\frac{dA\cos a}{r^2} = d\Omega,$$

the solid angle at P subtended by the polar surface of the elementary magnet, we have

$$dV = I\,d\Omega; \text{ and } V = I\Omega \quad (15)$$

This reasoning holds true for air; but (12), (13), (14) are true only for air, or a medium whose permeability is unity.

For *media other than air* equation (15) still holds. If μ_ε is the permeability of the space *exterior* to the space occupied by the magnetic shell to which the current is considered equivalent, instead of (12) and (13), we have [see equation (10)]:

$$dV = \frac{dm}{\mu_\varepsilon r} - \frac{dm}{\mu_\varepsilon r'} = \frac{1}{\mu_\varepsilon}\frac{l\,dm\cos a}{r^2}. \quad (16)$$

If μ_i is the permeability of the *interior* space, or that occupied by the equivalent magnetic shell, instead of (14), we have

$$l\,dm = \mu_i I\,dA. \quad (17)$$

Substituting (17) in (16), we have

$$dV = \frac{\mu_i}{\mu_\varepsilon}\frac{I\,dA\cos a}{r^2} = \frac{\mu_i}{\mu_\varepsilon} I\,d\Omega \quad (18)$$

$$V = \frac{\mu_i}{\mu_\varepsilon} I\Omega \quad (19)$$

This is the expression for the magnetic potential at a point P, due to a current I, in a circuit subtending the angle Ω at the point P, when μ_i is the permeability of the space occupied by an hypothetical equivalent shell, and μ_ε is the permeability of the surrounding medium.

In all cases usually considered $\mu_i = \mu_\varepsilon$; that is, in any uniform medium, the magnetic potential due to a current is

$$V = I\Omega \quad (20)$$

and is independent of the permeability of the medium.

On a Proposed Modification of the Generally Accepted Temperature Co-efficient of Resistance for Copper Wires.

BY A. E. KENNELLY AND REGINALD A. FESSENDEN.

In a paper entitled "Some Measurements of the Temperature Variation in the Electrical Resistance of a Sample of Copper," read at the International Electrical Congress in Chicago, 1893, and also published in the *Physical Review*, Vol. I., No. 4, page 260, the authors showed that the temperature co-efficient of resistance at any temperature ($t°$ centigrade) between 20° and 250 C., of a sample of good commercial copper wire, which appeared by chemical analysis to have a high degree of purity, could be very closely represented by the formula,

$$\rho_t = \rho_o\,(1 + 0.004065\,t) \quad (1)$$

Recent determinations by Messrs. Dewar and Fleming and Messrs. Swan and Rhodin * concur in giving a linear relation between the temperature and resistance of copper.

As the results of measurements made to determine the temperature co-efficient in annealed copper wire, we have for the range from 0° C. to 100° C. assuming a linear relation, as follows:

Benoit	.373
Cailletet and Bouty	.425
Matthiessen	.422
Siemens	.388
Dewar and Fleming	.424
Kennelly and Fessenden	.406
Swan and Rhodin	.415
We obtain as the mean	.4076

We therefore suggest that since the exact temperature co-efficient is not yet determined, and since it may possibly vary in different samples of copper in commercial use, that the simple formula,

$$\rho = \rho_o(1 + 0.004\,t) \quad (2)$$

may be accepted provisionally for all practical purposes, or, in other words, that the resistivity of copper be considered to increase by 0.4 per cent. per degree centigrade of temperature elevation reckoned from the resistivity at zero centigrade.

Should the corrected co-efficient be subsequently determined to be 0.0041, formula (2) would become,

$$\rho_t = \rho_6\,[1 + 0.004\,(t - 6)] \quad (3),$$

ρ_6 being the resistivity at 6° C.

Similarly, if the co-efficient ultimately accepted should be 0.0042, the corresponding formula would be,

$$\rho_t = \rho_{12}\,[1 + 0.004\,(t - 12)] \quad (4),$$

ρ_{12} being the resistivity at 12° C. and for an accepted co-efficient of 0.0043

$$\rho_t = \rho_{17\cdot5}\,[1 + 0.004\,(t - 17.5)] \quad (5)$$

Consequently, if we adopt equation (2) at the present time, we obtain, pending more exhaustive inquiry, a formula much simpler, more convenient, and probably more nearly accurate than that of Matthiessen, while any future correction can only have, it would seem, an influence upon the standard or datum temperature and a comparatively trivial quantitative effect within ordinary temperature ranges.

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* P. R. S., June, 1894.

Does Execution by Electricity, as Practiced in New York State, Produce Instantaneous, Painless and Absolute Death?—Observations Made at the Execution of David Hampton, at Sing Sing, Jan. 28, 1895.

BY A. E. KENNELLY AND AUGUSTIN H. GOELET, M. D.

Some observations by D'Arsonval, of Paris, having led him to the unwarranted conclusion that in electrical executions as practiced in New York State the death of the criminal was not produced by the passage of the current, but by the knife of the surgeon during the subsequent autopsy, considerable discussion has lately arisen as to the correctness of D'Arsonval's opinion.

On the 28th of last November, THE ELECTRICAL WORLD, in the desire to definitely settle this question, directed a letter to Governor Flower, of New York State, requesting that at the next electrical execution scientific witnesses should be selected whose duty should be to make such observations as would throw light upon the matter. This recommendation was favorably received and the writers were appointed to perform this very unpleasant duty on the occasion of the twenty-fourth electrical execution in New York State.

The following observations were made:

An alternating current was used in the execution, which was supplied from an alternator having a frequency of approximately 102.3 cycles, or 204.6 alternations or reversals per second, with an armature specially wound for a maximum E. M. F. of 2,500 volts effective. The field excitation of this alternator was controlled by means of a rheostat inserted in the exciter circuit and situated in the execution chamber.

The electrodes consisted of flexible brass gauze sheets firmly attached to sponges which were saturated with an aqueous solution of common salt. The upper electrode was fitted into a cap, shaped to conform with the top of the criminal's head, and provided with a chin-strap which held it firmly in position. The lower electrode consisted of a similar flexible brass gauze plate about 8″ x 3″ and its moistened sponge, attached by a strap to the calf of the right leg. The criminal was placed in a sitting position in a stout chair to which he was confined by straps. The criminal was a negro, short, but young and of robust physique.

Preparatory to the execution, in order to test the circuit, a bank of 20 incandescent lamps in series was placed in circuit in the chair, when a pressure of 1,740 volts effective was observed on both Weston and Cardew voltmeters, and this pressure was then maintained.

The following are the detailed observations made:

11.18.45	Criminal entered room.
11.18.50	Seated in chair. Straps applied.
11.19.58	Electrodes adjusted and connections made with same.
11.20.13	Current applied at pressure of 1,740 volts. Ammeter nearly dead beat, indicating approximately 8 amperes steady through body of criminal.
11.20.17	Pressure intentionally slowly reduced, and current falling slowly to 1.8 amperes.
11.20.42	Pressure intentionally increased to a maximum not observed, the current increasing to 4 amperes.
11.20.50	Pressure again reduced to about 150 volts, the current falling to 1.3 amperes.
11.21.10	Circuit broken, current off. Period of application 57 seconds in all.
11.21.20	Chest was examined and no action of the heart could be detected. At this time a marked hyperæmia or redness of the skin covering the chest, especially the upper part, was observed. This paled on pressure, the color returning slowly. There was marked pallor of the face, slight froth in the mouth, and pupils of the eyes were dilated.
11.25.00	The criminal was officially pronounced dead.

The moment the current was turned on, the whole body was thrown into a condition of intense tetanic rigidity, the hands were contracted or closed tightly, and the extremities straightened as much as the straps would permit. While the current was on, there was some frothing at the mouth, but there was no audible sound, and no evidence of sensation or suffering. Death was evidently instantaneous and painless.

At 11.33 a. m. the body was placed on the table for examination. At this time the rectal temperature was 100.8 degrees F., and the sphincter was relaxed. The superficial veins of the extremities, especially those of the arms, were empty and collapsed. Incision of the scalp and through the skin of the chest-wall showed that all, or nearly all, of the blood in the body had been driven into the head and upper part of the chest and neck, and that rupture of the over distended vessels had allowed extravasation of blood to take place into the cellular tissues of the scalp and under the skin covering the upper part of the chest, especially near the neck. Here the extravasated blood appeared to be congealed. In marked contrast with the condition of affairs in this location, incision through the abdominal wall showed the tissues to be almost bloodless. Incision into the tissues under the location of the leg electrode showed the same bloodless condition. On removal of the skull-cap, and puncture of the *dura mater* (membrane lining the interior of the skull and enclosing the brain) a great quantity of dark blood escaped, showing that there had been an extravasation into the cranial cavity. This was found to be due to the rupture of the blood vessels. This blood coagulated, but not firmly. A specimen preserved remained fluid and unchanged for days, except that the color became brighter. It was estimated that at least two quarts escaped from the scalp and cranium in removing the brain. On removing the *dura mater* the vessels on the surface of the brain were seen to be distended and there was evidence of rupture in many places. The same condition prevailed throughout its interior, and congealed blood was found at the base of the brain, a condition incompatible with either consciousness or life.

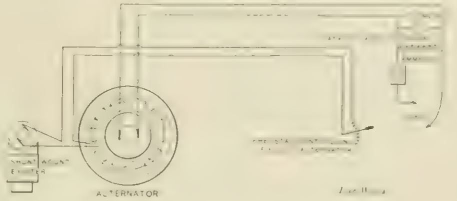


Diagram of Electrical Connections, Omitting Switches.

On opening the chest cavity the lungs appeared normal, but extravasation of blood had taken place into the lung tissues at the upper part.

The heart-walls were thin and flabby; the blood retained in the cavity was dark.

On opening the abdominal cavity, the vessels of the intestines, especially those of the small intestines, were distended with blood. The liver was normal but engorged with blood. The kidneys and spleen were normal. The abdominal aorta was empty.

From observations made at the time of the application of the current, which were abundantly substantiated by the result of the autopsy, we conclude that death was instantaneous and painless.

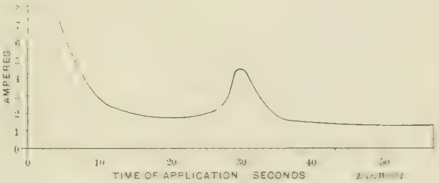


Diagram of Current Strength Applied.

The evidence is, therefore, that a current of 8 amperes, applied through the body at a pressure of 1,740 volts, and representing a power of (1,740 × 8 =) 13,920 watts, or about 18⅔ electrical horsepower, will produce instantaneous, painless, and absolute death; and that the evidence presented by an examination of the brain alone was sufficient to demonstrate the absolute impossibility of resuscitation.

Although in our opinion there is no hope of resuscitation in cases where, as in this electrical execution, an alternating current of sufficient E. M. F. is deliberately sent through the body of the criminal, yet in all cases of accidental contact with high pressure circuits, in our opinion, efforts for resuscitation should be made, since in most cases of accidents from electricity, either from the imperfection of the contact, or its short duration, the current strength passing through the body and the electrical energy expended thereby, might only be sufficient to produce a loss of consciousness.

On Potential.

BY WILBUR M. STINE.

Many scientific terms are employed by people in general with but a vague conception of their real physical meaning. By frequent repetition the term itself becomes so familiar that the mind ceases to concern itself with its definition, and its use becomes one of association merely, without the ability to employ the word in its individual sense. Again, the use of the term in a special, but constantly recurring sense, may be clearly understood as expressing a mere relation; but this leads to a narrow conception of the term and renders its full understanding the more difficult.

Because a term has become familiar through repetition by no means is evidence that it is comprehended. The extent to which our language is built up from the Latin and other tongues has doubtless led to much superficiality in the use of words. If our language was constructed only from native elements each complex term would form a "word-picture" of the idea which it is designed to express. To a native born Greek or Roman many of our abstruse scientific terms would be clearly comprehended, so far as the elementary ideas which they embody are concerned, and though their restricted scientific definition might not be realized, yet the fundamental idea would greatly assist in attaining the scientific one.

These remarks apply with peculiar force to the term "potential." Owing to the widespread interest in electrical matters there is probably no one term more commonly employed and less clearly understood than potential. We speak of the potential energy of a mass of matter which it possesses in consequence of having been raised above the surface of the earth against the attraction of gravity; of the potential energy of steam confined in the boiler; of the potential energy of oxygen and of coal, etc.; and lastly of the potential of a cell of battery, of a dynamo, and of a cloud during a thunder-storm—realizing but vaguely the connection which exists between these widely varying cases. In this busy, hurrying age, people do not stop long enough for definition, but employ words in a hit-or-miss fashion in their eager attempts at acquisition, and fail to see the beautiful relations which exist between the widely varying cases in which a term is often employed. All this is left until attainment has given leisure to go back and look up matters of detail. One of the greatest benefits which the popular scientific periodicals have conferred on the reading public has been the manner in which they have combated such superficiality by articles of clear and simple definition of matters scientific.

It is the purpose of this article to consider potential in its applications to the action of gravity, to chemical reactions, and to electromotive force as applied to electrical and magnetic phenomena. *Potential* may be provisionally defined as a *condition of stress.* Formerly the influence of attraction or repulsion which bodies mutually exerted upon each other was phrased by Newton's third law of motion. "To every action there is always an equal and contrary reaction; or the mutual actions of any two bodies are always equal and oppositely directed." At first these actions and reactions were considered to occur simply in space "at a distance." Clearer thought showed the absurdity of action occurring through simple space; and the necessity for a medium, the ether, as it is called, through which bodies could mutually influence each other, became apparent. Every intervening point in the ether would then be affected by this mutual play of forces. As the knowledge of natural phenomena grew the varieties of mutual actions also increased until a broad generalization was demanded, and these conditions are now expressed by the simple statement that "every action between two bodies is a stress."

Stress expresses either a condition of compression or extension, and may be clearly comprehended by reference to the behavior of springs. If a spring is extended and fastened to supports, it tends to return to its original shape, if perfectly elastic, with a force equal to that causing its extension. The supports react upon the pull of the spring to an equal extent, and both the supports and the spring are under an amount of *extension stress* equal to the *force expended* in pulling out of the spring. These same remarks apply to a spring which has been compressed instead of expanded.

We may now recognize two conditions of stress which for sake of exact reference may be classed from their *direction* of action, as positive and negative. The word potential expresses in general the ability to do or to act, a static condition due to the equilibrium of opposing forces, which once disturbed admits of the performance of a specific action. The spring as a body *acted upon* is *potential* to the amount of its condition of stress. Since a condition of stress is always due to the expenditure of energy, the resulting potential condition has a numerical value equal to the work done in producing it, and the energy so expended now exists in equilibrium as potential energy.

When the equilibrium is disturbed and the equivalent action results, the potential energy now becomes kinetic or active. Kinetic energy is a condition of stress in process of equalization. Recurring to the example of the extended spring, energy must have been expended upon it to a definite extent. In this condition it can do no work, but when released it begins to do work to the exact amount of the extension work, and the energy is kinetic in the equalization of this stress.

Thus the term potential always implies an exact amount of energy in equilibrium. Among the varieties there exist gravity or mass potential; chemical or molecular and atomic potential; electrical and magnetic potentials. Gravity or mass potential originates from the fact that all bodies of matter in the universe mutually attract each other. If the particular case of the attraction which the earth exercises upon all bodies near its surface be considered, the relations found to obtain here may be applied in general to the action of all heavenly bodies. To raise a mass of matter above the surface of the earth requires the expenditure of energy to do an amount of work that is represented by the force of the earth's attraction on the mass, multiplied by the perpendicular height to which it has been raised. In this position the body has stored in it the equivalent of this work as potential energy, the power to do a like amount of work, if allowed to fall freely. This potential energy is, then, the numerical value of the stress which exists between the body and the earth, and is measured in terms of an appropriate unit, the erg.

The erg, as a unit, is regarded as the amount of work expended in raising a unit mass against a unit attraction through a unit distance, the unit mass being designated the gramme, the unit force the dyne, the unit distance the centimetre. The dyne represents a force of such value as will, when acting continuously upon a gram mass for a second of time, increase its velocity by exactly one centimetre per second. The earth as an attracting body exercises a force or pull on bodies near its surface 981 times this unit value; or the earth's attraction on a gram is 981 dynes.

It should be here pointed out that the potential energy of a body raised above the earth must be distinguished from the potential of the earth on the body. A stone weighing 10 grammes raised to the height of 100 centimetres represents potential energy due to the expenditure of 10 × 100 × 981 or 981,000 ergs of work. Now all masses raised to this height represent potential energy equal to their mass in grammes multiplied by 100 times 981 dynes. It is evident then that the latter product, 100 times 981, represents in some sense a unit condition for this particular height. Such it does in fact; and this condition defines the potential of the earth on all masses at this particular height. The potential of the earth then at a given height is the value of the energy necessary to raise a gramme mass to this elevation. For example, the potential of the earth on all masses at a height of 100 centimetres is the product of 1 × 100 × 981 or 981,000 ergs or units of potential. We may now sum this up in a perfectly general statement or law, and say potential energy represents the total stress between the earth and a given body, while the potential of the earth on that body represents the unit intensity of the stress.

(To be continued.)

Electrical vs. Steam Railroads.

Lord Kelvin recently prophesied that steam locomotion may sometime be superseded by electricity, and Mr. Webb, a locomotive superintendent of a large English railway, recently stated that if the company gave instructions to have electric trains he would undertake to have one ready within two months. Commenting on these statements the London *Electrical Review* says "surely both Lord Kelvin and Mr. Webb were dreaming, and only dreaming of the substitution of electricity for the steam locomotive on trunk lines?"

A Theory of Electrolysis.

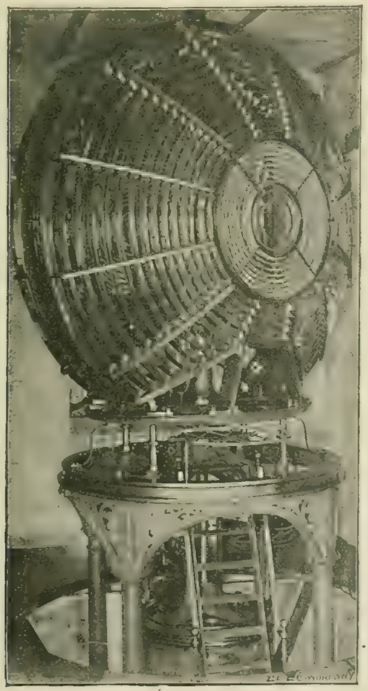
In the article by Mr. Alfred H. Bucherer under the above caption in our issue of Feb. 2 there is a misprint on the second page of the article; in the formulæ for the E. M. F.,

$$E = \frac{R\,T}{2} \log_e \frac{+P\,(1-x)^3\,p}{0.0819\;T\,(3-x)\;x^{2=22.35}}$$

the number 22.35 occurs as an exponent, while it should be a factor.

An Electric Lighthouse.

ALTHOUGH the first practical application of the dynamo was to lighthouse illumination, and the arc lamp for years found its only practical use in this connection, yet electric lighthouses have increased very slowly in number, and at the present time there is not one in operation in the United States. Aside from governmental conservatism, the reasons offered for this apparent neglect of electricity as a lighthouse illuminant are that its use requires expert attendance not necessary where oil is used, the danger from the light going out through an accident to the electrical machinery or other apparatus employed is greater, the cost of operation and maintenance is much larger, and the question of supplies is complicated on account of the greater quantity and variety required. On the other hand, the incontestable superiority of the electric light where great intensity is required has been recognized, though slowly, and the present tendency is to susbtitute it as an illuminant in the larger lighthouses of the world not too difficult of access, and convenient to sources of certain supply and expert inspection. The objection that the arc light will not penetrate fog and mist as readily as light from an oil flame, while true with respect to its rays of higher refrangibility, loses its significance in view of the fact that the quantity of light which is emitted of the same refrangibility as that of the oil flame is still much greater in the ordinary lighthouse arc than the entire quantity that can be obtained from the other source.



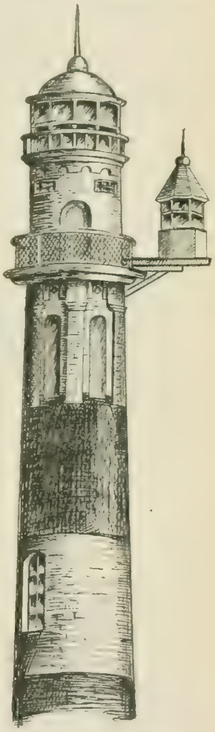
FIRE ISLAND LIGHTHOUSE LENS.

The first lighthouse in the United States to be equipped with an electric plant will be that at Fire Island in Great South Bay. The work has long been contemplated by the Lighthouse Board, but not until now have affairs so shaped themselves as to promise an early fulfillment of the plans. Mechanically nearly everything is ready. The slow moving governmental machinery is all that intervenes between the officers in charge and a quick installation. The work is in progress, however, and the practical success of the venture will decide the question as to whether other lighthouses shall be so equipped.

Equipping old lighthouses presents some difficulties which might not be encountered if the houses were to be opened for the first time. The lighting apparatus, which may take months to install and be properly adjusted, must occupy the very same place as did the old oil lamp outfit, and yet the light cannot remain extinguished for even an hour of one night. The absence of a signal might mean very serious disaster, and a light must be displayed during the transition period. At Fire Island the difficulty is overcome by the erection of a temporary lantern just outside the regular lantern. A small staging is being built on a level with the lamp platform at the top of the house. It is braced into position, and on it will be placed a regularly equipped electric lamp, which will be in use during the months while the electrical installation is being made.

Undoubtedly the most interesting part of the new apparatus is the immense revolving lens. It is nine feet in diameter, and was made in Paris by Henri Lepaute, who exhibited it at the Chicago Exposition last year, the Government buying it at the close of the exhibition. It is a large prism affair, but, except in size, does not differ from the large lenses ordinarily made. It was originally intended to be used with a kerosene lamp, but the lighthouse board decided to substitute electric lamps. The huge clam-like arrangement weighs more than a ton, yet by means of the mercury trough in which it rests it can be rapidly revolved by a force no greater than would come from the hand of a child. This ease in manipulation is a very necessary feature, as the lens must revolve rapidly enough to give a flash every five seconds.

Resting in its mercury trough the immense lens is controlled and revolved by a clockwork mechanism, a simple affair which gets its power from a heavy drop weight which is controlled by a governor. The only peculiar feature of this clockwork mechanism is its governor. The regulating balls of the latter are revolved in a basin. When they revolve too fast the balls, coming into horizontal line with each other, press against the sides of the basin and the friction caused thereby regulates the speed of the machine. As will be seen from the illustration the interior of the lens is large enough to allow two persons to stand within it. Here is where the electric lamp is placed, and in order to guard against the disaster which might follow a failure of one to work, there are two lamps, placed side by side. They are the ordinary Serrin lamp such as is used in nearly every French lighthouse. The two lamps rest on a turn table which is worked by a crank from the outside of the lens. For the purpose of adjustment, cleaning, or other necessary repairs, the table with the lamps upon it can be slid out at the side of the lens. It is, of course, necessary that the arc of the lamp should be directly in the focus of the lens. Should it fall below or rise above this point a great deal of the effect of the lens would be lost, as the beam of light would then tend to shoot too far up into the air, or too far down. Whenever this does occur, the fact is recorded by means of a small double convex lens placed at the side of the large lenses. This small glass projects a beam of light on to a small standard at the side of the lighthouse. On the standard is drawn a penciled horizontal line. When the arc is in the right position the small ray of light rests directly on the line. When the ray rises above or below the line, the lighthouse keeper knows that the arc of the lamp needs readjusting.

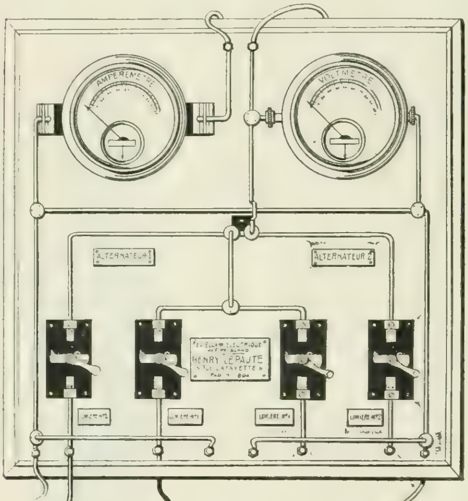


FIRE ISLAND LIGHTHOUSE, SHOWING TEMPORARY LIGHT.

The lamps are made to carry carbons of various sizes. The diameters of those tried are 1 cm carrying 25 amperes, 16 mm carrying 50 amperes, 23 mm carrying 100 amperes, and some large ones of 4 cm carrying 125 amperes. The large ones do not give as satisfactory results as do those whose diameter is 23 mm, when measured in the photometric room, the latter giving the best result in steadiness and quality of light. The length of the arc obtained with each is 4½ mm. This length has been found to be the best for lighthouses. The difference of potential, 48 volts, is the same for all sizes.

From calculations made it has been found that the maximum light the carbons of 23 mm diameter give outside the apparatus is above 8,000 candle power, but the maximum intensity of the flash, calculated in the usual manner, is equal to from 104,000.000 to 63,000,000, depending upon the amperage, the latter figure corresponding to a maximum ray of 5,400 candles, with a special distribution of the light. These are all practical intensities allowing for a considerable drop—at least one-fifth. Were it possible to elevate the lamp high enough to overcome the convexity of the earth the maximum flash would be visible from a distance of 142 miles.

The current to the lamp is brought up through the revolving platform on which the large lenses rest, the contact, or connection, between the revolving part and the stationary part being completed by means of a small circular mercury trough, in which a steel pin travels, the connection being thus absolutely sure; the other side of the circuit is completed by a ground.



SWITCHBOARD OF FIRE ISLAND LIGHT.

When this powerful beacon is installed in the present lighthouse on Fire Island it will change that somewhat isolated spot into an important electric station. There will be a generating house, with all its accessories, a system of underground wiring, a force of electricians, and, in fact, all the appurtenances that go with such a plant. The power house will be a corrugated iron structure, 52x24 feet in ground dimensions. Its smokestack will be 40 feet in height.

To guard against all accident, everything within the power house will be in duplicate. There will be two General Electric alternators, Type A-25, each capable of developing 7½ kw. They will be geared (friction style) to two Ideal engines, each of which can develop 25 hp if necessary, although 12 hp will be all that is needed to run the plant. The engines will be supplied with steam from Fitzgibbon boilers rated at 25 hp, and furnished by W. R. Fleming & Co., of New York.

The alternators running at 800 revolutions a minute develop a current of from 520 volts to 550 volts each, and are each excited from a small 1.5 kw exciter of 125 volts. The wiring from the power house to the lighthouse 200 feet away will be underground.

The switchboard for the lighthouse equipment has not been set up yet, but, as in the case of the other equipments, it will be in duplicate. Each side of it will contain 1 rheostat for the exciter, 1 rheostat for the arc current, 1 switch for the exciter, 1 ammeter and 1 voltmeter, 1 station transformer, and 2 lightning arresters. There will also be a polechanger and a ground detector. The switchboard for the lamps in the lens will be located in the lighthouse, of course. It is a simple affair, holding an ammeter and voltmeter and four switches, carrying each 25 amperes. The board is made by Lepaute, and was sent from France with the lens. The current to the lens lamp is controlled by means of a large water rheostat at present. Just what method of resistance will be used when the final installment is made has not yet been decided.

The experiments have so far all been made in the electrical department of the Lighthouse Board on Staten Island. The work of installing the new plant is expected to be finished in early summer. The first step will be the installing of the power station, and then will come the temporary lantern already spoken of. In this lantern will be installed an old flashing lamp with a Berjot regulator of 3,000 cp inside, which will give a flash upwards of a million cp. The duration of the flash will be the same as with the large lens—one flash every five seconds.

It may be remarked that the experiments at Staten Island show that alternating carbons do not burn equally, the under carbon being used more rapidly. The reason assigned is that there is a certain amount of draft upward, through the lenses forming a globe to the lamp, and the upper carbon is thereby subjected to a greater temperature.

The Effect of Armature Current on Magnetic Leakage in Dynamos and Motors.*

BY HARRY D. FRISBEE AND ALEX. STRATTON.

Several investigations have been recorded, which have had for their object to determine the extent and distribution of magnetic leakage in dynamos and motors, and many formulas have been deduced from a theoretical standpoint, to predict the magnitude of the stray field of a machine from its dimensions. But up to the present time, very little notice has been taken of the fact that the current in the armature usually has considerable effect on the magnetic leakage of a machine, and therefore the present experiments were made with the object of determining the nature and amount of this influence.

With this end in view, four machines were chosen, representing widely different types.

I—Crocker-Wheeler 5-hp motor (Over type).
II—Crocker-Wheeler 5-hp compound dynamo (Over type).
III—1½ kw Edison shunt dynamo (Under type or horseshoe type).
IV—2-hp Sprague motor (Consequent pole or Manchester type).

The two 5-hp machines were exactly alike in their frames and armatures, the only difference being in the winding of the field coils. This gave an excellent opportunity to make a comparison between the effect of armature reaction when opposed to a shunt field and when opposed to a compound field.

The method of investigation was to determine the flux in various parts of the magnetic circuit by means of a ballistic galvanometer. In every position of the exploring coil readings were taken, first with current in the field coil alone, and then with the maximum rated current in the armature. In the case of the compound-wound dynamo, the shunt coil only was used in the first set of readings, the series coil being thrown in with the armature for the second set. The differential coils in the Sprague motor were not used at all, as differential winding is now rarely found. The non-sparking position of the brushes was first found by running the machines fully loaded; but during the experiments the armatures were held still by a Prony brake, the current being supplied from an outside source and regulated by resistance. The galvanometer, which was a D'Arsonval ballistic, was placed in another and more quiet building a few feet away, where it gave deflections agreeing generally within one per cent., and often exactly. During the test of the two smaller machines, the period (or double swing) of the galvanometer was 7½ seconds, but this was afterward increased to 15 seconds for the two larger (5-hp) machines. It was found to be necessary to "break" the field circuit and the armature circuit independently, in order to prevent the armature short circuiting the field, and thus retarding the magnetic discharge. This was done by means of a double-pole switch, one pole of which was connected to the field and the other to the armature. The current was not reversed to overcome residual magnetism, because there would be much more error introduced than eliminated. The current impulse given to a ballistic galvanometer should be short, if it is to be measured accurately. But when the field of a machine is to be reversed, the iron must be demagnetized, and then remagnetized in the opposite direction, the latter process being much slower than the former, hence the duration of the measured impulse in the galvanometer is increased enormously. It was therefor considered better to submit to the light error due to residual magnetism. Furthermore, two of the machines were run as dynamos, and the voltage due to their residual magnetism was found to be about 3 per cent. of their rated E. M. F. The error introduced was still smaller than this percentage.

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*Graduation Thesis in Electrical Engineering, Columbia College.

In the tables the large and small letters refer to positions of the exploring coil, which are shown in the diagrams. A small letter always designates a position opposite to that represented by the corresponding large letter. Column I. gives the fluxes in various parts of the magnetic circuit, with no current in the armature, the maximum flux in the armature at no load being represented at 100. Column II. gives the same with full current in the armature, the maximum current in the armature at full load being in this case represented as 100. Column III. gives the ratio of the flux at full load divided by the flux at no load. This column cannot be found from columns I. and II. In other words, columns I. and II. merely give the relative distribution of magnetism at no load and at full load, respectively, and column III. gives the effect on the actual value of the flux when the armature current is thrown on.

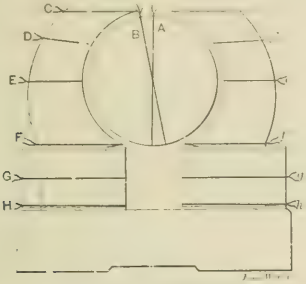

FIG. 1.—5-HP. CROCKER-WHEELER MOTOR.

Five-hp Motor. The general proportions of this machine are shown in Fig. 1. It has a large, toothed armature, with a small air-gap, and the winding is of the "ring" pattern. We may therefore expect that the armature reaction will be very pronounced. The rated current is 40 amperes at 115 volts.

TABLE I.—5-HP MOTOR.

	I.	II.	III.
A	97	97	.850
B	100	100	.8502
C	1.9	2.3	1 000
D	43.5	18.5	.362
E	58.5	33.8	.491
F	108	110	.863
G	115	120	.888
c	2 25	3.9	1.49
d	37.9	65.3	1.47
e	63.0	93.0	1.28
f	112	119	.903
g	117.3	121.5	.880
h	116.7	121.6	.885

1. The distortion of the field in the air-gap, due to armature reaction, is very evident from the increase of flux through *d* and *e* at full load, and the corresponding decrease in *D* and *E*, as will be seen from column III. The magnetic effect of the armature current is very strong in the pole pieces, as they are close to the armature, and embrace a large arc.

2. The influence just mentioned is stronger at *D* and *d* than at *E* and *e*, showing the increase of magnetic potential toward the poles of the armature.

3. The demagnetizing turns on the armature, due to the "lead" of the brushes, produce two results. One of these is the general diminution of flux in all parts of the magnetic circuit.

4. The other result is that the leakage coefficient is greater at full load than at no load, as is evident from a comparison of column II. with column I. This increased leakage coefficient is due to two causes: 1st, the increased magnetic difference of potential between the pole pieces at full load; and 2d, the decreased useful flux.

5. The armature when loaded sucks out, as it were, the lines of force from the upper part of the coil on one side, while it blows them back and keeps them from leaking on the other side. The leakage between *F* and *G* is increased from 7 per cent. at no load to 10 per cent. at full load; while between *f* and *g* it is diminished from 5 per cent. at no load to 2½ per cent. at full load. Consequently *F* shows in column III. a decrease of 14 per cent.; but *f*, only 10 per cent.

6. The flux through *c* is increased, showing that the armature attracts lines of force from the upper part of one pole piece.

Five-hp Dynamo.—The figure and description given of the 5-hp shunt motor apply equally well to this machine, the only difference between the two being that the field of the dynamo is compound wound.

TABLE II.—5-HP DYNAMO.

	I.	II	III
A	100	94.1	1.178
B	98.7	100	1.268
C	5.19	5.74	1.359
D	37.8	23.1	.764
E	63.2	45.3	.897
F	117.9	120.8	1.282
G	122.2	129.4	1.325
H	123.9	130.0	1.313
c	4.57	6.63	1.815
d	41.3	61.7	1.870
	61.3	85.2	1.739
e	110.7	121.0	1.367
g	115.2	125.4	1.362
h	117.0	127.6	1.[illegible]
x	0.14	......	......

1. The general increase of flux at full load is of course due to the compound winding; and if allowance be made for this fact, it will be seen that the reaction of the armature produces substantially the same results as in the 5-hp motor.

2. Notes 1 and 2 on the motor apply equally well to the dynamo. In column III. *d* and *e* show an enormous increase, while *D* and *E* show a decrease, in spite of the increase of flux everywhere else.

3. The armature flux is increased less than the flux through any other part of the magnetic circuit, and the leakage coefficient is increased much more than in the motor. In a compound-wound dynamo, besides the effect of the back ampere-turns on the armature (mentioned in Note 4 on the motor) there is a greater magnetic difference of potential between any two parts of the magnetic circuit at full load than at no load. The useless flux through the air is increased proportionally, while the useful flux through the iron is not increased nearly so much, owing to the decreased permeability at higher magnetic density.

4. The phenomenon mentioned in Note 5 on the motor appears also in the dynamo. There is a greater increase in *f* than in *g* and *h*, but a smaller in *F* than in *G* and *H*. But the leakage between *f* and *g* does not seem to have been decreased, probably because of the general increased leakage at full load.

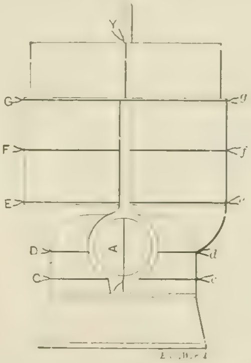

FIG. 2.—1-5-KW. EDISON DYNAMO.

5. Note 6 on the motor applies to this machine also. The increase in *c* is enormous.

6. The leakage from the base to the armature, through one of the pedestals and shaft, was tested, but was found to be insignificant (see *x*, column I.). This is because the parts of the magnetic circuit which they connect are of equal potential. Yet there is quite a little leakage from the field coils and pole pieces to the bearings, as may be shown by touching them with a screw-driver.

7. The flux through *F*, *G* and *H* is greater than in *f*, *g* and *h* at no load, but smaller at full load; and the increase of flux is greater in *f*, *g* and *h* than in *F*, *G* and *H*. Probably the iron was harder on the side where the increase is smaller. At no load,

the leakage between the pole piece and the base is greater on the hard side, because the flux produces a greater difference of potential in the hard iron; but as the softer iron allows more magnetism to pass through it in proportion to a greater magnetizing force, the leakage between pole piece and base becomes greater on the soft side at full load.

TABLE III.

	I.	II.	III.
[illegible]	100.0	100.0	1.000
[illegible]	17.4	16.7	.959
[illegible]	73.9	67.1	.909
[illegible]	142.9	142.9	1.000
[illegible]	156.6	156.9	1.002
[illegible]	155.9	155.6	.998
[illegible]	20.0	20.7	1.034
[illegible]	75.1	81.6	1.087
[illegible]	145.7	144.8	.994
[illegible]	157.1	158.1	1.006
[illegible]	159.6	158.6	.994
[illegible]	154.0	152.9	.993

Edison 1.5 kw dynamo.—Horse-shoe type. At full load this machine gives 12 amperes at 125 volts. The armature reaction is evidently insignificant. This is to be expected for the following reasons.

1. The armature is of small diameter and has few ampere turns relatively to those of the field magnet.

2. Large air-gap. The armature has a smooth core, wound with four layers of conductors, giving a total air-gap of nearly ¾ inch. It is evident that in such a construction the difference of magnetic potential between the pole pieces is so great that the ampere turns on the armature can have but little effect.

3. Drum winding. As is well known a drum wound armature usually has less armature reaction than a ring armature.

A glance at the table will show that the flux through the different sections of the field magnet remained practically constant except in the pole pieces, where the armature current caused a distortion of the field. This is well shown by the increased flux through the coil *d*, and the corresponding decrease through coil *D*, when the armature current was present.

The increased leakage through coil *c* and decrease in the leakage through coil *C* shows that one pole tip had become highly saturated, while the other pole tip was correspondingly relieved.

The leakage coefficient is large.

Leakage coefficient—No load = 1.596.

Leakage coefficient—Full load = 1.586.

The change in the leakage coefficient is quite remarkable, as an increase is usually looked for when the machine is loaded. The reason, however, is not far to see. Before the machine was loaded many of the lines of force passing out of the end of the pole piece, through the exploring coil *c*, leaked through the base to the other pole piece. When current is passed through the armature coils, the leakage through the coil *c* is increased by the distortion of the field, but most of these lines of force are drawn into the armature so that the leakage is a little less than before.

Two-hp Sprague Motor.—Consequent pole or Manchester type.

TABLE IV.

	I.	II.	III
A	100.00	92.50	.981
B	94.90	100.00	1.117
C	*4.29	24.00	5.857
D	59.60	64.61	1.042
E	85.10	81.83	1.022
F	89.40	84.80	1.007
G	86.00	77.20	.952
H	77.00	67.25	.951
c	*4.47	†16.91	3.931
d	57.20	51.47	.957
e	80.10	73.10	.969
f	86.30	82.70	1.018
g	81.90	81.30	1.053
h	70.80	69.03	1.036
[illegible]	22.79	21.37	.993
[illegible]	27.35	25.10	.997

* These readings not necessarily zero, as the centre of the consequent pole geometrically is not necessarily its centre magnetically.

† Induction actually reversed by armature reaction.

This machine at full load gives 17 amperes. The reactions in this type are very marked.

1. There is a great change in the flux through coils *c* and *C* where the field is much distorted by the armature current.

2. The leakage from the bearings is excessive, being 50 per cent. of the maximum flux through the armature at no load, and 46 per cent. of the maximum flux through the armature at full load.

Of course some of this leakage is merely apparent, as many of the lines of force get back to the armature but most of them are to be considered as absolute leakage.

Column III. shows that the leakage was slightly decreased from the bearings when the machine was loaded.

3. *Leakage coefficient*—No load = 1.76.

Leakage coefficient—Full load = 1.68.

It is most remarkable that the armature reaction actually increased the useful flux. This is due to two causes.

(*a.*) The armature was probably not highly saturated.

(*b.*) Many of the lines of force, instead of going through the pole pieces against the opposition of the armature reaction, poured into the armature from the field coils.

This is shown to be the fact by the increased flux through the middle of the field coils when the machine was loaded, while at the exploring coils *G* and *e* the flux was considerably decreased.

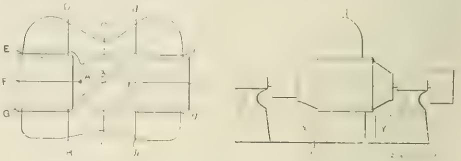

FIG. 3.—2-HP. SPRAGUE MOTOR.

General Conclusions.—A careful consideration of the machines shows that similar actions take place in all the types, the difference being principally in degree.

The following points are of interest;

1°. The change of flux in the pole pieces when current was passed through the armature coils caused increased induction in one pole piece and corresponding decrease of induction in the other, this being the case even with the compound wound machine.

2°. The magnetic effect of the armature current is more marked in machines which have
(*a.*) Armatures of large diameter.
(*b.*) Ring winding.

3°. With a large air-gap, as in smooth core armatures, the coefficient of leakage is very large, but this coefficient is less affected by armature reaction.

Conversely—With small air-gap, as in toothed armatures, the coefficient of leakage is small, but this coefficient is more affected by armature reaction. Freedom from armature reaction means large increase in the ampere turns on the field.

4°. With proper construction of the pole pieces, armature reaction is not such a thing to be dreaded; that is, if the air-gap provides ample space for the shifting of the lines of force consequent on loading the machine, the armature reaction does not cause marked trouble. Indeed, this same armature reaction can be made to keep the speed of a motor constant under all loads, or the motor can even be made to increase its speed with the load. In short, the advantages of differential winding can be obtained in a simpler way, and without the danger of entirely destroying or even reversing the field magnetism when the motor is overloaded.

This may be inferred from the fact that the 5-hp C. W. motor, before mentioned, was made to increase its speed considerably at full load by inserting resistance in the field winding, thus weakening the magnet. The same action would undoubtedly take place if the pole pieces were so shaped as to partially throttle the lines of force when the field was distorted by armature reaction.

Interior Conduit Litigation.

The United States Circuit Court of Appeals, Judges Lacombe, Wallace and Shipman presiding, on January 22 confirmed the decision of Judge Coxe in the case of the Interior Conduit Company against the Eureka Electric Company. The decision of Judge Coxe was rendered last spring, the points directly in controversy being the placing of a pair of wires, each wire forming one side of an electric lighting circuit, into a pipe made of insulating material, a safety catch being interpolated in said circuit. The opinion of Judge Coxe stated that if the construction broad enough to cover the defendant's structures is placed upon the above claims they must be held invalid. If limited to a complete system of pipes extending continuously through the building, "from supply to consumption," the claims may be upheld. But the defendant, he stated, does not employ such a system, and in no event is the third claim infringed for the reason that the defendant does not use a pair of wires twisted together.

Electrical Power Transmission—XIII.

BY LOUIS BELL, PH. D.

Ohm's law is the basis of all computations regarding the line, and lies behind all the formulæ used for this purpose. The most obvious way of applying it would be to find the resistance of the whole line corresponding to any required current and loss of volts, and then to look up in a wire table the wire which when taken of the required length woud give this resistance. As a matter of convenience in computation a large number of formulæ have been devised which include the distance, loss, expressed either in volts or percentage lost, energy transmitted, in watts, horse-power and the like, and various other factors, which may be convenient for particular applications. Some of them give the total weight of copper required and others the area of the conductor expressed in various ways.

Of these formulæ, all modified from Ohm's law to suit various conditions, the most generally convenient are those which give the area of the required conductors in "circular mils" (*i. e.*, circles one one-thousandth of an inch in diameter), a barbarous unit familiar in all tables of wire sizes, which unfortunately has obtained too firm a hold on electrical practice to be readily shaken off.

Of these "circular mil" formulæ one is subjoined which has been found by the author to be most convenient on account of its simplicity. It is derived from Ohm's law as follows:

$R = \frac{E}{C}$. Now for any length of wire $R =$

$$\frac{\text{Total length in feet} \times \text{resistance of 1 foot wire 1 mil in section}}{\text{Area in circular mils.}}$$

Taking the total length of wire as twice the distance of transmission in feet, since this distance is particularly in mind, and noting that the resistance of one "mil-foot" of commercial copper wire is quite nearly 11 ohms, we have

$$R = \frac{2\,D \times 11}{c.\ m.}$$

Substituting this value of R in the expression of Ohm's law just noted, and solving for the value of $c.\ m.$ we have,

$$c.\ m. = \frac{2\,D \times 11 \times C}{E}$$

In this expression E is the number of volts lost, and 11 is taken as the "mil-foot" constant, since it is large enough to take account of variations in diameter of wire, bad joints, flaws, and the like. The theoretical value is nearer 10.8, but experience has shown the wisdom of making the above allowance.

Having found in any case the area of the required wire in circular mils, its size and weight per thousand feet can be looked up in any wire table.

As a matter of convenience, the following table is inserted, giving, for the sizes of wire most used in power transmission work, the area in circular mils, the diameter, resistance per thousand feet, and weight per thousand feet, both bare and with insulation of the so-called "weatherproof" grade, which is well adapted for ordinary line work. Diameters are here given to the nearest mil, areas to the nearest 10 c. m., and weights to the nearest pound to facilitate reference. The table is not continued beyond the size given, because anything larger than No. .0000 is exceedingly troublesome to string, and when called for is better replaced with two smaller wires. On the other hand, wire smaller than No. 6 is seldom indicated by the conditions and produces a mechanically weak line.

Circular Mils.	Gauge No B. & S	Diameter in Mils.	Resistance per M feet.	Wt. per M feet Bare.	Wt. per M ft. We'th'rproof
211,600	0000	460	.04904	640	725
167,800	000	410	.06184	508	580
133,100	00	365	.07797	403	480
105,600	0	325	.09827	320	375
83.690	1	289	.12398	253	307
66,370	2	258	.15633	201	245
52,630	3	229	.19714	159	195
41,740	4	204	.24858	126	147
33,100	5	182	.31346	100	121
26,250	6	162	.39528	79	99

The above formula and table give sufficient data for computing the general character of a transmission line provided the loss in volts is determined. In actually working out the amount of copper needed in any given case certain details require to be taken into account which will be discussed later.

A glance at the formula shows that the voltage employed is the determining factor in the cost of the lines. For a fixed percentage of loss doubling the working voltage will evidently divide the amount of copper required by four, since the current for a given amount of energy will be reduced by one-half, while the volts lost will be doubled.

So in general the amount of copper for transmitting a given amount of energy a given distance at a fixed efficiency will vary invariably as the square of the voltage.

If the distance of transmission be doubled the area of the conductor will evidently have to be doubled also; consequently, since the length is doubled, the weight of copper will be increased four times. That is for the same energy transmitted at the same per cent. efficiency and voltage, the weight of copper will increase directly as the square of the distance. The advantage and, indeed, necessity of employing high voltages for transmissions over any considerable distance are obvious. In fact, it will be seen that by increasing the voltage in direct proportion to the distance the weight of copper required will be made a constant quantity independent of the distance.

If one were free to go on increasing the voltage indefinitely without enormously enhancing the electrical difficulties, power transmission would be a simple task, but unfortunately such is not the case. With very high voltages we meet difficulties both in establishing and maintaining the insulation of the line and in utilizing the power after it is successfully transmitted. The specific character of these limitations will be discussed later, but enough has been said to render it evident that in establishing a power transmission system both the working voltage and the volts lost in the line must be determined with great judgment.

In the matter of economy in the line, high voltage is desirable—first, last and always. In systems where the voltage undergoes no transformation its magnitude is somewhat arbitrarily fixed by the practicable voltage which can be employed in the various translating devices, motors, lamp and the like. For example, in a system at constant potential wherein incandescent lamps are an important item, 125 volts or 250 volts worked on the three-wire system would be the highest pressure advisable for the receiving system in the present state of the art. For a direct-current-motor system the corresponding figure would be 500 to 600 volts or 1,000 to 1,200 three-wire. Similar limitations indicated elsewhere will hold for other classes of apparatus.

When there is a transformation of voltage in the system, whether direct or alternating curren , so that the line voltage is not fixed by that of the translating devices, it is advisable to raise the voltage of transmission as high as the existing state of the art permits. It must be borne in mind, however, that this general rule is subject to modification by circumstances. It would be bad economy, for instance, to use very high pressures and costly insulation for a transmission of moderate length and trifling magnitude. Such practice would result in sending perhaps 100 kw over a line or through a conduit which could as easily serve for ten times the power without great additional cost for copper. It is well, however, not to stop at half-way measures, but if transforming devices are to be used at all, to go boldly to the highest voltage which experience has shown to be safe on the line, or in the generators if only reducing transformers are used.

For example, in most cases of alternating current work, 1,000 volts is of doubtful utility—if the line voltage has to be reduced at all it is better to get the advantage of 2,000 to 5,000 volts on the line—if raising transformers are employed the latter figure might as well be increased to 10,000 unless climatic or other special conditions are unfavorable.

It will be seen that quite aside from engineering details, divers really commercial factors must enter into any final decision regarding the voltage to be used. And these commercial factors are the final arbiters as to the working voltage, and even more completely as to the proportion of energy which it is desirable to lose in the line. Power transmission systems are installed to earn money, not to establish engineering theses.

It is evident to start with that whatever the voltage, high efficiency of the line and low first cost are in a measure mutually exclusive. The former means large conductors, the latter small ones; the former delivers a large percentage of salable energy with a high charge for interest on line investment; the latter a smaller amount of energy with a lessened interest account against it. At first sight it would seem easy to establish a relation between the cost of energy lost on the line and the investment in copper which would be required to save it, so that one could comfortably figure out the conditions of maximum economy.

In 1881 Lord Kelvin, then Sir William Thomson, attacked the problem and propounded a law, known often by his name, which put the general principles of the matter in a very clear light, but incidentally has been responsible for not a little downright bad engineering.

He stated, in effect, that the most economical area of conductor will be that for which the annual interest charge equals the annual cost of energy lost in it.

While it is true that for a given current and line Kelvin's law correctly indicates the condition of minimum cost in transmitting said current, this law can only mislead when applied to concrete cases of power transmission, for it omits most of the important considerations. It involves neither the absolute value of the working voltage nor the distance of transmission, and for long transmissions at moderate voltage gives absurd values for the energy lost. Indeed, as it deals directly only with the most economical condition for *transmitting* energy, it quite neglects the amount of energy delivered. In fact, one may apply Kelvin's law rigidly to a concrete and quite possible case and find that no energy at all will be obtained at the end of the line.

In other words, Kelvin's law while a correct solution of a particular thesis is in its orginal form totally inapplicable to power transmission problems.

Various investigators, notably Forbes and Kapp, have made careful and praiseworthy attempts to so modify Kelvin's law as to take account of all the facts; indeed, nearly every writer on power transmission has had a shy at the problem.

Perhaps the commonest attempt at improvement is to follow the general line of the original law but equate the interest charge on copper to the annual *value* of the power lost; in other words, to proportion the line by increasing the copper until the annual net value of a horse-power saved in the line would be balanced by the interest charge on the copper required to save it. This proposition sounds specious enough at first hearing. Practically, it produces a line of far greater first cost than is usually justified. It is evident that the possession of a few extra horse-powers thus saved brings no profit unless they can be sold, and in very few cases is a plant worked close enough to its maximum capacity during the earlier part of its existence to render a trifling increase in efficiency of any commercial value. When the plant is worked at a very high cost for power or soon reaches its full capacity a few horse-powers saved in the line may be valuable; but far oftener, especially in water-power plants, it would be cheaper to let the additional copper wait until the necessity for it arises. Furthermore, it evidently does not pay to so increase the line investment that the last increment of efficiency will bring no profit.

(To be continued.)

Practical Notes on Dynamo Calculation.—XXVI.

BY ALFRED E. WIENER.

In a very interesting paper entitled "On the Relation of the Air Gap and the Shape of the Poles to the Performance of Dynamo-Electric Machinery," Prof. Harris J. Ryan[1] has demonstrated the importance of making the pole pieces of such shape that saturation at the pole corners cannot occur even at full load; for the armature ampere turns cannot change the total magnetization established by the field when the pole corners are unsaturated. He further proved by experiment that for a sparkless operation at all loads of a constant current generator it is necessary that the air gap be made of such a depth that the ampere turns required to set up the magnetization through the armature without current and for the production of the maximum E. M. F. of the machine shall be a little more than the ampere turns of the armature when it furnishes its normal current. As long as the brushes were kept under the pole faces the non-sparking point was wherever the brushes were placed, no matter whether the armature core was saturated or not.

In order to enable currents to be taken from a machine at various voltages, W. B. Sayers has proposed to subdivide the pole faces by deep, wide slots parallel to the armature shaft, Fig. 117, thus providing a number of neutral points on the commutator, at which brushes may be placed without sparking. If, for instance, there are two such grooves in each pole piece, the total voltage of the machine is divided into three equal parts, and by employing an intermediate brush at one of the additional neutral spaces, two circuits can be supplied by the machine, one each between the intermediate brush and one of the main brushes, one having two-thirds and the other one-third of the total voltage furnished by the dynamo.

Chapter 15. Base, Zinc Blocks, Pedestals and Bearings.

(*a*) *Base.*

The *Base* is the only part of the machine where weight is not only not objectionable but very beneficial, and it should therefore be a heavy iron casting, especially as the extra cost of plain cast iron is insignificant as compared with the entire cost of the machine. A heavy base brings the center of gravity low, and consequently gives great stability and strength to the whole machine.

Besides this mechanical argument in favor of a massive casting there is a magnetical reason which applies to all types in which the base constitutes a part of the magnetic circuit, as is the case in the inverted horseshoe type, Fig. 68, in the vertical single magnet type, Fig. 73, in the inclined and vertical double magnet types, Figs. 78 and 79, respectively, in the iron-clad types, Figs. 83, 85, 86, 87, 98 and 99, respectively, and in the vertical quadruple magnet machine, Fig. 104. In these and similar types a heavy base of consequent high permeance reduces the reluctance of the entire magnetic circuit and effects a saving in exciting power which usually is sufficient to repay the extra expense involved, and often even reduces the total cost of the machine.

If the base forms a part of the magnetic circuit of the machine, constituting either the yoke or one of the pole pieces, its least cross-section perpendicular to the flow of the magnetic lines should be dimensioned by the rules given for cast iron magnets, that is, it should be at least 1⅔ to 2 times the area of the magnet cores, if the latter are of wrought iron or cast steel, and at least of equal area if they are of the same material as the base, *i. e.*, of cast iron.

(*b*) *Zinc Blocks.*

In some forms of machines, such as the upright horseshoe type, Fig. 67, the horizontal single magnet types, Figs. 71 and 72, the consequent pole, horizontal double magnet type, Fig. 77, the tangential multipolar type, Fig. 90, etc., the magnet frame rests upon two pole pieces of opposite polarity, and if these were joined by the iron base the latter would constitute a stray path of very much lower reluctance than the useful path through air-gaps and armature, and the lines of force emanating from these two pole pieces would thus be shunted away from the armature instead of forming a magnetic field for the conductors. In order to prevent such a short-circuiting of the magnetic lines it is necessary either to use material different from iron for the base, or to interpose blocks of a non-magnetic substance between the pole pieces and the bed plate. The former method can be applied to small machines only, and in this case the magnet frame is mounted upon a base of either *wood* or *brass*. For large machines a wooden base would be too weak and too light, and a brass one too expensive, and resort has to be taken to the second method of interposing a magnetic insulator, *zinc* being most usually employed. These zinc blocks must be of the necessary strength not only to carry the weight of the frame but also to withstand the tremor of the machine, and must be made high enough to introduce a sufficient amount of reluctance into the path of leakage through the base. The reluctance required in that path must be at least 4 times, and preferably should be up to 10 or 12 times that of the air-gaps; that is, its relative per-

TABLE LIV.—HEIGHT OF ZINC BLOCKS FOR HIGH-SPEED DYNAMOS WITH SMOOTH-CORE DRUM ARMATURE.

Capacity in Kilo-watts.	Diameter of armature core (from Table VIII.)	Height of winding space (from Table XV.)	Height of Binding.	Radial clearance (from Table XLVIII.)	Radial length of gap space. Inch.	Ratio of Height of zinc block to length of gap space.	Height of zinc blocks. Inches.	Approx. leakage through base in p. c. of useful flux.
1	3¼"	.3"	.03"	.045"	.375"	5	1⅞"	25%
2	3¾	.325	.03	.045	.4	5	2	25
3	4½	.35	.03	.045	.425	5¼	2¼	25
5	5¼	.375	.03	.045	.45	5½	2½	20
10	6	.4	.04	.06	.5	5½	2¾	20
15	6¾	.425	.04	.06	.525	6	3⅛	18
20	7½	.45	.04	.06	.55	6¼	3½	18
25	8¼	.475	.04	.06	.575	7	4	16
30	9	.5	.05	.075	.625	7¼	4½	16
50	10½	.525	.05	.075	.65	7¾	5	15
75	12½	.55	.06	.09	.7	8½	6	14
100	15	.6	.06	.09	.75	8⅝	6½	14
150	18½	.65	.065	.125	.84	9	7½	12
200	22½	.7	.07	.16	.93	9¾	9	10
300	28	.8	.07	.19	1.06	10½	11	10

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[1] Transactions A. I. E. E., Vol. VIII., p. 451 (Sept. 22, 1891); THE ELECTRICAL WORLD, Vol. XVIII., p. 252 (Oct. 3, 1891).

meance calculated from formula (114), chapter 38, according to the size of the machine, should range between ¼ and ½ of the relative permeance of the air-gaps as found from formula (126) or (127), chapter 39, the amount of leakage through the iron base being thereby limited to 25 per cent. of the useful flux in small dynamos, and to 8 per cent. in the largest machines.

This condition is fulfilled if the height of the zinc blocks, according to the kind and the size of the machine, is from 3 to 15 times greater than the radial length of the gap space. The following tables LIV., LV., and LVI., give the value of this ratio, the consequent height of the zinc blocks, and the corresponding approximate leakage through the base for high-speed dynamos with smooth-core drum armatures, for high-speed dynamos with smooth-core ring armatures, and for slow-speed machines with toothed and perforated armatures, respectively :

TABLE LV.—HEIGHT OF ZINC BLOCKS FOR HIGH-SPEED DYNAMOS WITH SMOOTH-CORE RING ARMATURES.

Capacity in Kilo-watts.	Diameter of armature core (from Table IX.)	Height of winding space (from Table XV.)	Height of Binding.	Radial clearance (from Table XLVIII.)	Radial length of gap space. Inch.	Ratio of Height of zinc block to length of gap space	Height of zinc blocks. Inches.	Approx. leakage through base in p. c. of useful flux.
1	7″	.25″	.03″	.045″	.325″	8	2½	15%
2	8	.25	.03	.045	.325	9	3	14
3	9½	.275	.04	.06	.375	9½	3½	14
5	11	.3	.04	.06	.4	10	4	12
10	14	.325	.05	.075	.45	11	5	12
15	15	.325	.05	.075	.45	11	5	12
20	16	.35	.06	.09	.5	12	6	10
25	18	.35	.06	.09	.5	12	6	10
30	20	.375	.07	.13	.575	12	7	10
50	24	.4	.07	.13	.6	13½	8	9
75	28	.425	.07	.155	.65	14½	9½	9
100	32	.45	.07	.155	.675	15½	10½	8
150	36	.475	.07	.18	.725	16	11½	8

TABLE LVI.—HEIGHT OF ZINC BLOCKS FOR SLOW-SPEED DYNAMOS WITH TOOTHED AND PERFORATED ARMATURE.

Capacity in Kilowatts.	Diameter of armature core (from Table X.)	Height of winding space (from Table XVI.)	Radial clearance (from Table XLVIII.)	Maxim. Radial length of gap space. Inch.	Ratio of height of zinc block to max. length of gap space.	Height of zinc blocks. Inches.	Approx. leakage through base in p. c. of useful flux
2	12″	1⅛″	$\frac{3}{64}$″	$1\frac{11}{64}$″	3	3½″	15%
3	15	1¼	$\frac{1}{16}$	$1\frac{5}{16}$	3	4	15
5	17	1⅜	$\frac{1}{16}$	$1\frac{7}{16}$	3½	5	12
10	21	1½	$\frac{5}{64}$	$1\frac{37}{64}$	3¾	6	12
15	23	1⅝	$\frac{5}{64}$	$1\frac{45}{64}$	4	6¾	10
20	25	$1\frac{11}{16}$	$\frac{3}{32}$	$1\frac{23}{32}$	4¼	7½	10
25	27	1¾	$\frac{3}{32}$	$1\frac{27}{32}$	4⅜	8	10
30	30	$1\frac{13}{16}$	⅛	$1\frac{15}{16}$	4½	8¾	8
50	36	1⅞	⅛	2	4¾	9½	8

From the comparison of the above tables LIV., LV. and LVI., it follows that the height of the zinc blocks increases in a nearly direct proportion with the diameter of the armature-core, and that, for the same armature diameter, a smooth drum machine requires a higher and a toothed or perforated armature machine a lower zinc than a smoothering dynamo. By compiling the results of tables LIV., LV. and LVI., the above table LVII., is obtained, from which can be seen that the heights of zinc blocks for smooth-ring machines are from 18 to 30 per cent. less than for smooth-drum dynamos, and those for machines with toothed and perforated armatures are from 11 to 20 per cent. less than for smooth-ring armature dynamos.

TABLE LVII.—COMPARISON OF ZINC BLOCKS FOR DYNAMOS WITH VARIOUS KINDS OF ARMATURE.

Diameter of Armature Core.	Height of Zinc Blocks.		
	Smooth Armatures.		Toothed and Perforated Armatures.
	Drum.	Ring.	
Inches.	Inches.	Inches.	Inches.
3	1¾	....	....
4	2	....	....
6	2¾	2	1¾
8	4	3	2½
10	5	3½	3
12	5¾	4⅛	3½
15	6½	5	4
18	7½	6	5
21	8¾	7	6
24	9¾	8	7
27	11	9	8
30	....	10	8¾
36	....	11½	9½

(To be Continued.)

Electric Shock from a Secondary Alternating Circuit.

To the Editor of The Electrical World:

SIR:—In my opinion discussion of the possible danger to life from electric current supplying incandescent lamps should be well considered before being given to the public, and, on the other hand, attention should be called to conditions that may not be generally understood.

In the case mentioned in your issue of Jan. 19, it appears that a fatal shock was received by a man standing with bared feet on damp earth while lighting a lamp supplied from a 52-volt alternating secondary circuit; that before and after the accident the lamps burned as usual, and the only faults discovered was a slight ground on the secondary circuit; and that the insulation was destroyed at one point in the transformer between the primary and secondary wires. In stating that no other faults were discovered, it is fair to assume that the primary circuit was tested for "grounds" and found clear *as usual*, but it is a fact that a ground detector always shows a slight leakage; if it is small, and the same on both sides of the line, then the condition being normal, it is regarded as clear.

Numerous opportunities exist for slight leaks throughout any system of distribution, and in the case of the primary lines of an alternating system exceptionally favorable conditions for leaks exist by reason of the numerous transformers and their connections. The "insulated" line wire offers many opportunities for slight escapes in trees and similar places where the resistances may be sufficiently high to prevent a serious leak or one which would be called a ground. When the man connected one side of the primary line to earth through the defective transformer over a comparatively low resistance (the secondary circuit and his body) all the leaks on the other side of the line acted collectively to establish a circuit of sufficiently low resistance to permit enough current to pass to be dangerous, and not enough to overload the fuses in the transformer or branch of secondary.

If your correspondent has any doubt as to this being the manner in which it occurred let him connect a 52-volt lamp between one side of the primary line and the earth—establishing a good connection with the earth—and note the result. JAS. I. AYER.

NEW YORK, N. Y.

To the Editor of The Electrical World:

SIR:—In reference to the article in THE ELECTRICAL WORLD of Jan. 19 concerning a colored man who was killed by contact with a 52-volt circuit, I would say that I find lamps will burn on a converter and no fuses blow or lamps burn out and yet have the primary in connection with secondary, through ruptured or defective insulation. In a transformer where the primary is in contact with the secondary a test will show 1,000 volts, or whatever the primary is, if a voltmeter be connected, one terminal to the secondary and the other to a good ground; or twenty 50-volt lamps connected in series will burn if connected as above. We have several converters in our station at present having this defect, and I have at several different times made the above test. The fuse would blow and the lamps burn out if the defective wiring were on a fixture connected with gas piping if primary should be connected with the secondary as I have seen demonstrated in practice. No change would be noticed in an installation of lights if there were no ground on the secondary and no access to the ground through gas or water pipes, but it would seriously affect a person standing on ground and making connection with the secondary. L. H. THULLEN.

LEETONIA, O.

To the Editor of The Electrical World:

SIR:—Referring to the communication in a recent issue of THE ELECTRICAL WORLD from a correspondent in Demerara in regard to a fatal shock from a secondary alternating main, we have had a dozen or more similar experiences during the past six years, though none has resulted fatally.

In one instance our lineman went into a damp cellar to do repairing, and upon taking hold of the socket of an ordinary cord drop he received a violent shock, throwing him down, breaking the cord and burning his hand badly. Upon examining the transformers in such cases we always find a "nigger" between the first few turns of the primary and the secondary, in most cases welding the copper slightly together.

In all cases the lamps continued burning as usual, and trouble was discovered only upon some one receiving a shock.

These troubles with us usually follow a severe thunder storm, where the lightning puncturing the insulation gets to ground through the secondary wiring.

Our system of lines is rather extended, both primary and secondary, running through thickly shaded streets, and in damp weather always show considerable leak to ground. J. B. FOOTE.

JACKSON, Mich.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 922 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Calculation of Multiphase Motors.—The "Elek. Zeit.," Jan. 24, contains the first half of an article by Mr. Cahen, in which he gives a combined graphical and analytical method which is simple and more convenient than either of the other two used separately and which can be used in practice; it is in agreement with the method in the latest edition of Kapp's work on the transmission of power.

Theory and Calculation of Non-Synchronous Motors.—The paper of Mr. Legrand is continued in "L'Eclairage Elec.," Jan. 12.

A New Mining Motor.—The first part of a paper by Mr. Henry A Mavor read before the Institution of Engineers and Ship Builders in Scotland is reprinted in the Lond. "Elec. Eng.," Jan. 25; it is quite elementary in character; an abstract of some length including the last part of the paper with illustrations of the motor is published in "Ind. and Iron," Jan. 25.

Phonograph Motor.—Detailed data, including windings, etc., of this motor running with 2½ amperes and 2 volts are given in the Lond. "Elec. Rev.," Jan. 25.

Lindner Dynamo and Portable Motor.—A brief, illustrated description is published in "Ind. and Iron," Jan. 25; (judging from the proportions of the dynamo it is of no special interest).

Dynamo Safety Device.—An apparatus intended to protect dynamos from damage due to grounds, crosses, etc., is described and illustrated in the "Elec. Eng.," Feb. 6; the principle is to form an auxiliary broken circuit which offers a less resistance than the insulation of the machine, thus being always ready to take the abnormal charge; the break in the auxiliary circuit is provided with carbon points, one connected to the field of the machine (presumably a constant-current arc light machine) and the other connected to the frame. To ascertain where the trouble has occurred the carbons are separated and an electric contact is made from any part of the frame to the brushes; if a current exists it is the insulation of the machine that has been punctured, and if not, the trouble is in the circuit.

Magnetic Brush-Holder.—A form devised by Mr. Henry is described and illustrated in the "Elec. Eng.," Feb. 6; the carbon brush is pressed against the commutator by an iron core in a coil through which the main current passes; the pressure is therefore proportional to the load on the motor.

LIGHTS AND LIGHTING.

The Electric Arc.—The paper by Mrs. Ayrton (see Digest last week) is continued in the Lond. "Elec.," Jan. 25; it includes numerous tables and curves. A set of curves shows the general character of the changes in the curves caused by varying the diameters of the carbons; the chief one is the change in the smallest current which causes hissing; with both carbons solid, hissing occurs with a much smaller current for a given length of arc than when the positive carbon is cored; "even with the same pair of carbons the smallest current with which continuous hissing first takes place, and the largest current with which a silent arc can be maintained continuously for a given length of arc, are almost impossible to determine with absolute certainty." Hissing always occurs with very much smaller currents with the smaller carbons than with the larger ones; the largest current which can maintain a silent arc of given length, that is, the hissing point, increases with the cross section of one or both of the carbons; the voltage has always gained a fairly constant value before hissing begins, and it is constant for a much larger range of current before hissing begins with large carbons than with small; therefore if the object is to keep the voltage constant for a large range of currents large carbons should certainly be used. One of the figures shows that the largest current which can maintain a silent arc with given carbons is greater for long arcs than for short ones, that is, if with a certain length of arc there is hissing then by lengthening the arc and keeping the current constant it will become silent. The two following conclusions are arrived at: 1. "The smallest current which produces hissing with a given length of arc increases with the cross-section of the carbons. 2. The smallest current which produces hissing with a given pair of carbons increases with the length of arc." From some of the figures it appears that increasing the cross-section of the carbons has more effect in increasing the current that can flow without hissing, than increasing the length of the arc in the same ratio. Regarding silent arcs it is stated that the permanent value of the voltage for a given current and length of arc depends but little on the cross-section of the carbon. Curves connecting the voltage with the current show that the curve for a cored positive carbon is from 3 to 6 volts lower than with a solid positive; this diminution of voltage is not uniform with the length of the arc as it is much greater with short arcs and with smaller currents. Curves connecting the apparent resistance with the length of the arc are shown; the simple formula of Cross and Shepard for this resistance agrees with these results with solid carbons, but for cored positives no such equation is correct. Measurements of the depths of the craters were made and it was found that with a given current the depth is greater the shorter the arc; the influence of this depth on the apparent resistance is greatest with arcs less than 3 mm, and the two may be connected; the soft core may volatilize more easily, diminishing the voltage, or it may increase the amount of volatile carbon given off per second and thereby increase the cross-section of the conducting medium; she believes that the core acts in both of these ways; the widths of the craters were also measured and were found to vary very slightly with the length of the arc for a given current; for a given length the width of the crater minus a constant varies as the current; a simple formula is given; the diameter of the crater does not vary directly as the current, as stated by Prof. Thompson; the width of the crater can have very little influence, if any, in lowering the resistance of the arc when it is short.

Arc Lamp.—Prof. Thompson's second Cantor lecture is abstracted briefly in the Lond. "Elec. Rev.," and discussed editorially in the "Elec.," Jan. 25. Among other things he stated that there are such extraordinary variations that it would be impossible to use the crater as a standard of light; the area of the crater is rigidly proportional to the current and therefore the candle power should be directly proportional to the current; the energy developed in a resistance is proportional to the square of the current, but in the arc there is a back E. M. F. and the energy is therefore proportional to the current; it remains to be proved that twice the current gives more than twice the light as is often supposed; he believes it to be absurd to suppose that there can be any difference in the light given out by alternating and continuous current arcs. The editorial argues that for about half the time the light in the alternating arc is comparatively small and that this is surely not the right way of utilizing the energy; if the usual degree of brightness is not maintained the efficiency must be smaller.

Lighting Power of Projectors.—In a continuation of the long serial in "L'Eclairage Elec.," Jan. 12, photographic experiments with the light from the projectors are described, including a number of illustrations showing photographic images of wire gratings.

Mercury Pump.—The "Elek. Anz.," Jan. 24, publishes an illustrated description of the Bock-Kiel pump which is used in the large lamp factories at Lynn and Newark.

Lamp Filaments.—According to the Lond. "Elec.," Jan. 25, a French firm is making lamps with pure graphite filaments; they start at about 1.7 watts per candle and last about 500 hours, during which time they increase to 2.2 watts per candle.

Incandescent Lamps for Explosive Factories.—The Lond. "Elec. Eng.," Jan. 25, abstracts a brief description from a recent lecture by Prof. Lewes, of an incandescent lamp mounted in a glass tube; the description, however, is not very clear.

Carriage Lighting.—The current United States Consular Reports contain a report from France on this subject; the system used in France being briefly described; the lamp is suspended from a sheet of rubber to neutralize the vibration; one accumulator (?) weighing 2 pounds is the allowance for each lamp; an 8-cell storage battery for an ordinary family carriage contained in a box 8 inches long, 4 wide and 7 deep, will light the lamp for 18 hours, which is said to cover a period of 1 to 2 months; the cost of recharging varies from 50c. to $1.00; it is believed that there is a fair prospect that in the course of a few years the majority of public and private vehicles will thus be lighted; a 2.5-cp lamp will enable one to read in comfort.

Area Lighted by a 16 cp Lamp.—Some figures by Mr. Bain are given in the "Elec. Rev.," Feb. 6; (he does not, however, give the basis on which they are determined, using merely such terms as "ordinary illumination").

Brooklyn Bridge Car Lighting.—The system which is being installed is described and illustrated in the "Elec. Rev." Feb. 6, and "St. Ry. Gaz.," Feb. 2; the current will be supplied by means of the overhead trolley system, the return being through the rails.

Automatic Mercury Pump.—In the "Amer. Jour. of Science" for January, Dr. Pupin describes a new form of pump devised by himself which is claimed to be more rapid and convenient; no cocks are used; an abstract with illustration is published in the "Eng. Mag.," for February.

POWER AND HEAT.

Designing Transmission Plants.—The paper by Mr. Mountain mentioned in the Digest last week is concluded in the Lond. "Elec. Eng.," Jan. 25; he gives comparative estimates in detail of steam and electrical plants for the same purpose. The last part of the paper with illustrations and tables is published in "Ind. and Iron," Jan. 18; it appears to be chiefly for non-electrical engineers.

Electricity in Mining.—A long, illustrated paper by Mr. Lavergne on the mechanical applications is published in the "Rev. Gen. des Sciences," Jan. 15; among other things he illustrates and describes a number of drills and some traction motors.

Direct-Driven Centrifugal Machines.—Several forms made by the General Electric Company, of Berlin, are well illustrated in Lond. "Engineering," Jan. 18.

Electrically Operated Guns.—An illustration of a system installed by Krupp is given in the "Elek. Anz.," Jan. 20.

Operating Ships' Turrets.—The illustrated article on this subject is contained in the "Engineering," Jan. 18 and 25.

Electric Cooking.—In Lond. "Lightning," Jan. 24, Mr. Webber gives the following temperatures: with a jacketed vessel with oil a constant temperature of 400 degrees C. can be obtained and between this and that of a water jacket all stewing processes can be carried out; for roasting-screens before an open fire the best temperatures are 265 degrees F. to begin with and 210 at the end; for baking large bread in an open oven 450 degrees F., for smaller bread 470 degrees F., and for very small pastry 490 degrees F.; for frying in oil, fat or butter a temperature of about 400 degrees F. is obtained, at which there is no risk of spoiling.

Electric Power for Isolated Factories.—An illustrated paper under this heading, by Prof. Anthony, is contained in the "Eng. Mag." for February. The advantages of using electricity are not yet well understood and it is not employed as generally as its advantages warrant; it is not always superior to other methods and each case must therefore be considered by itself; he summarizes the general considerations which will assist in arriving at a solution. He gives several load diagrams made by the Crocker-Wheeler Electric Company giving the indicated hp of the steam engine for every 15 minutes during the day; the average load was 44.1 hp of which 12.8 is useful and the rest friction, 21.3 of which is absorbed by the shafting, thus amounting to 62.5 per cent. of the power delivered by the engine, or 166.4 per cent. of the useful load; if this power were transmitted electrically the power lost in transmission should not be more than half the useful load; assuming that an electric plant to replace the shafting would cost $2,000 it would represent a saving of nearly $700 per year. Another load diagram is given for a large silk manufactory in which the efficiency of transmission is 65 per cent.; it is questioned whether, in this most unfavorable case for electric transmission, the saving affected would not more than pay for the electric installation. He gives a brief description of some typical plants showing the advantages of electrical transmission. The cost will perhaps in most cases exceed that of shafting and pulleys, but in most cases the saving of power more than warrants the additional outlay; he considers it a mistake in any new project not to make a careful estimate of the relative advantages; the advantages must not be expected in all cases to warrant the discarding of existing shafting.

Centrifugal Machines.—Those mentioned above, made by a German firm, and run with polyphase motors, are illustrated in the "Elec. Eng.," Feb. 6.

TRACTION.

Suspended Railway System.—The "Elek. Zeit.," Jan. 17, contains a very favorable report of a municipal commission of Berlin on the Langen system, which it is proposed to use in Berlin. The overhead construction will not interfere with light and air in the houses and is not as unsightly as the usual elevated railways; the absence of a floor reduces the noise to a minimum; the height to which passengers must mount is about 4 feet less; the security against derailing and swinging is quite reliable; a speed of 24 miles an hour can be obtained on level stretches; it is very well adapted for an elevated city railway; it is not possible to transfer the cars on to existing railroad lines but that is not considered an important defect; the cost is relatively small; they recommend constructing a line in Berlin.

The Dietrich-Mueller system is described in the "Elek. Anz.," Jan. 20; in this the car is suspended over the side of the car and not over its centre of gravity, there being an additional track and wheel on the side of the car near the bottom; by this means lateral oscillations are prevented entirely; it is claimed that the supports may be made much fewer than in the Langen system, about 150 ft. apart, as compared with 80 to 100 feet, and that therefore the amount of material required is lessened.

Rapid Transit in Large Cities.—A paper by Mr. Busschere, with particular reference to the London and New York lines, is briefly abstracted in the "Mem. Soc. Ing. Civ." for November; the data seem to be somewhat old.

Underground Railway in Paris.—An illustrated description of the steam road at present under construction, which "it is hoped may be regarded as a forerunner of a metropolitan railway system" is published in Lond. "Engineering," Jan. 25.

Tramway Statistics.—Some statistics in the form of curves from the year 1878 to 1894, compiled for the House of Commons, are reprinted in the Lond. "Elec.," Jan. 25, and discussed editorially; they give the authorized and expended capital, the mileage, the passengers carried, gross receipts, working expenses and net receipts; the mileage and capital in municipal tramways is much less than one-half that of lines built by companies.

Electric Traction.—The third installment of Mr. Dawson's article is contained in the Lond. "Engineering" Jan. 25; it includes some interesting tabulated information concerning electric lines in Europe.

Electric Carriage.—The carriage of Mr. Jeantaud is described and illustrated in "L'Energie Elec.," Jan. 16. The accumulator used is the "Fulmen;" the plates are made of a light lead frame filled with active material and surrounded by an envelope of perforated celluloid; the cells are made of wood lined with celluloid. The carriage contains 21 cells weighing 29.3 pounds each, giving 100 amperes at 40 volts, and capable of discharge at 200 amperes; it will run 1.5 hours, corresponding to 5 ampere-hours per pound at a slow rate, 3.4 at a mean rate and 6.8 at a maximum (there is evidently something wrong with these figures) the speed of the carriage on a level is 12 miles an hour, the total weight is 2,640 lbs., including two passengers, the accumulators weighing 924 lbs., the carriage a little more than this, and the motor 242 lbs.

Power Required in Electric Traction Under Varying Conditions.—In a paper by Mr. Lyman published in the "Sibley Jour. of Eng." for January he gives the results of tests made on electric railways, most of them being from the laboratory records of the Sibley College. He gives the results of a test by Dr. Bedell, at Rochester, in 1891, including some power curves; by Messrs. Wood and Palmer, in Buffalo, 1892; in a large Western city, 1892; at Minneapolis by Profs. Shepardson and Burch (see "Trans. of Am. Inst. of El. Eng.," vol. 9, page 578) and concludes with a description of the tests made in Ithaca, in November, 1894, by Mr. Hewitt and himself. The first of these tests are now somewhat old, but the following results of the last one may be of interest; the results are limited on account of quite a number of mishaps. A baggage car (whether with or without motors is unfortunately not stated, but presumably it had motors) was connected with a dynamometer to a passenger car, the former weighing 8.4 tons and the latter 8 tons; the car was equipped with two 25-hp T.-H. motors of which an illustration is given; he considers the results reliable, although those with the dynamometer had to be discarded. Two round trips were made with this car and trailer from which the following results, all of which are averages, were obtained, the first representing the first trip at about six miles an hour and the second the second trip at about ten miles an hour: Speed in miles per hour 5.93 and 10.18, trolley current in amperes 18.7 and 35, trolley E. M. F. 456 and 456, effective motor counter E. M. F. 188 and 384, applied hp 11.5 and 21.5, applied hp per ton .7 and 1.3, delivered hp 9.4 and 17.85, delivered hp per ton .57 and 1.09, motor efficiency 81.5 and 84.0 per cent., electrical traction in pounds 596 and 657., electrical traction in pounds per ton 36.3 and 40, dynamometer traction in pounds per ton 53.6 for the first trip. During the first run the motors were in series with full field and no rheostat, during the second the two motors were in parallel with full field and no rheostat; it represents normal work with light load; the motor efficiency is the ratio of the effective counter E. M. F. of the motor to the trolley E. M. F. and it was assumed that the load was equally divided between the two motors; the traction per ton varies from 36 to 40 pounds or from 1.8 to 2 per cent. of the weight of the car. Another test was made up a hill 1,793 feet long, the average results of which are as follows: Per cent. grade 8.85, speed in miles per hour 5.45, trolley current in amperes 156, trolley E. M. F. 412., effective motor counter E. M. F. 308., applied hp 87, appled hp per ton 5.3, maximum applied hp per ton 6.8, delivered hp 64.5, delivered hp per ton 3.9, motor efficiency 74.7 per cent. He deduct the actual traction per ton per 1 per cent. of grade for each section and obtains as an average from the developed electrical hp 31.8 pounds and from the traction dynamometer 41.8 pounds per 1 per cent. of grade per ton; these results indicate that the assumption commonly made that the power is equal to "the weight multiplied by per cent. of grade or 20 pounds per ton, is incorrect; the friction of motor gearing which increases rapidly with the traction is probably the cause;" the average current for each motor was 78 amperes and the maximum 98. He adds that the traction of the regular trailer per ton is undoubtedly very much less (from which it seems that the trailer used had motors). In general construction where grades are moderate and where not less than ten cars are on duty at once probably 2.5 indicated hp per ton of car would be a correct estimate for determining the engine power; for not less than twenty cars this would probably be 2.2 indicated hp.

Railway Statistics for the United States.—The "St. Ry. Jour." for February gives a table containing the number of cars and miles of single track in each State at the end of the years 1893 and 1894; the number of cars include both motor and trail cars. The totals for the year 1894 are as follows:—horse: 2,243 miles, 11,507 cars; electric: 9,008 miles, 22,849 cars; cable: 662 miles, 4,673 cars; steam: 614 miles, 2,639 cars; total: 12,527 miles, 41,668 cars. For the end of 1893, horse: 3,574 miles, 16,875 cars; electric: 7,547 miles, 17,128 cars; cable: 657 miles, 47,089 cars; steam: 656 miles, 2,023 cars; total: 12,434 miles, 40,815 cars.

Feeder Cables.—The "St. Ry. Jour." for February contains an article by Mr. Easby on the calculation of feeder cables. He gives a graphical method and shows how the most economical sizes are to be determined.

Chicago Elevated Railway.—The "St. Ry. Jour." for February contains a well illustrated article describing this, the first permanent all elevated electric railway in this country which is now nearly completed; the total length is 18 miles. Regarding this the "West. El.," Feb. 2, quotes Mr. Rae, a large stockholder and director of the Liverpool line, as saying that it is vastly superior to the Liverpool road and he believes it to be the most perfect electric elevated railway in the world.

New York Rapid Transit.—The experts' report is published in the "Elec. Eng.," Feb. 6, and "St. Ry. Jour." for February. They confirm the estimates of Mr. Parsons and suggest modifications and changes to reduce the cost; they recommend electricity as the motive power.

The "Eng. News,' Feb. 7, sums up the recent history of this enterprise.

Germany.—The "St. Ry. Jour." for February abstracts a brief description of some German roads from a recent work published by the General Electric Company of Berlin.

Staten Island.—In the "Elec. Eng.," Feb. 6, Mr. Cochrane discusses the development of the electric railway on Staten Island.

Binghamton.—A description of some length with a number of illustrations is contained in the "St. Ry. Jour." for February.

Conduit in Washington.—A cross-section with a brief description is published in the "Elec. Eng.," Feb. 6.

Conduit Construction in New York.—A cross-section of the street with double tracks is published in the "St. Ry. Jour." for February.

Trolley-Steam Competition in New England.—The "Elec. Eng.," Feb. 6, publishes some recent statements by Mr. Hall, vice-president of the New York, New Haven and Hartford Railroad.

Wheels.—The "St. Ry. Jour." for February contains an article by Mr. Partridge on "Wheel Metal," accompanied by a number of cuts showing the peculiar wear of the wheels; another by Mr. Uebelacker on street railway wheels; another by Mr. Partridge on some figures in regard to car wheel mileage; there are also several communications on wheels.

Motor Repairs.—A paper by Mr. Shepard is contained in the "St. Ry. Jour." for February; he discusses the Short single reduction motors with which he has had extended personal experience; he admits some of their shortcomings, but points out their advantages and believes that they compare favorably with some of the more recent motors on the market; their emergency power he states is remarkable.

Inspection of Rails.—An article on this subject by Mr. Lowenherz is contained in the "Elec. Eng.," Feb. 6.

Fender.—The Yost Fender is described and illustrated in the "Elec. Eng.," Feb. 6.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Amortization.—Part of a recent paper by Mr. Pruecker is reprinted in the "Elek. Zeit.," Jan. 17. He discusses in detail the subject of amortization of an electric light installation for a period of 40 years, giving curves and data regarding the renewals; he arrives at the approximate figure of 2.3 per cent. of the total capital, or in general beween 2 and 3 per cent. and concludes that the usual 4.5 to 7 and even 9 per cent. do not represent the true amount.

Rules and Regulations.—A discussion of those suggested in Germany (see Digest, Jan. 12) is contained in the "Elek. Zeit.,' Jan. 24.

Electricity in Mines.—A short article by Mr. Chalon, but giving apparently nothing new, is contained in "L'Elec.," Jan. 26; he claims that up to the present time there has not been any explosion due to fire-damp ignited by the electric spark, and he claims that the temperature is not sufficient; it favors chemical combinations, however, and in this respect it becomes dangerous.

Switch Operated from a Distance.—The Wahlstroem system is described and illustrated in the "Elek. Anz.," Jan. 17; it is intended to light or cut out incandescent lamps by means of push buttons placed at any convenient point. The apparatus consists of a magnet having a high resistance winding excited by the push button circuit, the magnet operating a mercury switch; when a push button is pressed the magnet draws up the armature, which at the same time is turned through 90 degrees, and when the push button circuit is broken it drops, closing the lamp connection; when the push button is pressed the second time the same action takes place, but in descending the armature does not drop into the mercury cups; one circuit of all the push buttons is connected directly to the lighting circuit and the other through the magnet to the other pole of the lighting circuit.

The Liesegang system for the same purpose is illustrated and described in the "Elek. Anz.," Jan. 20. There are two magnets opposite each other operated by a battery circuit and acting on a common armature mounted on a spring; when drawn to one side and released its momentum turns a bent lever through 90 degrees which closes the lamp circuit and switches the battery circuit on to the other set of magnets; when this circuit is closed and again opened the oscillating armature turns the lever back to the other position.

Halifax.—An lillustrated description of the station in England is given in Lond. "Lightning," Jan. 17.

Accumulators in Central Stations.—A paper by Mr. Markle read at the recent meeting of the Northwestern Electrical Association is reprinted in full in the "West. El.," Feb. 2, and "Elec. Rev.," Feb. 6. He considers that accumulators are eminently fit for fulfilling the three prime functions, namely, as storage reservoirs, for equalization of energy and for transforming, each of which he discusses; a space of 10 yards square will suffice for storing 1,000 kw hours; such accumulators cost less than those used for steam, air or water, the depreciation is less, the life longer and the pressure remains constant; they form the best equalizer, therefore enabling lamps of 2.5 watts per candle to be used, and this represents an economy of current of about 20 per cent.; German statistics show that by far the greatest fuel economy and net earnings is shown by accumulator stations; one firm alone has installed 100 central stations and 3,000 isolated plants. He states that the loss and voltage should not be estimated singly, but should be "computed on the total electrical energy generated by the station, and the total values thus fairly arrived at. Average practice shows that where batteries are working at an efficiency of 75 per cent. the ratio of battery loss to total net output is from 10 to 14 per cent. and at 85 per cent. battery efficiency, 6 to 9 per cent." The depreciation and repairs he states are about the same as on a steam plant; he cites the railway plant in Zurich (described in the Digest, July 28); he states that it is erroneously believed that an accumulator plant is expensive, and gives an estimate for a 500-hp plant which by the direct system costs $47,000 and by the storage system $46,000, in the latter the steam and electric plant having half the hp, the price of the accumulators being $22,500.

Municipal Plants.—A brief description of the question why they succeed and why they fail is discussed briefly by Mr. Winchester in the "Elec. Eng.," Feb. 6. He is connected with the South Norwalk municipal station; he advocates municipal ownership only under the most favorable conditions, which are seldom met with; their increase he thinks is largely due to schemers who erect a cheaply constructed plant which is unsatisfactory and it is then as a last resort that the people consider a municipal plant; the great enemies to the latter are politics and partisanship, and success can never be expected until such plants are constructed on strictly business principles; when such a time arrives there is no reason why cities cannot operate such plants with more economy, as the profits would go back to the taxpayers.

Mexico.—A brief description of a central station at Aguas Calientes is given by Mr. Guy in the "Elec. Eng.," Feb. 6.

WIRES, WIRING AND CONDUITS.

Explosions Due to Underground Mains.—Lond. "Elec. Eng.," Jan. 25, publishes a reply from the managers of 21 stations in England to a number of questions regarding this subject; the answers, which are very brief, appear to contain nothing new but may be of some interest as showing the systems of mains and conduits used and their freedom from trouble; one writer believes that freedom from trouble is due to the use of concentric cables in connection with sealed fuse boxes; another suggests preventing explosions by charging the gas company with the expenses and damages.

Leads and Networks of Conductors.—A paper by Mr. Teichmuellel is reprinted in full in the "Elek. Zeit.," Jan. 3; it is in part somewhat elementary in character. In reviewing the history he credits Ronalds with having laid the first underground lines in the year 1816; he describes at some length the "German" system of calculating the cross-sections in a network of conductors, claiming that it is after all the only proper way of attacking the problem; after making a number of such calculations one is then better able to make proper estimations; there are four methods, each of which he discusses.

Laws Concerning Electric Lines.—The French laws concerning lines other than those for telegraphic and telephonic purposes are published in "L'Eclairage Elec.," Jan. 12.

Interior Conduits and Interior Wiring.—A paper by Mr. Burton read at the recent meeting of the Northwestern Electrical Association is reprinted in the "West. El.," Feb. 2; he enumerates the advantages of this system; its cost is about 20 per cent. greater than that of the ordinary system.

ELECTRO-PHYSICS AND MAGNETISM.

What Is Electricity.—Prof. Fleming's views as stated in a recent Royal Institution lecture are given in "Ind. and Iron," Jan. 18. Science is beginning to recognize that electricity is probably a wave disturbance of the ether, analogous of that called light; with light the waves vibrate at the rate of 45 millions per second with an amplitude of oscillation of 37,000th of an inch; electricity is a wave motion with waves yards in length and also of great rapidity.

Electricity.—A long paper by Mr. Feldmann on the latest views on the nature of electricity is reprinted in the "Elec. Echo" for January; it appears to consist of a summary of the present views on the subject.

Electromagnetic Theory.—In a communication to the Lond. "Elec.," Jan. 25, by Prof. Perry, he explains some points in Mr. Heaviside's article with the intention of making it clearer to the beginner.

Electromagnetic Oscillations.—Some recent researches by Prof. Minchin are discussed briefly in the Lond. "Elec. Rev.," Jan. 25.

Propagation of Electric and Magnetic Perturbations.—The serial by Mr. Blondin (see Digest, Oct. 6 and 27,) is continued in "L'Eclairage Elec.," Jan. 12; he discusses the measurement of the velocity.

Thermoelectric Properties of Platinoid and Manganin.—A paper by Mr. Peirce from the "Am. Jour. of Sc.," Vol. 48, Oct., 1894, is reprinted in the Lond. "Elec. Rev.," Jan. 25; he gives the results of a series of measurements.

Phosphorescence.—The Lond. "Elec.," Jan. 25, states that Prof. Dewar recently corroborated the theory of Prof. Stokes, in which he regarded phosphorescent bodies as optical transformers that is, as an apparatus for converting the short non-luminous rays into light; Prof. Dewar found that at —200 degrees C. numerous substances, including photographic plates, phosphoresced.

ELECTRO-CHEMISTRY AND BATTERIES.

Electricity Direct from Coal.—The Lond. "Elec. Rev.," Jan. 25, comments on the recent papers on this subject, all of which have been noticed in the Digest. Regarding Mr. Reed's criticism (see THE ELECTRICAL WORLD, Dec. 22, p. 637) in which he claims that the E. M. F. is derived from the copper, it is claimed that this was foreseen by Dr. Borcher, and that in a special experiment he found that when carbonic oxide was dissolved in the electrolyte in contact with the copper, then instead of the copper being dissolved there was a slight deposition of copper on the copper electrode and, therefore, the chemical energy cannot be derived from the consumption of the copper. The practical utility of Dr. Borcher's invention has yet to be proved; it has been seriously damaged by hostile critics. "It is not to be expected that a discovery which has been received with enthusiasm in Germany by such authorities as Prof. Ostwald should turn out to be merely a mare's nest."

Gas Batteries.—The Lond. "Elec. Rev.," Jan. 25, abstracts briefly the recent paper of Mr. Smale, giving but very little more than was contained in the Digest, Feb. 2. The original appeared in the "Zeit. f. Phys. Chem.," Vol. 14, page 577. The following are also recommended: "The Potential of Hydrogen and some Metals," by Mr. Neumann, "Zeit. f. Phys. Chem.," Vol. 14, page 193, and the "Voltaic Chain," by Mr. Goodwin in the same, Vol. 13, page 577.

Process for Reducing Aluminium.—The process of Mr. Gooch (New Haven, Conn.) is described and illustrated in "Ind. and Iron," Jan. 18; it consists in general of passing a current through a fused bath containing a halogen compound of aluminium and supplying to the bath a vapor of water; the best compounds are chloride and fluoride of aluminium.

Fulmen Accumulator.—See description under Electric Carriage.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Testing Primary Batteries.—In an illustrated paper of considerable length by Mr. Strecker published in the "Elek. Zeit.," Jan. 3, he points out that it is not rational to test an open circuit battery by discharging it at a continuous current nor by short circuiting it; to test a cell by connecting it with a bell is rational only when it is to be used for such continued service; to test cells by discharging them through a small external resistance and measuring the current and the voltage, is subject to errors and is not rational; a general method of testing cannot be given, as it should be modified according to the use for which the cell is intended. He then describes at considerable length a method which he recommends; for closed circuit work all that is necessary is to discharge it continuously at the required rate; for open circuit work he describes and illustrates an apparatus which he has used for some time in which the circuit of the cell is closed through a given resistance periodically by a clock; for a telepone cell, for instance, it is closed every 15 minutes for 3 minutes though a resistance of 5 ohms; the hands of a clock were removed and discs with pins substituted; as often as is desired the E. M. F., the internal resistance, and the current are measured; for measuring the voltage the galvanometer should have a resistance of at least 20 ohms per volt; for measuring the internal resistance he describes and illustrates the modified Wheatstone bridge method, in which an alternating current from an induction coil is used as the source of energy, a telephone replaces the galvanometer, the battery forms one arm of the bridge and the two other arms are formed by a slide wire resistance. By this method of testing a good cell will last from a few months to a half a year; with the apparatus described he tested 40 cells at a time; curves are given showing the results of some of the measurements.

Testing and Inspection of Electric Light Cables.—The article in the Lond. "Elec. Rev." is concluded in the issue of Jan. 25; for the first part see Digest, Feb. 2. It is claimed that a maker's guarantee of 100 per cent. conductivity is worthless, as neither the weight nor the diameter of the copper wire in the finished cable can be determined; the specifications should call for a resistance equivalent to one of 100 per cent. He recommends a convenient instrument made by Elliot for measuring conductivity; he calls attention to the great importance of the electrostatic capacity when the cables are to be used for alternating current; care should be taken not to use only one or two cells in determining the capacity as the earth plate may have an E. M. F. of its own.

High Tension Cable Tests.—In a communication to the Lond. "Elec. Eng.," Jan. 25, the importance of the use of high voltage continuous current dynamos for testing continuous current cables is pointed out, and it is stated that dynamos up to 5,000 and even 10,000 volts have been constructed.

Measuring Resistances.—The formulas and a diagram showing the connections of the system devised by Dr. Pasqualini, described in the Digest, Jan. 12, is published in the "Rev. Gen. des Sciences," Jan. 15.

In a short Academy paper by Mr. Colson he calls attention to important errors in measuring resistances by the bridge method with an alternating current and a telephone, and points out the precautions which must be taken.

Resistance Wire.—A table of the electric qualities of some resistance wires made by a German firm is published in the Lond. "Elec. Eng.," Jan. 25; the patent wire called Ia. Ia. hard has a specific resistance of 50.2 microhms per cb. cm. and a temperature constant of + 0.00011 per degree C.; for a new quality called "superior" these figures are 86 and + 0.00072.

Conductivity of Organic Substances.—The Lond. "Elec. Rev.," Jan. 25, gives the results of recent investigations by Mr. Bartoli. (See also Digest, Dec. 1.)

TELEGRAPHY, TELEPHONY AND SIGNALS.

Review of the Past Year.—The "Jour. Teleg.," Jan. 25, contains an interesting review of telegraphy and telephony during the past year. After reviewing the history for the past 25 years as recorded in that journal, a number of interesting statistics for the past year are given. The total number of cables laid in 1894 amounts to 6,832 miles; a table giving the mileage of the telegraph and telephone cables of the world is given; among the totals are the following: 1,240,000 miles of telegraph lines amounting to 3,000,253 miles of wire; for telephony these figures are 151,000 miles of lines, amounting to 846,000 miles of wire. Another table gives the number of messages, showing an increase of 3.05 per cent. over the messages sent in the countries themselves and an increase of 10.91 per cent. in the number of international messages; the increase in incomes was 6.04 per cent. Another table, though not complete, gives data regarding the telephone messages during the last year, the average of which is 6.4 messages per subscriber per day, the figure for United States being 7.3, which is exceeded only by Austria, in which it is 12.4.

Telegraphic Statistics for 1893.—The "Elek. Zeit.," Jan. 17, reprints a large table from the "Jour. Teleg.," which is incomplete, and adds some further data.

Paying for Telephone Service.—The "Elek. Zeit.," Jan. 24, contains a long illustrated paper by Mr. v. Barth describing his system, devised to solve the problem of charging for the number and lengths of the conversations; in an editorial the system is discussed favorably with the addition of some criticisms; it is used in the city of Stockerau near Vienna, where it was started in December.

Origin and Development of the Telephone Switchboard.—An Institution paper by Mr. Kingsbury, of some length, is reprinted in full in the Lond. "Elec. Eng.," Jan. 25.

Muirhead vs. Commercial Cable Co.—The Lond. "Elec. Rev.," Jan. 25, contains a communication by Mr. Dearlove, upholding the recent views expressed in "Engineering." (See Digest, Jan. 19.)

Phonopore.—A well illustrated description by Mr. Spagnoletti is published in Lond. "Lightning," Jan. 24.

Synchronizing Apparatus.—The Blut system for synchronizing printing telegraph apparatus with clockwork motors is illustrated and described in the "Elek. Anz.," Jan. 13.

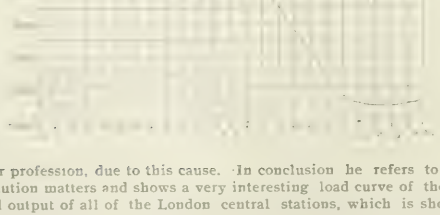
Clocks.—The system of Mr. Kesel for operating clocks by means of alternating currents is described and illustrated in the "Elec. Echo," Jan. 12.

Dynamos for Fire Alarm Telegraphy.—The "Eng. Mag." for February abstracts from "Fire and Water," Nov. 17, an article by Mr. Flanders; he uses a motor-generator driven from central station mains; the average current for each circuit is 0.04 ampere at 50 volts; it replaces 350 gravity cells and will suffice for double the plant; he considers it greatly superior in every respect to any form of battery; it has been definitely adopted in a station which he is equipping.

Microphone.—An article of a popular nature by Mr. Perry is published in "El'ty," Feb. 6.

MISCELLANEOUS.

Mr. Crompton's Presidential Address to the Inst. Elec. Eng.—The Lond. "Elec. Eng." reprints the whole address and the "Elec. Rev." and "Elec." give the first part; the latter journal also discusses it in the leading editorial. He deals with electrical engineering chiefly from the mechanical engineer's point of view, believing as he does that its great development dates from the time when the mechanical engineer first undertook the design and construction of dynamo-electric machinery; he forms a mental picture by considering electricity as "an infinitely flexible connecting rod by which we transmit energy and reproduce it at a distance in any desired form." He discusses the chief materials used, iron, copper and insulating materials; the improvements in the first two have been very marked and have probably reached a finality, but little advance has been made in insulating materials, which latter subject he discusses. The conditions under which electrical engineers work their engines and boilers differ so widely from those for driving factories that the experience of mechanical engineers is of little of no value, in fact is misleading in many respects; it was the exigencies of electrical engineering that led the late Mr. Willans to carry out his extensive series of experiments. In speaking of the load factor he calls attention to the differences between the summer and the winter diagrams; this will always exist if the energy is used only for lighting, the remedy being to encourage its use for motive power, heating and cooking and he believes the public ought to be educated to the advantages of using electricity for heating; electrical cooking is certain to obtain popularity in hot climates or in summer. Regarding the use for motive power he calls attention to the large motor load in American stations while that in England is insignificant; he discusses the use of motors and shows that in many small workshops it would be an advantage to use such motors. He believes that electrical energy could be applied in considerable quantities in residential districts for the production of artificial cold by means of motors driving air compressors and then expanding the cooled compressed air; he believes that the advantages of such cold storage are so obvious that it is unnecessary to further insist upon them. He discusses briefly the advantages of electrical transmission to machine tools, quoting Prof. Kennedy's recent figures in favor of belt transmission, but pointing out that the great advantage of the electrical system is when the machine tools are standing idle during a comparatively large time and he adds that these cases are far more numerous than Prof. Kennedy's figures lead one to suppose; he corrects these figures accordingly and obtains others very much more favorable for electrical transmission; of all methods of transmission that exist none involve so little waste of power during the periods of idleness as electrical transmission. He discusses the subject of variable gearing, calling it "speed torque ratio gear" and he thinks the first real step which promises to revolutionize our ideas on this matter has been the solution of the problem in the electrical part of the plant; as an illustration of one solution he describes the well known system of H. Ward Leonard, which he discusses very favorably; he believes that there are many similar methods by which this can be worked out electrically with great simplicity; he describes how it may be applied to long distance transmission with high tension alternating currents transformed down to say 500 volts and then used to work an alternating current synchronizing motor driving the generator which in turn drives the main motor. Regarding the electrical instruments he protests against the very impossible degree of accuracy which is often claimed and points out the advantages of an easy method of checking instruments, which he does by a balance method, namely, by means of the potentiometer and the standard cell; in this instrument there are no moving parts and the only calibrated portion, the slide wire, can be subjected to extremely rough treatment without altering the accuracy of it (but will the standard cell stand rough treament?); he speaks very highly of the recent progress in the platinum thermometer, which he says becomes a very valuable instrument in connection with the potentiometer; he believes that this method of measuring temperature is not generally known and appreciated. He approves of the zero methods and states that there are two, one in which there is a simultaneous balancing of two forces and in the other a balance of each of two in turn against a third, the latter being the one which he prefers, as it avoids great possibilities of error; for accurate measurements of large currents, he uses sheets of manganin. Regarding electrical storage he says that the progress in its development has been quite as marked and quite as satisfactory as that of the dynamo or the alternator; he alludes to the improvement in detail and in manufacture rather than in alleged new inventions; he believes that there exists a great and unwarranted prejudice against the storage battery; it demands as high qualities for its patient investigation as does any other branch of electrical engineering; those who cannot see the importance of improving electrical storage show that they have a very incomplete grasp of the requirements; the difference between the charging and the discharging E. M. Fs. is satisfactorily made up by the various booster systems; many of the troubles were due to a want of knowledge of the necessity of the extreme purity in the materials used, impurities being the cause of self-discharge of the negative plates and account for most of the early breakdowns which seemed so mysterious; copper and arsenic have a very prejudicial effect. He spoke at some length against placing too much confidence in very young engineers whose engineering life and experience has been very short; he believes that soon a reaction will set in which will greatly damage the interests of our profession, due to this cause. In conclusion he refers to some Institution matters and shows a very interesting load curve of the combined output of all of the London central stations, which is shown in the adjoined figure; it was taken simultaneously for this purpose on the 20th December, ending at 6 a. m., and he believes that it is one of the largest that has ever been drawn; the maximum load was at 5.30 p. m. and was equal to 11,600 kw, the minimum load was at 4 a. m. equal to 800 kw, the load factor is 33 per cent.



Mr. Crompton's address is discussed editorially in the Lond. "Elec. Rev.," Jan. 25, which expresses agreement regarding the dangers arising from the growing number of young and inexperienced engineers; belief is expressed that the only means of overcoming the load factor difficulty is by the use of adequate storage; heating, cooking, motors, etc., will not improve it as they overlap with the lighting load in winter.

Calcic Carbide.—A recent lecture by Prof. Lewes, on illuminating hydocarbons, is reprinted in full in Lond. "Ind. and Iron," Jan. 25, and abstracted briefly in the Lond. "Elec. Eng.," Jan. 25; it is devoted almost entirely to the gas acetylene $C_2 H_2$ and more particularly to its production from calcic carbide $Ca H_2$ produced in the electrical furnace (see Digest, Jan. 12 and 26); it contains much interesting information. He states that it is hardly possible to foresee the results which will be ultimately produced by a cheap and easy method of preparing this most useful gas; he gives its properties and shows how it may readily be converted into benzol, aniline and other useful products; he considers that the field opened up by the commercial production of calcic carbide is wonderfully and intensely interesting. Calcic carbide contains 40 parts by weight of calcium and 24 of carbon and on the addition of water the oxygen combines with the carbon to form slaked lime while the hydrogen unites with the carbon to form acetylene; calcic carbide is a dark gray substance having a specific gravity of 2.262 and when pure a pound will yield 5.3 cb. ft. of acetylene; its surface is slightly acted upon by atmospheric moisture unless it is protected, and in practice it therefore does not yield more than 5 cb. ft., but in lumps it does not degenerate very fast; for commercial purposes it is cast into rods 12 inches long and 1.25 in diameter weighing 1 pound and giving 5 cb. ft. of gas 98 per cent. pure; the gas has such a penetrating odor, resembling that of garlic, that it would be practically impossible to go into a room which contained any dangerous quantity of the gas; when liquefied and then sprayed into the air it freezes into a snow-like solid which burns; he has a grave mistrust of the methods used in this country in which the gas is mixed with an equal volume of air before being burned, as the danger of making an explosive mixture must be very great and furthermore the diluting action of the nitrogen reduces the illuminating value from 240 to 130 candles; it may easily be stored by liquefying and it is then of great value for portable lamps, floating buoys, illuminating country houses, etc.; the gas when burned in a suitable jet at the rate of half a cubic foot per hour will give a light of over 20 candles for about 10 hours from one stick weighing 1 pound; it is well adapted for railway lighting; London gas has an illuminating power of 16 candles (presumably per 5 cb. ft. per hour) whilst acetylene gives 240 candles, or for the same light-giving value it will be equivalent to London gas at less than 12c. per 1,000 cb. ft; 100 cb. ft. of London gas yields 50 cb. ft. of carbon dioxide and 140 of water vapor, whilst the same quantity of acetylene gas yields 200 ft. of the former and 100 ft. of the latter, but for equal illumination the amount of the carbon dioxide and water produced is enormously smaller; he gives a table for 48 candles showing that the amount of acetylene consumed is 1. (presumably 1 cb. ft. per hour), the amount of carbon dioxide produced is 2. corresponding to the amount exhaled by 3.6 adults; by way of comparison number 5 flat flames with ordinary gas consume 22.9 cb. ft. generate 12.1 of carbon dioxide, corresponding to 20.1 adults; a paraffin lamp corresponds to 22.5 adults, while 48 sperm candles would correspond to 32.7 adults. The flame is a distinctly cool flame, the temperature being about 1,000 degrees C, while that of the ordinary gas flame is 1,360 degrees C, or for the same illumination the heat effect would not be much greater than that of the ordinary electric incandescent lamp. It is stated by another writer to have great diffusive power combined with high illuminating power. (If this gas should turn out to be a serious rival to the electric light, might it not be profitable to utilize the machinery at central stations during the day time for the production of calcic carbide, thus obtaining a very profitable and adjustable day load?)

The Lond "Elec," Jan. 25, reprints the paper abstracted in the Digest, Jan. 26, and comments on it unfavorably. It states that the attempt to calculate the cost of the process is not a satisfactory one, as no charge is made for capital depreciation, etc.; it merely proves that 2,000 pounds of acetylene cannot be generated by this process for $37; Prof. Lewes stated that a 5-ft. burner consuming pure acetylene can develop 240 cp; it is claimed that this is balanced by the highly explosive and poisonous nature of this gas, also by the fact that it would never do to distribute it commercially in the pure state; it considers the development as being little past the laboratory stage.

Price of Ozone.—In a paper by Dr. Froelich in the Lond. "Elec. Rev.," Jan. 18, he gives the quantities of ozone required for various purposes. Twenty grams are produced by 1 hp-hour costing in Berlin about 4c.; this will bleach 110 pounds of linen as well as grass bleaching during 3 days; it will bleach and refine 88 pounds of potato starch, in the presence of some chlorine, to such a degree that the color becomes a beautiful white and all the bad odor and taste are removed; if this is roasted and ozonization continued, a product resembling gum arabic is obtained; 20 grains of ozone being sufficient for 66 pounds of this product; the same quantity will ozonize a room containing 8,000 cm in such a way that healthy persons can just endure it; the quantity has the same oxidizing effects as 1.1 pound of the ordinary solution of peroxide of hydrogen and it can be made at half the cost. The ozone is measured by the absorption in a solution of iodide of potassium and measuring the precipitated iodine.

Graphite in Iron.—In an Academy note by Mr. Moisan published in "L'Elec," Jan. 26, he gives certain conclusions regarding the formation of graphite in iron at various temperatures and pressures.

Educational.—The Lond. "Elec.," Jan. 18, contains a communication of some length by Prof. Perry on the subject of "labor saving apparatus" (see Digest, Feb. 2). The article does not admit of being abstracted; it is in defence of Prof. Ayrton's method, which he says has become very general all over the world; he calls attention to the fact that the students have a very extensive course of laboratory instruction in which corrections of all sorts of errors and the calibration of instruments occur over and over again; "his critics seem to think that in measuring the mechanical equivalent of heat his students should not go straight at the actual problem but should take up every problem that any investigator found in his way. Is it a lack or a superabundance of humor?" "Too many teachers believe that as the great chemists of a hundred years ago had only tumblers and water-buckets for apparatus, it is making the road to the chemists' heaven too irreligiously easy for him to give the beautiful apparatus now at his command;" he is convinced that there is no teaching power whatever in mere lectures on physics and mechanics and that individual laboratory instruction must be given, without it, students may pass examinations, but the teacher is causing a deterioration of their mental powers all the time. He gives his idea of the work in a mechanical laboratory and states that the apparatus should be as small as possible, for if it is complicated and requires all sorts of corrections it only causes confusion in the mind of the beginner; this system was begun by Prof. Ayrton and himself in 1881 and is now in active use in most institutions all over the world; his experience has confirmed his opinion that this is the only proper way, "on any other system the mental fatigue of the demonstrators must be appalling, if the whole thing is not a farce;" those doing original work, design and make the apparatus themselves; the ingenious instructor will find enough elasticity in the system for what is practically perfect freedom.

The subject of "Labor-Saving Apparatus" is discussed by Mr. Boys in a communication to the Lond. "Elec.," Jan. 25. (See also Digest, Jan. 26, Feb. 2.) He objects to the title of the original paper (see Digest, Jan. 12) as the student does not determine the mechanical equivalent of heat, nor does he determine anything except that "the various figures that are given to him, when multiplied and divided in the manner he is told to employ will work out and produce an answer which is right;" the student does not find any of the important data and depends only on what he is told; a true determination is one which ultimately brings the experimenter to length, mass and time alone; he believes it would have been better to have used mechanical means. He states that he has nothing to do with teaching technical students; he believes in the use of primitive and extemporized apparatus as it will teach the student more and will prevent him "developing into the helpless creature that a pure system of science-made-easy is apt to produce." "This sort of training will produce not the self-reliant engineer but an eminently useful drudge. It is not by such methods that Hopkinsons and Kennedys are made to exist." He protests against the title of the paper in order to prevent less enlightened teachers from taking this paper as a model of educational propriety.

Birds Killed by Lightning.—The question of whether birds on the wing are ever killed by lightning is discussed briefly by Mr. Varley in the Lond. "Elec. Rev.," Jan. 18. He believes that it may occasionally happen but simply by their being accidently in the line of the path of discharge or in very close proximity to it; he believes that it is possible that a bird might be killed by the concussion of the expanded air close to the line of discharge.

Measuring Wires.—A convenient form of apparatus for measuring the length of wire as it is wound on magnets is illustrated and described in the "Elek. Anz.," Jan. 13.

Biographical.—The Lond. "Elec.," Jan. 25, contains a biographical sketch of Mr. Crompton, accompanied by a full-paged steel engraving.

Electrical Discovery.—A new fortnightly publication with this name has been started by a firm of patent agents in London.

Magnetic Governor.—The Melott Engine Governor is described and illustrated in the "Elec. Eng.," Feb. 6. The action of the balls in a flywheel governor is supplemented by magnetic attraction produced by a coil on a core, the main current passing through the coils; when an extra load is thrown on the dynamo it will cause the governor to regulate before the centrifugal force has a chance to act.

Aluminium.—According to the "Eng. and Min. Jour.," Feb. 2, the French Government has given a single order for 92,400 pounds of aluminium to be used for the construction of steam launches for the navy; the only company in Europe which can fill this order without great delay is the one at Neuhausen; this is probably the largest single order ever given.

Shock from Static Dischdrge.—In the "Elec. Eng.," Feb. 6, Mr. Henry relates a case in which a man was severely shocked from a circuit of 50 volts and he believes it was due to a static discharge from the core of the transformer; he recommends the European practice of grounding the transformer cores.

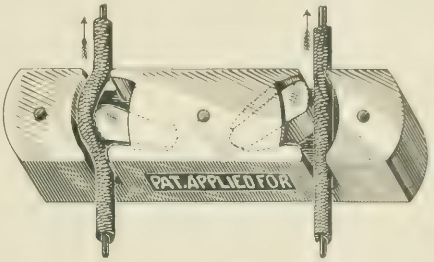
Treatment after Electrical Shock.—The "Elec. Rev.," Feb. 6, reprints the rules prepared for the Ministry of Public Works in Paris, mentioned in the Digest, Feb. 2.

Rheumatism.—In a short communication to the "Elec. Rev.," Feb. 6, Dr. Hornsby discusses the application of electricity and concludes that as high frequency alternating currents act as stimulants of nutrition, and as rheumatism is primarily due to bad nutrition, therefore electricity intelligently applied would seem to be indicated.

Review of the Past Year.—The "Journal of the Franklin Institute for February contains an abstract from the Secretary's report on the annual review of science and industry, a considerable portion of which is devoted to electrical subjects.

A New Self-Locking Cleat.

We illustrate herewith a new self-locking cleat, shortly to be put on the market by Creager & Connard Company, Marseilles, Ill., which is claimed to be both positive and reliable in its operation. The arrows in the cut show the direction in which the line is being run. It is claimed that it is only necessary to draw the wire as taut as possible or desirable and release it, when the serrated face of the dog will cramp the wire into the curved wall and hold it taut. It is further claimed that the use of this cleat will enable one man to do the work usually done by two, as it does not require one to pull the wire while another fastens it, the mode of precedure being that the wireman first puts up all his cleats, reversing the first so as to hold the starting end, and then simply pulls the wire taut from cleat to cleat, or at alternate cleats, where it is held by the dogs. The cleats are, of course, made of porcelain to conform to underwriters' requirements.



SELF-LOCKING CLEAT.

A Municipal Lighting Plant in Trouble.

The town of North Attleboro, Mass., some time ago appropriated $50,000 to buy the local electric lighting plant and extend it. The Municipal Light Act, passed by the Massachusetts Legislature in 1891, provides that when a town and a private company cannot agree on the price to be paid for the plant of the latter, each party shall file, within sixty days after the final vote of the town, a petition with the Supreme Court for the appointment of commissioners to settle the question. In this case neither side did so. The town's committee went ahead and put in the plant and paid for it, and it has been in operation nearly a year. The old company has now brought action against the town in the amount of $20,000 and applied for a writ of injunction to prevent the town from further running their plant. It is reported that some of the ablest legal talent in the State contend that the town has no legal right to be in the electric lighting business.

Water Power Development and Electric Transmission for Atlanta, Ga.

For several months past negotiations have been in progress looking to the development of large water powers on the Chattahoochee River near the city of Atlanta, Ga.

The matter has chiefly been carried forward by Mr. J. H. Vail, of New York City, and has resulted in the organization of the Atlanta Electric Power Company, which will control an aggregate of about 30,000 hp divided between two powers, one-half of the amount within nine miles of the city of Atlanta, and the remaining amount of 15,000 hp within thirteen miles from the same city. Both powers are derived from the rapids of the Chattahoochee River. The first dam and power house will be located near Vinings Station on the Western and Atlantic Railway. The surveys have been completed and the plans and specifications for the construction of the dam and power house and system of transmission are finished.

The principal parties interested are: James Swan, President of the Atlanta National Bank, Atlanta, Ga.; A. E. Thornton, Vice-President Atlanta National Bank, Atlanta, Ga.; H. R. Garden, lawyer, of New York City; J. H. Vail, President of Electrical and Mechanical Engineering Company, of New York City, together with other prominent business men in the city of Atlanta. The entire construction has been placed in the hands of the Electrical and Mechanical Engineering Company, 39 Cortlandt street, New York City. It is stated that ground will be broken at an early date and the work pushed forward rapidly.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Feb. 9, 1895.

GENERAL ELECTRIC alone of the electric stocks has betrayed any distinct signs of being alive this week. What with the approach of the annual meeting and the closing of the company's books on Jan. 31 last, speculation is rife as to what the year's operations have resulted in, and considerable interest is evidenced regarding the stock's future. Of late a distinct bearish tendency has developed in the stock, and certain official statements have been twisted into admissions of weakness that have had a deal to do with the recent sagginess of quotations. These perverted reports have been brought to the ears of the company's managers, and they have hastened to counteract the baneful influence created by these misconstructions of former statements by definitely declaring the General Electric Company's position. There is nothing to warrant the statement so much circulated during the last two weeks that it has no net earnings beyond its interest charges, and that bonds retired were purchased from proceeds of liquidated accounts. Nothing has been officially said to justify any such inference. The forthcoming report will show that the company has increased its plant and machinery, and that for the year ending Jan. 31, 1895, it earned not only interest on its bonds, but the full dividend on the preferred stock issue, and something on the common stock. It has been freely charged that all this apparent increase of profits will be wiped out by the depreciation in the value of the General Electric Company's franchise and patents which in the last annual report was figured at $8 159,264. In this connection it might be well to quote what a well posted electrical authority has to say in the *Wall Street Journal*. He remarks: "While it is true that a number of important patent issues have been decided against General Electric, notably the 'Feeder and Main,' nevertheless the company still controls a sufficient number to enable it to manufacture every line of goods. These various patents will expire from year to year (the incandescent lamp will be among the first), but this will not necessarily interfere with the business of the company. General Electric no longer controls business through a monopoly; but it can manufacture the best at the lowest price. This is the secret of the company's strength to-day. If it cannot in the future control certain patents now owned by it, it is certain that no other concern can. This means open competition, for which the General Electric Company is as fully equipped as any of its competitors." To-day the company is on a bed-rock basis. The stock has discounted long ago all the disastrous features revealed in the report of 1894, and, if it was worth 30 a year ago, it is certainly worth more now. If it had not been worth 30 a year ago, it would surely have gone lower, in view of the demoralized aspect of affairs at that time. Prospects now are bright; the electric industry is a rapidly growing one, and General Electric, with its prestige, must secure its proper share of the increasing business.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	128	130
Edison Electric Ill., New York	100	100	100½
" " " Brooklyn	100	108	110½
" " " Boston	100	123	126
" " " Philadelphia	100	120	125
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	35	40
General Electric	100	28¼	28⅛
General Electric, pref	100	61	67
Westinghouse Consolidated, com	50	32	32¼
" " pref	50	49	50

BONDS.

Edison Electric Ill., New York	1,000	108	109
Edison Electric Light of Europe	190	75	85
General Electric Co. deb. 5's	1,000	90	90½

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	191	192
American District Telegraph	100	45	49
American Telegraph & Cable	100	92	93
Central & South American Telegraph	100	117	120
Commercial Cables	100	135	140
Erie Telephone	100	48	50
Gold & Stock Telegraph	100	104	110
Mexican Telegraph	100	180	190
Mexican Telephone	100	75	80
New England Telephone	100	67	69
New York & New Jersey Telephone	100	97½	99
Postal Telegraph-Cable	100	54	58
Western Union Telegraph	100	87⅛	88

WESTINGHOUSE ELECTRIC issues have fluctuated very little this week. What change was noted has been more in accord with the general speculative feeling than by reason of anything in the affairs of the company. There are good grounds, however, for basing hopes of increased profits and accordingly higher stock market quotations. The company, it is stated, is getting the bulk of the street railway business. By reason of certain economies introduced in manufacture, the Westinghouse Company is now in a position to undersell its competitors. It is offering, so it is reported, street car equipments $100 cheaper than its leading rivals. Working in connection with the Westinghouse Air Brake Company, it is forcing prices down by now selling for $150 what it costs other makers $225 to manufacture. Then again it may be that its appeal from the lower court's decision in the suits for alleged infringement of the Sawyer-Man electric light patents will be decided in the Westinghouse Company's favor. In such an event, other concerns will have to pay large royalties to the Westinghouse Company. At any rate, stockholders have cause to be elated by the company's prospects, and there is likely to be an early and substantial market appreciation of these facts. Pittsburgh still reports a lively demand for the scrip at 97, with none coming on the market.

EDISON ELECTRIC ILLUMINATING, of New York, holds very strong. The company enjoyed an enormous increase in business in 1894, and there is every reason to believe that the electric lighting business will make equally rapid strides forward during 1895. As is aptly pointed out, the industry has been hampered in the past, owing to the high price demanded for apparatus, but manufacturers and operators are now contenting themselves with moderate profits, and their business is sure to be largely benefited thereby.

EDISON ELECTRIC ILLUMINATING, of Boston, justifies equally nice things being said of it. The stockholders have just testified to their appreciation of last year's record by re-electing the company's directors and officers. The annual report for 1894, just published, shows that gross earnings were $628,406, a gain of $34 318 over the figures for 1893, and the net income, by reason of reduced expenses, was $307,164, a gain of $54,913 over the profits of the preceding year. There were 100,047 incandescent lamps connected, a gain of 13,585 over 1893, and 853 arc lamps, a gain of 148. A sum sufficient to meet the cost of new lamps, services and meters, as well as possible depreciation of storage batteries, underground and other construction, has been taken from the 1894 net earnings, and during 1895 these deductions will be made monthly.

ERIE TELEPHONE is very quiet. The company makes this report for the quarter ending Dec. 31: Gross, $270,337; increase, $13,011; dividends received, $61,587; increase, $3,587; dividends paid, $48,000; surplus to Erie Company, $13,587.

AMERICAN BELL TELEPHONE remains practically unchanged. Not much interest is taken, apparently, in the stock's doings. It comes from good authority that there are to be three syndicates to bid for the 3,300 shares of Bell Telephone Comany stock soon to be sold at auction; this is in addition to a syndicate made up of large Bell Telephone stockholders who will see for self-protection that the price realized comes up at least to market quotations.

ELECTRIC TRACTION stocks have again remained stationary. There is very little at present doing in them. In view of the enormous interest these issues represent, it is strange that so little attention is devoted to their doings. As illustrating the scope of these interests it is to the point to quote some offical figures recently made public. The Massachusetts State Railroad Commission reports that for the year ended Sept. 30, 1894, street railways increased to 928,843 miles; of this 824,971 miles were operated by electricity. Electrically equipped roads increased in one year 113,889 miles. The New York State Railroad Commission reports that since 1883 the increase in the capital stock of electric and horse roads has been $34,930,000, and most of this was for electric roads.

ELECTRIC TRACTION STOCKS.

	Bid.	Asked
Union Ry. Co. (Huckleberry)	115	125
Brooklyn Traction, com	9⅛	11½
" " pref	54	58
Long Island Traction	9	9½
Rochester St. Ry	36	38
Columbus St. Ry	48	50
Louisville St. Ry. com	37	39
" " " pref	87	88
Cleveland Electric Ry	59	60
Cleveland City Ry	68	70
North Shore Traction	23	25
New Orleans Traction	15	16
New Orleans Traction pref	56½	59½
Worcester Traction com	12⅛	14
" " pref	78½	80
Metropolitan Traction, Philadelphia	96½	97
Philadelphia Traction	86¾	87
People's Traction	45¾	46
Binghamton R. R. common	100	—

BONDS.

	Bid.	Asked
*Union Ry. 1st. mtge 6s	105	108
*Westchester Electric 1st. mtge. 5s	98	101
Rochester St. Ry. 1st. 5s	95	97
*Columbus St. Ry. 1st 5s	95	97
Columbus Crosstown 1st. 5s	95	97
*Binghamton Railroad Co. 5s	99	100

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*With accrued interest.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD
253 Broadway, NEW YORK, Feb. 11 1895

THE BROOKLYN STRIKE is about spent. The cars are running with little or no interference from the strikers although the service is somewhat hampered by the inexperience of the new men.

MR. EDGAR MIX, of the Thomson Houston Electric Company, this city, was one of the passengers on the French steamer La Gascogne, which arrived to-day, more than a week overdue. His friends were becoming anxious.

AN AMATEUR PERFORMANCE of "East Lynne," undertaken by the New York Telegraph Operators' Association, Saturday night, Feb. 9, was brought to an untimely close by the excessive cold. A few of the party remained in the hall and danced out the night in ulsters and cloaks.

PITTSBURGH NOTES.

PITTSBURGH, Feb. 9, 1895.

THE PHŒNIX GLASS COMPANY'S factory near Rochester, Pa., was burned to the ground on the afternoon of Feb. 3. The loss amounts to $175,000 and 500 men were thrown out of work. The fire originated from a furnace. Immediate arrangements were made by the company to have its works operated somewhere else, and to-day it is stated that it has secured the lease of the Dithridge glass factory at New Brighton, and the plant will be in operation within a few days.

THE ALLEGHENY COUNTY LIGHT COMPANY has at last been able to locate a thief, who for a year or more caused the company a great deal of trouble. Complaints have been coming in to the company from a number of their patrons that a man, ostensibly representing himself as their employe, asked to examine their arc lamps. The request being granted, the man would decide that the lamps were out of order, and then he would take them away for repair. However, "he never came back," and in that way about a hundred lamps have been stolen. A few days ago the man even grew bold enough to go into a store opposite the light company's office and removed a lamp. Fortunately, he was known, traced, and eventually locked up. It was discovered the thief at one time occupied the position of inspector for the light company.

General News.

NEW INCORPORATIONS.

THE PHŒNIX TELEPHONE AND ELECTRIC COMPANY, Denver, Col., has been incorporated by P. H. Baker and others, with a capital stock of $750,000.

THE MARSEILLES (ILL.) TELEPHONE COMPANY has been incorporated by H.R. Adams, F.T. Neff, L. M. Jennings and R. F. Knott. Capital stock $ 2,000.

ELECTRIC LIGHT PHOTOGRAPHIC COMPANY, Chicago, has been incorporated by Oscar L. Sturtz, Robert E. Brown and Chris Florup. Capital stock $5,000.

THE HARRISON ELECTRIC COMPANY, Chicago, Ill., capital stock $500,000 has been incorporated by Edward M. Harrison, Lewis H. Painter and Lewis Rinaker.

THE LAS VEGAS WATER AND ELECTRIC AND POWER COMPANY, Santa Fe, N. M., has been incorporated by F. A. Manzanares M. W. Browne, J. S. Duncan and John I. Pace.

VALDOSTA, GA.—The Valdosta Telephone and Telegraph Company has been organized by J. D. Whilaw, general manager, and others, to establish a line. All arrangements completed.

ATCHISON, KAN.—The Western Telephone Company, Atchison, Kan., incorporated by F. M. Baker, J. W. Sharrard, M. J. Traverse, R. A. Miller and E. D. Mills. Capital stock $10,000.

CLARKSVILLE, TENN.—The Clarksville Telephone Company has been organized by B. H. Owens, president; M. Savage, secretary; F. P. Gracey, D. N. Kennedy, B. H. Owens and others.

AMERICAN DISTRICT TELEGRAPH COMPANY has been incorporated by W. H. Wakefield, C. W. Coker, A. A. Clark, W. D. Hardin, Fred Davis, W. C. James and Emmet Tinley, of Omaha, Neb.

THE SAN ANTONIO ELECTRIC COMPANY has been incorporated at San Antonio, Tex., by R. T. McDonald, of New York and Fort Wayne; Edward J. O'Beirne and William H. McGaw. Capital stock $100,000.

THE LLANERCH HEAT AND LIGHT COMPANY, Llanerch, Pa., capital stock $25,000, has been incorporated to supply light, heat and power. The promoters are Ed. Worth, Mercer Strong and Frank A. Hays, Lansdowne, Pa.

THE UNITED SWITCH COMPANY, Newark, N. J., capital stock $100,000, has been formed to manufacture, purchase, sell and lease electrical machinery, etc. Henry C. Hines, Wm. C. Morton and Robert D. Beatty, Newark, are interested.

THE ANDERSON (S. C.) TELEPHONE COMPANY has been incorporated, with R. E. Ligon, president; L. P. Brock, secretary, and J. L. Maulding, superintendent. Plant will be constructed at once. Want telephones, wire, poles, insulator pins, brackets, switchboards, etc.

THE NEWTON LIGHT AND POWER COMPANY, [illegible] stock $50,000 has been [illegible] ton. The promoters are [illegible] delphia, and John C. Nicholson, Newton, Kan.

SIGOURNEY ELECTRIC LIGHT AND POWER COMPANY [illegible] rated by H. C. Brown, W. S. Harlan, H. O. Schipper, C. M. Harlan and E. Latter, of Sigourney, Ia., with a capital [illegible] furnish electricity for light and power in Sigourney.

THE FLORENCE BELT LINE RAILWAY COMPANY, Florence, Col., has been incorporated with a capital [illegible] street railway in the town of Florence. Col. E. M. Weil, S. Siess, Leon Siess, C. L. Huff, all of Florence, Col., and James B. Crandell, of Denver, Col., are interested.

THE UNIVERSAL ENGINEERING COMPANY, of Baltimore, Md., has been incorporated to do a manufacturing, mechanical and industrial business, to make and sell electrical instruments, machinery and supplies; construct, own and operate telegraph and telephone lines. Capital stock $10,000. Promoters, Geo. W. F. Vernon, Theo. F. Wilcox, Wm. J. Klug, Julius Stern and Leopold Stern.

TELEGRAPH AND TELEPHONE.

JOHNSTOWN, PA.—The Johnstown Telephone Company has been organized.

WESTMINSTER, MD.—R. B. Hazlett is endeavoring to establish a telephone system.

ST. JOSEPH, MO.—A new telephone exchange is expected to be in operation by May 1.

MATTOON, ILL.—The Mattoon Telephone Company's plant is being rapidly pushed to completion.

MINNEAPOLIS, MINN.—The United Electric Company has applied for a telephone franchise.

IRONTON, MICH.—E. A. Croll has petitioned the City Council for a franchise for a telephone company.

TALLAHASSEE, FLA.—The Bell Telephone Company, of Atlanta, Ga., will construct a telephone exchange.

SEATTLE WASH.—The Sunset Telephone and Telegraph Company has been granted a franchise for 25 years.

SILVER CITY, N. M.—A telephone line wire is being strung between this city and the Mongollon country. It will be 80 miles long.

LOUISIANA, MO.—The work of putting in a new telephone system has been commenced. Already 100 subscribers have been obtained.

TAYLOR, TEX.—The Southwestern Telegraph and Telephone Company has been granted a franchise for a telephone system, and work is to begin on the plant within a few weeks

CLARKSVILLE, KY.—Capt. E. P. Gracey, Hon. D. N. Kennedy, M. Savage, H. Owen, R. H. Burney and James Bowling, leading business men, have formed the Clarksville Telephone Company.

ROCK RAPIDS, IA.—A scheme is on foot here to organize a company for the purpose of putting in a telephone exchange to connect the towns in this county with Sioux City. The same company will also ask for a franchise from the city to put in an electric light plant.

SAULT STE. MARIE, MICH.—A party of capitalists have asked for franchise to operate a telephone line. The Edison Sault Electric Company is in the deal, and has proposed to string the wires on their electric light wire poles. The proposed company agrees to sell an instrument to subscribers for $35, and then furnish service at the rate of $15 a year for residences and $18 a year for business places.

ELECTRIC LIGHT AND POWER.

TAUNTON, MASS.—Municipal lighting is being urged.

RICHMOND, WIS.—An electric light plant is to be established.

NORTHFIELD, VT., intends putting in an electric light plant.

KINGSTON, N. Y.—The electric light project seems to have fallen through.

STAUNTON, ILL.—An electric lighting system will probably be established.

PEORIA, ILL.—The electric light company will soon increase its plant materially.

NEOSHOE, MO.—A $10,000 electric light company has been organized by John McElhany.

SMITHVILLE, GA.—Address Wells Bros. concerning the erection of an electric light plant.

LYONS, N. Y.—A dynamo may be added to the electric light company's plant here for lighting private residences; its present machines are loaded to their utmost capacity.

MARSHALL, ILL.—Address the mayor regarding the establishment of an electric light plant.

FULTON, KY.—Fulton town authorities are considering a petition for an electric light franchise.

NEWCOMERSTOWN, O.—The city has voted to issue bonds for the erection of an electric light plant.

MALCOLM, ILL.—The Grinnell electric light plant is advertised to be sold by the sheriff Feb. 18.

CAPE CHARLES, VA.—Address the city clerk concerning the establishment of an electric light plant.

DANSVILLE, N. Y.—The electric light plant here has been sold for $8,000 under mortgage foreclosure.

TECUMSEH, MICH.—The city will vote on the issue of $10,000 bonds to establish an electric light plant.

CLINTONVILLE, WIS., has granted D. S. Stewart a 20 year franchise for an electric light and power plant.

DOTHEN, ALA.—The mayor will give information regarding the establishment of an electric light plant.

MARTINSBURG, W. VA.—The city will issue bonds to the amount of $15,000 to purchase an electric light plant.

GREENSBORO, N. C.—Address the mayor concerning $25,000 to be issued to build or buy an electric light plant.

BALLARD, WASH.—City bonds have been sold to the amount of $42,000 for a water system and electric light plant.

WASHINGTON, ILL.—The machinery of the Washington electric light plant was recently destroyed by an explosion.

PINE GROVE, PA.—It is probable that a company of Philadelphia capitalists will erect an electric plant at Pine Grove.

MEXICO, N. Y.—The taxpayers have voted to light the streets of the city by electricity. They favor owning the plant.

UNION SPRINGS., ALA.—Address the Mayor concerning $30,000 of bonds to be issued for electric light plant and water works.

SABETHA, KAN.—Address City Clerk for information concerning $15,000 electric light plant and water works to be established.

WASHINGTON, D. C.—Address Bishop Keane concerning $50,000 electric light plant to be established at the Catholic University.

ST. JOSEPH, MO.—W. C. Stewart and associates have asked for a franchise for an electric light plant and it will probably be granted.

NIAGARA FALLS, N. Y.—It is reported that the Niagara Falls (Ont.) electric light company intends to spend $20,000 in increasing its plant.

BLAINE, ME.—Col. F. C. Robinson is thinking about an electric plant at his place to light up his village and mills, this place, and Mars Hill.

BOSTON, MASS.—The Edison Electric Light Company will erect a four-story building on Bumstead Court, to be used for a storage battery plant.

BALTIMORE, MD.—The Mount Washington Electric Light and Power Company has purchased a site on the Falls turnpike for a power house.

WINONA, MINN.—Mr. John F. Gay has been appointed manager of the Winona General Electric Company, vice Mr. Andrew H. Hill, resigned.

WASHINGTON, D. C.—The House Committee on Ventilation and Acoustics has recommended that an appropriation be made for an electrical plant.

NORWALK, O.—The local electric light plant, which has been in assignee's hands for the past two years, has been ordered sold at auction about March 1.

MT. STERLING, KY.—J. P. Martin, Xenia, O., may be addressed or information concerning the establishment of an electric light and railway system.

CANON CITY, ILL., has given the local electric light company a ten years contract from Feb. 1, for 19 or more full arc lamps at $11 per lamp per month.

ST. JOSEPH, MO.—The Wyeth Harness and Collar Factory was burned Jan. 11. The factory was equipped with dynamos and motors, which were totally destroyed.

DES MOINES, IA.—The Board of Public Works has awarded the contract for lighting the streets for the ensuing year at $8 per light per month. Arc lights will be used.

PINE GROVE, PA.—Steps are being taken to establish an electric light plant on the Octoraro, near Oxford. It is reported that 1,000 to 1,400 hp can be generated by the falls.

BALTIMORE, MD.—James L. Kernan will begin the erection on April 1 of a new theatre on the site of the Howard Auditorium. The house will be lighted by electricity.

RAWLINS, WYO.—The Rawlins Electric Light Company and the Dillon coal mines have consolidated, with M. W. Dillon manager. A telephone system is also contemplated by the company.

PALATKA, FLA.—The city has contracted with the Palatka Gas Light and Fuel Company for one hundred 32-cp incandescent lights and fifteen 2,000-cp arcs for five years. The lights must be in operation by April 9.

ELKHART, IND.—It is proposed to utilize the water power of the St. Joseph River by erecting a plant a few miles north of South Bend, to furnish power in Elkhart and neighboring cities for operating street railways and electric lights.

STAUNTON, VA.—The Augusta Electric Company has completed its new plant comprising four Edison 20-kw incandescent dynamos and two 80-hp Ideal engines. The city has abandoned commercial arc lighting and is placing fifty additional lamps on the streets.

KINGSTON, N. Y.—At a recent meeting of the Rondout harbor masters and pilots a petition to the Common Council was drawn up, asking that all the arc lamps along the river front be shaded so as to eliminate the confusing effect upon the pilots of the glare of the lights.

LORAIN, O.—A company with $100,000 capital has been organized to construct an electric line between Lorain, North Amherst and Wellington. E. M. Pierce, John Stang, Q. Gillmore, C. G. Washburn and James B. Hoge, of Lorain, are interested. Application will be made at once for a charter.

YORK, PA.—The rate war between the local Edison and Westinghouse companies is over, and prices have been very materially raised. The Edison company has served notice on its patrons that a discount of 10 per cent. will be substituted for the former discount of 50 per cent., beginning Feb. 1.

MONTREAL, CAN.—The St. Jean Baptiste Electric Company will shortly require additional equipment in the way of engines and dynamos, and the capital stock is to be increased to $500 000. The officials are Arthur Caron, president; Hon. Louis Tourville, first vice-president; Jos. Girard, second vice-president; Jules Bourbonniere, secretary and treasurer, and Otto Wendel, electrician.

GREELEY, COL.—A movement is on foot for the organization of a company to furnish light for the city and to operate a system of electric railways running through the country about Greeley, touching at Lucerne, Seeley's Lake, La Salle and other points. The company proposes to dam the Poudre several miles up and conduct the water in pipes to the works to be located on the bottoms below the city.

THE WAVERLEY (N. Y.) ELECTRIC LIGHT AND POWER COMPANY, which furnishes current for the town of Waverley, N. Y.; Sayre, Pa., and Atheus, Pa., reports a very prosperous condition of affairs, and is a fair instance of the results obtainable by good management. This company a few years ago bought out the old Brush company, then insolvent, and installed new apparatus throughout, under the supervision of Mr. J. George Kaelber, of Rochester. The plant has now a capacity of 200 arc lights and 3,000 incandescents, and has paid dividends from the start. The active management of the company's affairs is in charge of its president, Mr. Kaelber, who is ably assisted by Mr. Fred. E. Lyford, vice-president and secretary, and Mr. Geo. C. Hoffman, superintendent, and much credit is due these gentlemen for the satisfactory results obtained.

THE ELECTRIC RAILWAY.

CICERO, ILL.—Cicero and Proviso Street Railway Company has increased its capital stock to $2,500,000.

OGONTZ, PA.—Ground has been broken for a new power house, work on which will be pushed vigorously.

MILTON, N. Y.—A franchise for an electric railway has been formally granted to the Ballston Electric Railroad Company.

TOLEDO, O.—The Toledo Consolidated Street Car Company will extend its line from Michigan avenue to the Robinson Casino.

PLAINFIELD, N. J.—The Plainfield Street Railway Company has petitioned the Common Council for permission to extend its lines.

NEWBURGH, N. Y.—An electric railway is contemplated from Newburgh to Patchin's Pond via the Middlehope and west neighborhood highway.

GENESEO, N. Y.—Citizens are considering the building of an electric railway from this place to Long Point, Conesus Lake, to be six miles long.

MANCHESTER, N. H.—Application has been made for charter for a crosstown and belt line electric road at Manchester, with a capital stock of $500,000.

NEW LONDON, CONN.—A company is being organized with a capital stock of $200,000, to build an electric railway between New London and Norwich.

STAUNTON, VA.—The City Street Railway Company is contemplating the substitution of electricity for horses, and a two-mile extension of its road.

PHILADELPHIA, PA.—The Tamaqua and Pottsville Trolley Company has borrowed $250,000 with which to build an electric line to connect the two towns.

PORTLAND, ME.—The Portland Railroad Company has applied to the Board of Aldermen to operate its lines within the city limits by the single trolley system.

DENVER, COL.—By the explosion of a battery of boilers at the West Side station of the Tramway Electric Railway the power house was reduced to ruins. Loss $50,000.

NORWALK, CONN.—South Norwalk City Council has appointed a committee to oppose a petition of the Norwalk Street Railway Company for permission to extend its lines.

BRATTLEBORO, VT.—The proposed electric street railway in Brattleboro is meeting with opposition on the part of some of the citizens, among them Ex-Governor Fuller.

CONCORD, N. H.—Hon. Thos. Sanders, of Haverhill, Mass., has been in this city furthering his scheme of an electric railway from Haverhill, Mass., via the Merrimack Valley to Quebec.

SOUTH WEYMOUTH, MASS.—Chas. H. Blood, C. H. French and W. O. Chapman, of the Weymouth and Braintree Street Railway Company, have asked for a franchise for an electric road.

KEARNEY (P.O. ARLINGTON), N. J.—The Union Traction Company of Rutherford has petitioned for permission to run a trolley line along the Belleville Townpike road and on Elm street, Kearney.

BALTIMORE, MD.—The City and Suburban Company has decided to build its Cantonsville double-track extension of the Point Breeze road to St. Helena as soon as possible. J. E. Hayward is superintendent.

WHITE PLAINS, N. Y.—The Board of Trustees has granted a franchise to the New York, Elmsford and White Plains Railroad Company to construct and operate an electric railway, to be completed by Aug. 1.

BOONSBORO, MD.—The Boonsboro and Keedysville Electric Railway will probably be reorganized by Dr. A. W. Lakin, S. S. Davis, Samuel Knode, A. C. Huffer, J. C. Brining, D. W. Barkman and H. S. Beard.

PITTSBURGH, PA.—The Carnegie branch of the West End Traction Company is rapidly nearing completion, and as soon as the weather moderates the tracks will be completed to Carnegie borough within three weeks.

JOPLIN, MO.—The Joplin Electric Railway and Motor Company has changed hands, and the franchise, real estate and rolling stock is now the property of the Carthage, Webb City, Joplin and Galena Railway Company.

CORNING, N. Y.—The Corning and Painted Post Electric Railway will be begun not later than March 1, and completed by Dec. 1 of this year, and wil cost from $125,000 to $150,000. The franchise extends fifty years.

MARINETTE, WIS.—The street railway company of this city will extend its tracks along the bay shore to a new park purchased last fall. The extension will be two miles in length, and will occasion an outlay of $20,000.

BALTIMORE, MD.—Thos. B. Hatch and James Gilmore are directors of the Baltimore, Middle River and Sparrow's Point Railway Company, which desires to secure a franchise for its extension along several suburban streets.

REMSEN, N. Y.—An effort is being made to organize a company to build an electric railroad to connect Remsen with Hinckley, a distance of five miles. The Trenton Falls Lumber Company may be addressed for information.

ELLSWORTH, ME.—An electric railway from Ellsworth Falls to the bar in Union River is contemplated. A gentleman has made a proposition to furnish two-thirds of the capital required, provided the other third can be raised by the city.

JEFFERSON CITY, MO.—A company is being organized to build and operate an electric railway across the new bridge, the purpose being to connect Jefferson City for freight and passenger business with the two railroads across the river.

CORNING, N. Y.—The Common Council decided to modify the C. & P. P. Company's franchise in such a manner that the company accepted the franchise and will build the road. Work on the road must begin by March 1 and be finished by Dec. 1, 1895.

PEORIA, ILL.—The Fort Clark electric road is in the hands of a receiver, suit having been brought by the Illinois Trust and Savings Bank, which holds a mortgage on it for $250,000, having advanced the money to equip it. This line is several miles in length.

HIGHLAND PARK, ILL.—The Interurban Railway Company is securing the right of way for an electric railway from the Cook County line north to Fort Sheridan. The right has been secured through Highwood village and will be asked through this city and the county.

STROUDSBURG, PA.—It is rumored that a charter will be asked for an electric railway to connect at Stroudsburg with the Bangor, Pen Argyl and Wind Gap Electric Railway Company's line, and run over to Saylor's Lake. Henry Fulmer, of Easton, is one of the principal projectors.

AUGUSTA, ME.—A bill has been introduced to incorporate the Somerset Traction Company. Those interested are R. B. Shepherd, Thos. H. Anderson, Jos. P. Oak and others. It is proposed by the promoters to operate an electric railway between Skowhegan, Madison, Cornville and Athens.

BANGOR, ME.—A. F. Gerald, of Fairfield, president and general manager of the Bangor, Orono and Old Town Railway, says the electric road will be built at the earliest possible time between Bangor and Old Town. Hon. I. C. Libby and C. E. Richardson, of the Worcester Construction Company, are interested.

YORK, PA.—Capt. William H. Lanius, president of the electric railway companies of York City, proposes to build railways from York to Dallastown, York to Dover, York to Manchester and York to Wrightsville, and says work will be commenced as soon as the legislature allows electric railways to carry freight. There is a bill pending now to this effect.

CLEVELAND, O.—Mr. L. M. Coe, of this city, has been authorized to operate an extension of his electric street railway in Rockport Hamlet. Mr. Coe already has the right to construct and operate an electric street railway across the new Stranahan bridge now in process of construction across Rocky River, and thence westerly through the counties of Cuyahoga and Lorain to the city of Elyria.

NEW HAVEN, CONN.—A petition has been in circulation for the last few days to urge upon the New Haven Street Railway Company the advisability of laying double track on Whitney avenue from the city to the lake. The petition has been very generally signed, and efforts will be made to induce the street railway company to take the necessary steps to secure the improvement.

NORTHAMPTON, MASS.—A petition to the legislature has been presented by Lyman D. James, of Williamsburg; Alvan Barrus, of Goshen; J. C. Hammond, of Northampton; John Olmstead, of Springfield, and others, for the incorporation of the Western Hampshire Street Railway Company, with a capital of $200,000. The proposed road is to run from Williamsburg to Goshen, Cummington to Worthington, the total distance being about twenty miles

READING, PA.—The stockholders of the Mount Penn Gravity Railroad Company, at its annual meeting in Reading a few days ago, agreed to take the second mortgage bonds of the company at 75 per cent. of their face value, the payment of the coupons to be deferred for four years. The money raised will be used in discharging all the indebtedness of the company except the first mortgage of $40,000. The road will be operated this year as usual, the season opening about April 1.

ATTLEBORO, MASS—The Boston Safe Deposit Company, under a deed of trust, has conveyed to Edward R. Price, cashier of the Mutual Bank of North Attleboro, as trustee, all the property of the Attleboro, North Attleboro and Wrentham Street Railroad Company, the consideration being $50,000. Coupled with this is the sale by W. H. Haskell, of Pawtucket, of the North Attleboro Steam and Electric Company to the Attleboro Steam and Electric Company, for 647 shares in the stock of the latter company, subject to a mortgage of $10,000. This means an immediate starting up of an electric road in this town.

ELYRIA, O.—The construction of the electric street railroad from Cleveland to Elyria will be begun as soon as the frost leaves the ground. The distance between the public square of Cleveland and Elyria is 25 miles. The road will connect with the Lorain street line. The tracks of the Berea street railroad will be used for four miles. The new company will have but 16 miles of track to build, and the western terminus will be the public square at Elyria. The officers of the company are: President, A. H. Pomeroy, Berea; vice-president, L. M. Coe; secretary, A. E. Atkins; treasurer, F. T. Pomeroy, of Cleveland.

NEW BRIGHTON, S. I., N. Y.—The Staten Island Interior Railway, Staten Island Midland and the Staten Island Electric Railway companies applied for rights to build electric railways through the streets of the village, each of the companies asking for a separate route, with the exception of the ferry approaches, for which all asked. The trustees granted all the rights to run to the ferry landing on condition that each permit the others and any others who might come in the future to run over the tracks. The understanding is the companies will unite in building that portion of the road which they will use in common.

MISCELLANEOUS NOTES.

SUNDAY LECTURES ON ELECTRICITY.—The first of a series of Sunday afternoon lectures on electricity was on Feb. 3, at Cooper Union, New York, under the auspices of the National Association of Stationary Engineers. These lectures will be continued until April 28.

Trade and Industrial Notes.

CALENDARS.—The Central Electric Company, of Chicago, Buckeye Electric Company, of Cleveland, and Alfred F. Moore, of Philadelphia, are distributing among the trade some handsome and useful calendars for 1895.

THE INDIANA TELEPHONE AND CONSTRUCTION COMPANY, [illegible], Ind., has secured a contract from the Merchants' Mutual Telephone Company, of Michigan City, Ind., to equip its plant with the Strowger Automatic Telephone system.

THE GERSON ELECTRICAL MANUFACTURING COMPANY, of Philadelphia, is a new competitor in the telephone field. Some very strong claims are made for its instruments, which are said to work equally well on very long and very short lines

MR. JOSEPH SACHS will represent at the Cleveland Electric Light Convention the following firms: D. Van Nostrand Company, Scientific Book Publishers; The Solar Arc Lamp Company, the McCreary Electrical Specialty Company, and Rossiter & MacGovern, all of New York.

THE D. & D. ELECTRIC COMPANY, of Minneapolis, Minn., is to be congratulated upon a most attractive show-card calling attention to its well-known dynamos and motors. This card is one of the handsomest specimens of [illegible] advertising lithography we have seen.

THE CENTRAL ELECTRIC COMPANY, of Chicago, has issued an 1895 catalogue of street railway supplies which is most comprehensive in its scope and complete as to details. The print is unusually good, and the book is provided with a substantial and handsome embossed cover.

THE HART & HEGEMAN MANUFACTURING COMPANY, Hartford, Conn., has issued a handsome pamphlet of 24 pages, Catalogue "B," describing numerous forms of the Hart snap switch. Among these, besides the usual forms, are 3 and 4-way switches and many varieties of flush-plate switches.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., has just completed the new power house for the Hartford Street Railway Company, and it is said to be one of the finest, if not the finest, in the New England States. It is 66 ft. wide and 230 ft. long, entirely fireproof, no woodwork at all being used about the building.

THE WILMOT & HOBBS MANUFACTURING COMPANY suffered a serious loss on Monday, the 4th inst., when its rolling mill and factories at Bridgeport, Conn., were entirely destroyed by fire. The company will at once commence rebuilding its plant, and hopes that in the course of three months it will be able to have manufactured goods ready for the market.

MR. JOHN A. JUST, of Rochester, N. Y., has perfected a new paving compound which he calls "Asphaltine." It is claimed that asphaltine is a good insulator, non-absorptive and not subject to decay, and it has been suggested that in view of these properties the compound might be also used to advantage in protecting underground pipes from the electrolytic influence of street railway currents.

THE FISCHER FOUNDRY AND MACHINE COMPANY, Pittsburgh (S. S.), Pa., has issued a large page and well illustrated catalogue descriptive of the Fischer high-speed automatic engine, the construction of which is shown in a number of well-executed sectional views. The makers claim for their engine that its regulation is unsurpassed, and the counter-balancing is so even that the engine will run at its rated speed on a smooth plate without holding down bolts. Particular attention has been paid to material, workmanship and finish.

THE INTERIOR WIRING AND FIXTURE COMPANY, of No. 60 West Twenty-sixth street, New York, is placing on the market a line of aluminium reflectors for incandescent lamps, for which special advantages are claimed. One form of reflector is made to be held between the neck and tip of any incandescent lamp, without the use of a shade holder, and is claimed to be entirely self adjusting. Another type is made in the form of a narrow ring to slip down over the lamp about half-way the bulb. It is claimed that these reflectors will never tarnish.

THE ELWELL-PARKER ELECTRIC COMPANY OF AMERICA, Cleveland, O., is now building for the Cleveland City Railway Company a 1 000-hp direct-connected railway generator that is to be driven by a triple-expansion condensing engine of the marine type, manufactured and supplied by the Globe Iron Works, of Cleveland. The speed of the generator and engines is to be 110 revolutions per minute. This combined plant is designed to work at an efficiency as high, if not higher, than anything heretofore obtained. The maximum overload capacity of this plant is to be 2 000 hp.

THE SPRAGUE ELECTRIC ELEVATOR COMPANY, New York city, has just been awarded the contract for 15 electric elevators in the Parrott Building, San Francisco, in competition with hydraulic machines. Eleven of these are Sprague-Pratt multiplying-sheave machines, and four are the new Sprague tandem-drum machines. This is one of the largest buildings and one of the largest elevator plants in the world, and coming immediately after the awarding of the machines for the Boston Globe Building and the New York Custom House, emphasizes the "passing" of the hydraulic elevator.

MR. J. R. WILEY has just been engaged by the Standard Underground Cable Company to represent them in the West, with headquarters in the Rookery Building, Chicago. Mr. Wiley is well-known in electrical circles, having been connected with electrical enterprises for many years. He is a brother of Mr. Geo. L. Wiley, who has represented the Standard Underground Cable Company in New York and the East for the past ten years. Mr. J. R. Wiley assumed the management of the Western sales department, made vacant by the untimely death of the well-known and popular Fred. E. Degenhardt.

THE NEW YORK ELECTRIC EQUIPMENT COMPANY, S. Bergmann president, contractors for electric light plants, construction and wiring, as well as agents of the Edison Illuminating Company, of New York, for the Edison patented supplies, has removed its principal offices and salesroom to the new and commodious building occupied by its works at Nos. 572 to 578 First avenue, corner of Thirty-third street. The more central location of the company's new headquarters, and the increased facilities consequent upon bringing together its executive, selling, constructing and manufacturing forces in one building, will enable it to meet the demands of its rapidly increasing business more promptly and thoroughly than ever. The building at 59 Duane street, where its offices were formerly located, will continue to be occupied by the company as a branch salesroom for the convenience of nearby customers, and as a branch supply depot for other contractors. The company is now approaching the close of its third year of business as successors to the construction, wiring and supply department of the Edison Electric Illuminating Company, and the removal was rendered necessary by the fact that it has outgrown the facilities offered by its old quarters at the corner of Duane and Elm streets.

Business Notices

WOVEN WIRE BRUSHES.—The Belknap Motor Company, of Portland, Me. are the patentees and manufacturers of the best woven wire commutator brush on the market.

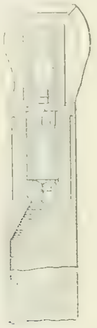
BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEBRUARY 5, 1985.

In charge of Wm. A. Rosenbaum, 177 Times Building, New York]

Re-issue 11,470. APPARATUS FOR STOPPING ENGINES; F. D. Taylor, Hartford, Conn. App. filed Jan. 3, 1895. This comprises a spring actuated shaft, clutch parts connected therewith, releasing and resetting mechanisms comprising with other elements a tumbler, and a swinging shipping lever in operative engagement with each other.



No. 533,459.—ELECTRICALLY LIGHTED BUOY.

533,427. AUTOMATIC TELEPHONE SWITCH; H. D. Bayne, Brooklyn, N. Y. App. filed May 31, 1894. This comprises a bracket for holding the receiver, having one jaw stationary and the other pivoted, the latter being adapted to engage a sliding bar.

533,445. ELECTRIC DENTAL MOTOR APPARATUS; F. N. Denison, Toronto, Canada. App. filed May 26, 1894. The combination of a foot pedal pivoted, swiveled and making contact, of an insulating plug provided with an insulating ring.

533,447. ELECTRIC RAILWAY; J. G. Douty, Williamsport, Pa. App. filed May 17, 1894. This comprises a car and trolley wire, a frame secured to the car, a tubular arm having trunnions mounted on the frame, springs between the tubular arms and the bearings of its trunnions, a trolley arm carried by the arm, and a trolley wheel carried by the trolley arm.

533,459. ELECTRICALLY LIGHTED BUOY; I. W. Henry, New York. App. filed May 29, 1893. The combination of a buoy, a transformer housed in a socket formed in the buoy, and a lamp or lamps electrically connected with the low tension winding of the transformer. (See illustration.)

533,490. ELECTRIC FIRE ALARM AND POLICE SIGNAL BOX; G. E. Paynter and W. H. Thompson, Richmond, Va. App. filed May 4, 1894. This comprises a releasing lever signal transmitting mechanism, locking device normally engaging the releasing lever, and means operated by the sliding movement of a key upon its insertion in the door for unlocking the lever.

533,502. METHOD OF AND MEANS FOR TESTING INCANDESCENT LAMPS; F. S. Smith, Pittsburgh, Pa., and J. A. Vandegrift, Allegheny, Pa. App. filed July 9, 1894. The method of definitely ascertaining the proper moment for putting lamps, under process of exhaustion, into circuit for the purpose of expelling occluded gases, which consists in causing electrical oscillations of high frequency and potential to pass from the circuit aforesaid through the space within the lamp bulb.

533,607. INSULATED CONDUCTOR; H. G. O'Neill, Boston, Mass. App. filed March 22, 1894. This consists of a paste composed of powdered silicates and rendered waterproof.

533,619. TELEPHONE ARM REST AND RECEIVER HOLDER; W. Stuebing, Cincinnati, O. App. filed Oct. 30, 1894. This comprises a rod moving in a bar and bent near its upper end, a spring holding the rod in place, a curved and forked support for the receiver attached to the upper end of the rod, a round and notched bar held vertical by arms on the base, an elbow rest at the top of the arm, a sleeve adjustable on the vertical bar with which the arm is integral, and a pawl pivoted in the socket and holding it in place on the bar.

533,627. CONDUIT ELECTRIC RAILWAY; W. H. Baker, Pawtucket, R. I. App. filed May 18, 1894. A trolley having an elongated dome-like hood for catching drip falling through the conduit-slot, the hood terminating at each end in a down-turned point and having troughs along each side leading to the points. (See illustration.)

533,631. SUBWAY FOR ELECTRIC RAILWAYS; F. E. Button, Rochester, N. Y. App. filed June 6, 1894. The combination with the opposite rails, a cross-sleeper arranged beneath the rails, and a tie bar having a downwardly deflected central portion secured to the cross-sleeper, and upwardly extending extremities secured to the rails.

533,698. SAFETY CONNECTION FOR ELECTRIC CONDUCTORS; R. E. Bates, Brooklyn, N. Y. App. filed June 20, 1894. This comprises supports, a cover plate connecting a conductor with the cover and having vertical slots at their outer ends and horizontal slots at their inner ends, and bolts for engaging the slots.

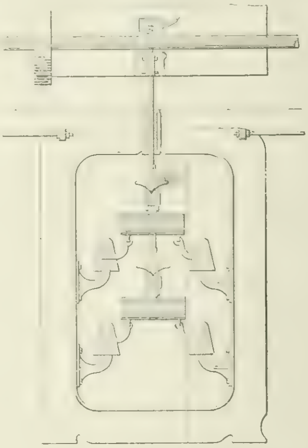
533,729. TELEPHONIC OR ANALOGOUS ELECTRODE; T. McCoubray, New York, N. Y. App. filed Aug. 9, 1894. A telephonic electrode made from carbon residuum of an oil such as petroleum, which residuum is recarbonized.

533,751. SEPARATOR PLATE FOR STORAGE BATTERIES; P. G. Salom, Philadelphia, Pa. App. filed May 9, 1894. A separator made of non-conducting material having perforated flat sections, one side adapted to rest against a battery plate, and having hollow ribs formed by crimping the plate, the ribs being on one side only so as to leave a space between the main body of the separator and the battery plate resting against the ribs.

533,785. TELEPHONE EXCHANGE; M. Brooks, Minneapolis, Minn. App. filed Oct. 17, 1894. The induction terminals comprising each a hollow coil and an iron core coil together mounted upon an iron yoke, the two terminals being adapted to be placed together to form a closed circuit magnetic induction coil.

533,791. ELECTRIC BATHING APPARATUS; C. Doehring, New York, N. Y. App. filed June 22, 1894. This comprises a tub having a heating jacket, and a pad of flexible metal sheets suspended therein and constituting electrodes.

533,795. ELECTRIC BROILER OR TOASTER; L. T. Edwards, Haverford, Pa. App. filed March 2, 1894. This consists of a frame, a grid contained therein and through which the current is intended to pass, and insulating connections between the opposite side portions of the grid and the frame.



No. 533,627.—CONDUIT ELECTRIC RAILWAY.

533,810. CONDUIT ELECTRIC RAILWAY; A. Rosenholz, San Francisco, Cal. App. filed May 22, 1894. This comprises means for intermittently transmitting current from main line conductors to the cars as they pass along the track, the connection with each switch being cut off as soon as the car has passed.

533,836. CONDUIT SYSTEM; C. M. Yost, Washington, D. C. App filed Nov. 3, 1894. This comprises a main conductor, alternately arranged, fixedly mounted conductor bars, having an independent connection with the main conductor and arranged with their ends overlapping and a separate plate for each bar by which it is secured in proper position with relation to the slot.

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ANOTHER RECORD BREAKER.

The present number of THE ELECTRICAL WORLD is the finest that has ever gone to a convention. The articles are of unusual timeliness and importance, while in number of advertisements and in volume of advertising no previous convention issue has ever reached as high a mark. The figures for the corresponding issues for the last five years—all announcements of the publishers; all "office advertising" being entirely omitted from the calculations—compare as follows:

	Pages.	Number of Advertisements	Inches of Advertising.
March 7, 1891	42	301	2,099
February 27, 1892	52	357	2,613
March 4, 1893	56	378	2 828
March 4, 1894	76	386	3 215
February 23, 1895	84	395	3,560

THE ELECTRICAL WORLD is trying conscientiously to give manufacturers the best advertising service possible in its field at the least cost, and it is most gratifying to see from the figures quoted that manufacturers appreciate this more and more as time goes on.

ECONOMY IN THE BOILER ROOM.

The article by Lieut. Cahoon, in another column, brings out in a forcible manner the influence of the boiler room factor on the economy of operating central and power stations—a subject upon which too much stress cannot be laid. While the question of firemen has been discussed before the National Electric Light Association, and its importance is freely acknowledged by station managers whenever it is brought forward, yet it cannot be said that much progress has been made in carrying out the many suggestions offered. One reason seems to be a disinclination on the part of employers to offer the wages of skilled labor to a class of workmen who have from time immemorial been considered as not differing from day laborers—the reluctance having probably its real cause at the present day in the fear of establishing a precedent that might lead to demands for increase of pay from other classes of employes. Of the different items that go to make up the cost of producing electrical energy, but few in a given case are capable of being materially reduced; the capital charges are fixed, the costs of management, superintendence, and labor are usually kept at a point not admitting of further economy, but the large item of fuel, though its importance may be recognized, is yet the one that in most cases receives the least intelligent attention. It is true that firemen are the subject of much complaint, and it is generally felt that the boiler room is a weak point in the station economy, but it is rare that the remedy, and there is but one, is applied—the payment of the wages that the skill required warrants. That skill and intelligence on the part of the fireman are demanded should not be a matter of opinion, for it can readily be seen that the conditions predicate them. There are definite conditions for a maximum economy in burning a given fuel, and as these conditions vary with the rate of combustion, an intelligence is required that cannot be expected of the day laborer. Furthermore, the attention necessary to see that the fires are kept in proper condition, the frequency and quickness with which they should be fed, and the care required in properly working them are what one cannot expect from those receiving the usual rate of wages now paid, even if they should possess the necessary intelligence. When it is once generally recognized that firing is a skilled trade, and when firemen are paid as skilled workmen, then we may expect to hear less often of stations using from four to six pounds of coal to develop an indicated horse-power.

ARC LAMP CARBONS.

We have referred several times to the great influence of the quality of arc lamp carbons on the candle power, and in the present issue Prof. Stine confirms our statement that the light given with different carbons in lamps using the same amount of energy may show a difference as high as 50 per cent. In the article to which we refer stress is laid upon the fact that the electric arc is not the direct source of light, and that the real principle is the same applying in the case of other illuminants, which is that of the action of heat upon a vapor, rendering it luminous. The function of the carbons in acting as electrodes has nothing directly to do with the production of the light, that depending upon the quantity and quality of the luminous vapor which they supply under the action of the intense heat of the arc proper. It would be absurd to judge of the value of a gas without reference to its light-giving qualities, but this is what is too often done in the case of carbons, the question of life being usually the one which determines a selection. As pointed out, the intense brilliancy of the arc renders it difficult for the eye to appreciate readily and directly even great differences in candle power, so that variations which would be at once detected and not endured in the case of other illuminants, do not receive prompt attention when occurring in arc lighting. Perhaps the comparative newness of the light has also something to do with the lack of concern manifested, for the quarrels now so frequently occurring between arc lighting companies and their customers on this score seem to indicate that the public is finally learning to appreciate the difference between a good arc light and a poor one. The qualities necessary for a good carbon follows from the definition given of its true function. It should give off vapor readily, and of a quality to radiate the greatest number of luminous rays, and be of uniform texture. If it does not possess this latter property the arc will be unsatisfactory, even if the carbon is soft and of good material, as conditions will be introduced that will not permit it to burn to the best advantage. To vaporize readily, the carbon must not be hard, and, therefore, its life cannot be as great as that of a hard carbon. The same caution here applies with respect to long life as in the use of incandescent lamps, a long life in the latter case implying a direct loss instead of a saving. As a consequence, an arc carbon recommended to burn an unreasonable number of hours should be avoided, as long life will here, also, through the lesser quantity of light given, more than overcomes the difference in cost. When light becomes to be considered as light and not measured in lamp-hours, and is paid for according to this basis, these considerations will be given their true weight, and poor carbons will be rated at their real value.

THE CLEVELAND CONVENTION.

The Convention of the National Electric Light Association at Cleveland promises to be even more important than that held at Washington last year, though the latter was, in many respects, perhaps the most important in the history of the association. The interim between these meetings has witnessed such an unusual number of events affecting the electrical industry that the older members have doubtless been reminded of the earlier days of the Association, when the interval between meetings often witnessed a revolution in the art or its methods. While the expiration of the incandescent lamp patent and the invalidation of the feeder-and-main patent were most interesting events, the practical effect, however, was comparatively slight and the Convention will have brought before it several matters that promise to affect more largely the interests of its members during the coming year than they have been by the occurrences in the one just closing. The most important of these is the subject of power distribution by alternating currents, which the rapid perfection of induction motor is quickly bringing to such a point that it can no longer be neglected by the central station manager. Should the claims now being made in regard to the practicability of using these motors for general power distribution on lighting circuits be maintained, and this seems probable, the continuous current will be definitely placed in such a serious state of inferiority as to give real cause of alarm to its adherents, and should tend to make them consider the advisability of taking advantage themselves of the new advance rather than wait for it to be exploited by a rival. Another subject also coming well to the front is that of central station storage which, as far as relates to storage batteries, has already received an impetus from the recent ending of the unfortunate litigation which so long had crippled the industry. The paper on direct connected arc dynamos will doubtless be submitted to a thorough discussion, and unless it is shown that real objections exist against such machines, we may expect as a result their rapid adoption in all large stations, and one of the principal causes thus removed of the remark so frequently heard in regard to the backwardness of arc lighting from a technical standpoint. Another subject of lively interest to be brought before the Convention is the competition of the Welsbach burner, and in this connection we think that stress might be laid by the older members on the fact that the present "scare" is but the recurrence of others that have several times before taken place on the same subject and had in each case but a short existence. The character of the light given, the unsightliness of the mantle, its fragile character and the trouble which its use entails, will probably again have the same result as when on previous occasions it for a time received the favor of the public, and of this fact indications are already to be seen in New York City.

COAL CONSUMPTION IN CENTRAL STATIONS.

The article by Mr. E. A. Merrill, in another column, will be found an important contribution to a subject of vital importance in the design and operation of generating stations, and we know of no other paper on the same subject which has so thoroughly considered all of the factors involved. Much has been written of the influence of the load factor, but usually in general terms or based upon only part of the factors entering in economy of operation. In the tables accompanying the article, however, will be found figures that can be accepted with the assurance that they embody every quantity affecting the result, and represent all the different types and sizes of engines now generally employed in stations. As will be seen, the coal and water consumption are referred to the dynamo and this, as remarked by the author, is the only logical basis of comparison, as will be realized upon consideration of the varying rate of the many losses between the boiler and switchboard. A striking illustration of the influence of the load factor is given by the various curves. In Fig. 5, for example, we find that with the most efficient type of engine and dynamo, and generating a kilowatt-hour on about two and one-quarter pounds of coal at full load, this figure is increased at 10 per cent. to 11 pounds, and even at 30 per cent. is 5 pounds; with the least economical type of machinery, these figures become 34 and 21 pounds respectively. It should be understood that the data from which the curves are constructed are not based upon theoretical deductions, but are taken from good engineering practice, while the machinery is that supplied by good makers, and assumed to be operated under ordinary conditions. Considerable surprise was expressed at some of the data reported at the Washington Convention of the National Electric Light Association by the committee investigating the subject of fuel consumption in central stations, but in the light of the results of Mr. Merrill's study it will be seen that the returns showing even the lowest economy were well within the possible limit. The lesson to be derived from this investigation is the absolute necessity, in the absence of storage, of so proportioning the units of a station as to admit of each unit being worked at as nearly full load as possible. The general remedy, however, seems to be the employment of an auxiliary storage system, particularly where the load varies over wide ranges. It should be borne in mind that such a system, aside from very largely decreasing the consumption, would also entail other advantages and savings, as demonstrated in European practice. In conclusion we desire to call attention to the author's remarks on the necessity, in order to enable reforms to be initiated, of comprehensive and accurate station records, in detail, accompanied in each case, when published, with a description of the station equipment and details of operations; with these data in hand all will agree with the opinion expressed that much of the uncertainty now surrounding the subject of coal consumption will be dissipated. The desirability of referring the consumption to the out-put at the switchboard is also evident, and that method should be more generally followed.

Since the Last National Electric Light Convention.

The Convention of the National Electric Light Association at Cleveland during the present week naturally recalls the several important events affecting the electrical industry that have occurred since the Washington meeting, and which our artist has attempted to pictorially represent. The expiration of the Edison lamp patent last November was the most notable electrical event of the past year, but its effect had previously been largely discounted and the uncertainty in regard to the result of the Bate refrigerating case has probably resulted in restraining the great competition in the incandescent lamp field, which was so confidently looked forward to.

The decision in the feeder-and-main case also served to clear up the atmosphere, and the opinion of the Court had the effect of strengthening the growing tendency of Federal judges to apply a more severe construction as to what constitutes invention—a tendency quite marked in the opinion of Judge Grosscup in the recent arc regulator case. Another principle in patent law of interest to the electrical public generally, and which is also being more literally interpreted, was that involved in the Berliner case, Judge Carpenter basing his decision upon the Supreme Court opinion of last year restricting the practice of issuing two or more patents on substantially the same invention—using the word in its latest legal sense.

The cessation of hostilities among storage battery manufacturer through a combination of their interests was received with a pleasure not usually felt toward similar business arrangements; it was felt that a promising industry had been stunted by the incessant litigation to which it had been subject for years, one effect of which was to discourage the application of the storage battery in this country to many cases in which its value had been strongly demonstrated in Europe.

Perhaps one of the most important advances made for years in connection with arc lighting was the recent direct-coupled arc dynamo installation at Chicago. The use of large arc units, which at the Washington Convention was discussed as an innovation, has, during the year, entirely passed through the transition period and entered into every-day commercial practice.

The Niagara plant, while not yet in operation, has nevertheless passed into such a stage that its success from an engineering standpoint is no longer the matter of conjecture that it was reasonably considered to be at the Washington meeting.

A New Method for Deducing the Expression for Electromagnetic Force.

BY CARY T. HUTCHINSON, PH.D., AND E. R. CARICHOFF, M.A.

The usual method followed in deducing the expression for electromagnetic force, even in the simplest cases, is very abstract and does not leave a satisfactory impression upon the mind.

The following deductions are presented as tending to afford a clearer understanding of the facts involved, while involving none but the simplest notions:

"The magnetic force at a point is the force which unit pole at the point would experience."

"The strength of a magnetic field is measured by the magnetic force at each point, and is represented by the density of the lines of force, one line of force per unit area corresponding to unit magnetic field. At unit distance from unit pole, the force, by definition, is unity; the area of unit sphere is 4π; therefore, from unit pole 4π lines of force radiate, since each unit area must have one line."

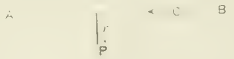


FIG. 1.

"When by any means whatever the number of lines of force passing through a circuit carrying current, C, is changed by N, the total work done by or upon the circuit is equal to CN."

This is Faraday's fundamental experimental result; all that follows is based upon it.

Faraday's law involves a definition of unit current, in order that the work may be numerically equal to 4π times the product of the current by change in flux.

Biot and Savart and Maxwell have shown experimentally that the force due to a current in an unlimited rectilinear conductor on a pole of unit strength at a distance r from the current is $\frac{KC}{r}$, where K is a constant to be determined so that the expression for work done shall be equal numerically to NC.

To determine this constant:

Imagine unit pole at P; let the conductor, AB, revolve uniformly about P, describing a cylinder of radius, r. The conductor cuts the entire 4π lines which radiate from the unit pole; the work done is therefore $4\pi C$. The distance that the conductor moves is $2\pi r$, and the uniform force is $\frac{KC}{r}$.

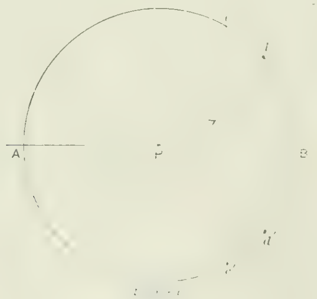


FIG. 2.

The work then is:

$$W = \frac{KC}{r} 2\pi r = 2\pi KC.$$

This must equal $4\pi C$, and therefore $K = ½$. This is the usual electromagnetic definition of current, but obtained in a different way. With this definition of unit current the expression for work becomes numerically equal to NC. Using this we shall deduce the expression for the force in other cases.

I. To find the expression for the force at the centre of a circle of radius, r, due to current, C, flowing around the circumference. Imagine unit pole at the centre, P. Revolve the circular conductor about a diameter, AB, through 180 degrees; then all the 4π lines from the unit pole will be cut, and the total work done will be $4\pi C$.

Each element of the conductor, as cd, contributes a part to the work proportional to its length and to the distance it moves through. The sum of all these products of length and distance, however taken, is equal to the surface of the sphere, or $4\pi r^2$. If then $\mathfrak{F}$ be the force due to unit length

$$\mathfrak{F} \times 4\pi r^2 = 4\pi C.$$

$$\mathfrak{F} = C/r^2.$$

The force due to the entire circumference is

$$\mathfrak{F}' = 2\pi r \times \mathfrak{F} = 2\pi C/r.$$

II. To find the force at a point within an indefinitely long solenoid:

Let there be n turns per centimetre. Assume unit pole at P to move parallel to the axis to P' where $PP' = (1/n)\ Cm$. Every line of force will cut one spire of the circuit, for any line that was at E moves to E' and $EE' = PP'$.

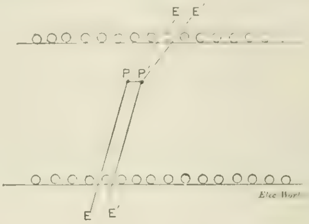


FIG. 3.

The entire circuit will then be cut by all 4π lines of force; the work will then be $4\pi C$, and the uniform force between P and P' will be $4\pi C \Big/ 1/n = 4\pi n C$. This is irrespective of the position of P within the solenoid.

Electrical Energy Obtained Directly from the Cold Combustion of Coal Gas.

BY CARL HERING.

In connection with the recent experiments of Dr. Borchers which have been attracting so much attention, the following simple little experiment made in 1883 by Mr. von Dobrowolsky and myself, at the suggestion of the former, may be of interest as it seems to show conclusively that a cell *can* readily be made in which the cold combustion of coal gas (or at least some constituent part of it) with atmospheric air will take place, yielding its energy in the form of an electric current.

Two carbons, such as used in Leclanché cells, were carefully cleaned and platinized with platinum black; they were then placed in dilute sulphuric acid and kept short-circuited for some time in order to discharge them, should there be anything different in the two causing a difference of potential. One was then placed in a jar containing ordinary illuminating gas from the street mains and the other was held in the air. After a while they were inserted in the dilute sulphuric acid and connected to a crude galvanometer made of a small coil of wire around a pocket compass. The current obtained when started and stopped at proper time intervals caused the needle to spin around on its pivot with considerable speed. It may, therefore, be said that a motor, although only an infinitely small one, was run with the energy thus obtained. No further measurements were made as it was considered to be of no practical interest and as we had no suitable measuring instruments at the time.

I believe that the problem of the conversion of the energy of coal into electrical energy without the aid of that frightfully wasteful converter, the steam engine and boiler, will be solved first by some of the numerous possible indirect ways. If scientists and inventors would direct their attention to these rather than to the direct methods we would, I think, be relieved much sooner from the necessity of using the wasteful steam engine and boiler, which, although very useful in the absence of something better, must still be regarded as merely a temporary, unsatisfactory makeshift. The efficiency of the engine boiler converter is so very low that it will require but a very poor and inefficient electrical converter to relegate it to the museums.

Two Thirteens a Lucky Combination.

Miss McLaughlin, cashier of THE ELECTRICAL WORLD, completed, on February 13, her thirteenth year's service on the paper. Not only all the money, but all the correspondence has passed through her hands. Probably a million letters have been opened by her during this time.

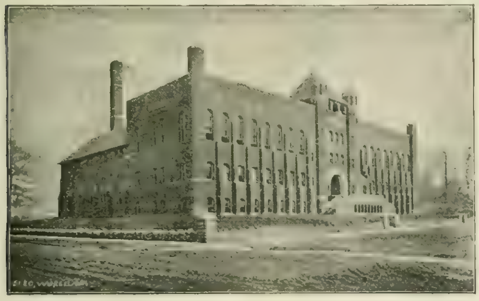
Manual Training and Technical Education in Cleveland, O.

BY E. P. ROBERTS.

CLEVELAND being a city noted for the excellence of its schools and also for its manufactures and its engineering works, it is not surprising that manual training and technical education have been carefully developed there.

The manual training schools connected with the public school system are two in number — the Central Manual Training School and the West Manual Training School. Both of these schools are for high school students, and are under exceptionally competent instructors—Mr. W. C. Skinner and Mr. W. E. Roberts, respectively. Before reaching the manual training schools the students obtain a very considerable training of the eye and hand while passing through the primary and grammar grades, such as clay modeling, work in paper and card board, drawing, knife work in wood, etc. The University School, under Mr. N. M. Anderson, principal, and with Mr. S. P. Rider and W. E. Graves in charge of machine work and carpenter work, respectively, is a high grade school, preparing boys for classical or technical courses in college. Special attention is given to manual training and with marked success.

Adelbert College is a portion of the Western Reserve University. Its most recent building is the physical laboratory, which is in charge of Prof. Whitman, assisted by Mr. W. M. Woodworth. In the design of the building great care was taken in the special adaptation to advanced work in electrical measurements. The two rooms used for electrical work are entirely free from iron in their construction, have a cement floor, solid brick piers, and slate slabs built into the wall to accommodate the most sensitive instruments. A good sized storage battery has a room by itself, and current for charging this is kindly furnished by the street railway company.



University School.

In the dynamo room is a small Brush arc light machine and a Westinghouse incandescent machine for lighting the building. The latter was designed by the Westinghouse Company for this laboratory, and is provided with collector rings, so that a 110-volt direct current and a two phase alternating current may be obtained from the machine at the same time. A switchboard with the usual station indicators, volt and ammeters, and converters completes the electrical equipment. The department of physics is in charge of Prof. Frank P. Whitman.

The Case School of Applied Science was founded in 1877. During the past few years, and under the leadership of President Cady Staley, it has made most marked progress. It has a well equipped mechanical department under Prof. C. H. Benjamin, and the electrical department under Prof. J. W. Langley is most efficient. Civil engineering, technical chemistry, etc., are all given in the most thorough manner, and under exceptionally competent instructors.

The following information in regard to the course in electrical engineering we extract from the last annual catalogue: The course is intended to fit students for professional work in the various branches of applied electricity. To this end the instruction is both theoretical and practical, and is combined with so much of the courses in mechanical engineering and physics as will form a preparation from which to specialize in the direction of electical work. During the first two years the instruction is nearly identical with that in mechanical engineering. In the third year a thorough course in theoretical electricity is given; this includes lectures and recitations on the principles of the science and its elementary mathematical treatment. A large portion of the afternoon hours is devoted to laboratory or shop work. In the electrical laboratory students make measurements of resistance, potential, and induction by all the recognized standard methods. In the shop they have tests of materials dynamometer and indicator practice with the steam engine, and general shop work. In the fourth year theoretical electricity in its advanced development is taken up. On the practical side students give special attention to methods of testing and measuring the out-put of dynamos and motors; methods of wiring for arc and incandescent circuits and testing for faults in the same; photometry of electric lights and distribution of power for street railroads and other purposes. The principles of dynamo and motor designing receive practical illustration. In addition to this a considerable fraction of the time of the last two years is given to details of construction. This is an important feature of the course; each student personally constructs at least one part of a dynamo or motor on a commercial scale of magnitude. The increasingly important applications of electricity to the treatment of ores and the reduction of metals also receive working illustration in the electrical engineering laboratory.

Workshop, University School.

In addition to the customary outfit of galvanometers, voltmeters and ammeters, the electrical engineering laboratory contains two engines, four dynamos and a 108-cell storage battery.

Frequent visits are made to electrical establishments, and each student before graduating must present a thesis on some topic connected with the commercial applications of electricity.

Engineering Laboratory, Case School of Science.

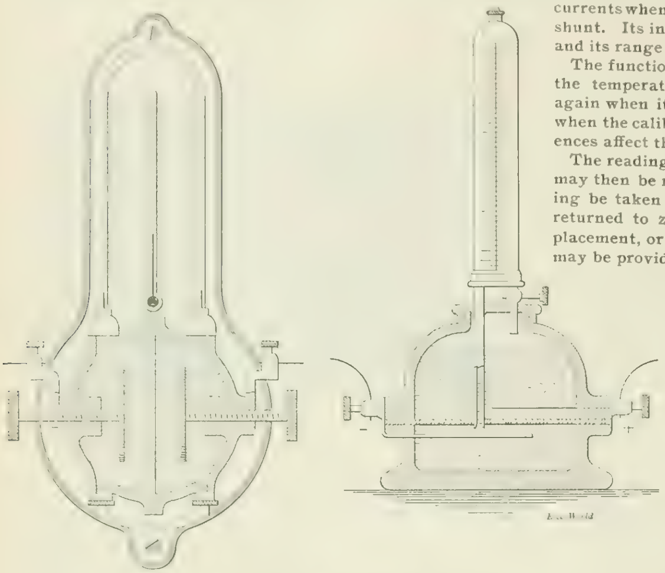
If any of the exhibitors at the National Electric Light Convention have any question as to what to do with their exhibits after the close of the convention, it is believed that Prof. Langley will give them full instructions.

Suggestions for Metering Devices—VII.*

BY S. D. MOTT.

Osmotic Meters.

The curious action of liquids subjected to electrification in the capillaries of porous materials known as electro capillary phenomena is a field for research promising in results, I believe, to the scientific investigator, and one which has so far been comparatively neglected.



FIGS. 1 AND 2.—OSMOTIC METERS.

Under this head is the osmotic flow of fluids from the positive to the negative electrode of a conducting path, which may be observed by the difference of level of fluids capable of mixing through a porous diaphragm separating them, which difference of level is the result of the circulation of electric currents.

This has the sound of a familiar physical principle, and it is up to a certain point where we become involved and environed by physical actions not wholly understood but which are well worthy painstaking research.

This phenomena, first observed by Porrett, was confirmed by Quincke, Crosse, Wiedermann, Miller, and others. The laws of endosmic action were first formulated by Wiedermann and afterwards confirmed by Quincke.

Wiedermann's apparatus consisted of a porous earthenware vessel closed at the bottom and terminated at its upper end by a glass tubulure, to which was attached a horizontal section for the escape of the liquid raised in the tubulure. The battery terminals were attached to platinum electrodes placed respectively inside the porous cell and in a vessel of water outside the porous cell in which the porous cell was placed. On the passage of current from the outside containing cell to the inside of porous cell the liquid rose in the glass tube and ran through a horizontal section thereof into a receiving vessel. The flow of liquid was found to be in proportion to the strength of current and the action otherwise conforming to the following laws:

I. The quantity of fluid which flows out in equal times is directly proportional to the current strength.

II. Under otherwise equal conditions the quantities of fluid flowing out are independent of the magnitude of the conducting porous surface.

III. The height to which a current causes a fluid to rise is directly proportional to the extent of the porous surface.

IV. The force with which an electric tension present on both sides of a section of any given fluid urges the fluid from the positive to the negative side is equivalent to a hydrostatic pressure which is directly proportional to that tension.

Fig. 1 is arranged as a glass receptacle divided into two compartments by a porous partition for the metering of delicate currents when in direct circuit or strong currents when placed in shunt. Its internal resistance may be made very small indeed, and its range is limited to the height of the scale.

The function of the thermometer is for the purpose of taking the temperature reading when the measurement begins and again when it ends, allowing therefor. This is only necessary when the calibre of the tubulure is such that temperature differences affect the height of the fluid medium on the reading scale.

The reading is taken from the ascending column; the current may then be reversed to bring it back to zero and the next reading be taken from the other column, or the instrument may be returned to zero through the medium of the electrodes by displacement, or a communication between the two compartments may be provided as is shown at the bottom of illustration.

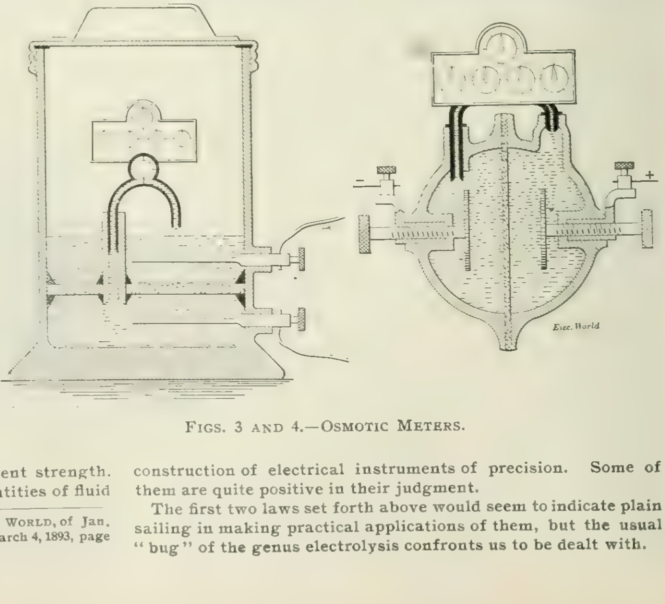
It is believed that such an instrument could be made to meter the most delicate currents; such, for instance, as telephone currents, and for this purpose may be standardized to measure such in arbitrary units or the time use of such instruments and kindred instruments used in commercial life.

Fig. 2 is substantially the same except that the fluid medium is delivered into a larger scaled measuring tube for the purpose of increasing its range of action. In this case the fluid would be scaled down, reducing the meter reading to zero by means of the small cock on the right.

In Figs. 3 and 4 the range is *ad infinitum*, the fluid flow being measured like unto water or gas and registered on an ordinary dial mechanism.

It may be well to state (Fig. 3) that the part which measures the flow may preferably be placed in the down leg of the siphon. The hydrostatic balance of Figs. 3 and 4 is nearly perfect, sufficiently so for all practical purposes. These instruments, made of glass, have the valuable characteristics of cheapness, simplicity, and accuracy.

It is the opinion of several well-qualified experts to whom I have taken occasion to submit the suggestions herewith illustrated that they present a plausible basic principle for the construction of electrical instruments of precision. Some of them are quite positive in their judgment.



FIGS. 3 AND 4.—OSMOTIC METERS.

The first two laws set forth above would seem to indicate plain sailing in making practical applications of them, but the usual "bug" of the genus electrolysis confronts us to be dealt with.

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* For parts I., II., III., IV., V. and VI. see THE ELECTRICAL WORLD, of Jan. 14, 1893, page 26: Jan. 28, 1893, page 63; Feb. 11, 1893, page 105; March 4, 1893, page 162: March 25, 1893, page 228: Aug 19, 1893, page 129.

The first question is can we have a propagation of fluid conforming in its action to the above laws without electrolytic action, *i. e.*, without either the evolution of gas or the carrying of metals, or either one of these actions without the other. Are there combinations of elements which will eliminate these factors or render them negligible?

We are told there would be no metal carried from platinum or iridium electrodes provided a properly selected solution devoid of chlorine were used, and with fluids like mercury gas is not evolved, yet it is subject to electro capillary influences. The electro capillary propagation of mercury has been used for E. M. F. readings, but seems to have been ignored by experimentalists for the metering of currents.

The fused salts of borax conduct electricity and are said to be not subject to chemical action from such use. Could not mercury be used as the fluid conductor, and lead or its equivalent, such as would not be attacked by the mercury, be used for the dividing partition?

If an intervening space between two bodies of mercury formed by two porous diaphragms be filled with nitrate of mercury, would not the desired results be obtained? I have a distinct recollection of having seen these elements used for metering currents by having two receptacles containing mercury connected by a tubulure filled with nitrate of mercury disposed as a balance, the oscillation of which—by the preponderance of weight to one end or the other as the mercury was transferred to the negative end by the current—being registered on an ordinary dial and the current being reversed at the completion of each pendulation in the manner similar to the balance beam electrolytic meter.

Assuming such a combination a practical reality, the arrangement of parts such as is indicated in the drawings, but using two diaphragms instead of one, as described, should make a satisfactory instrument.

Experimentation with animal substances such as albumen, or vegetable products as sugar, might be found promising elements; these play an important part in the economy and sustenance of the human frame and perform their functions by endosmic action, or what is so nearly allied to it. imbibition.

Do porous diaphragms intercept the electrolytic carrying of metals in an otherwise properly arranged bath? It is evident that if a partition, porous or otherwise, were of such a nature as allowed electrolytic action to take place through it, *i. e.*, if such a diaphragm were interposed by immersion between the anode and kathode resulting in separating the bath into two independent receptacles, the mere act of *displacement* of fluid by the building up of a metallic deposit on the kathode would totalize the current passing, which could be read off a scaled tube, as represented, the same action taking place as in the commercial chemical meter, except that no weighing would be needed.

It may be unfortunate that some form of liquid must be a functional part of this apparatus, but the great advantage of simplicity and cheapness is gained, as the instrument may be made wholly of glass, except the binding posts and diaphragm.

Some time since I took occasion to look up the state of the art as related to this type of instrument, but unfortunately have mislaid my notes taken at the time and cannot, therefore, treat the subject as fully as I had intended, but can say that what the records do not contain is much more interesting, I believe, and quite as important possibly as what they do contain.

Possibly some of your readers who have special knowledge of electro capillary or electrolytic actions, derived from practice or experiment, may be inclined to throw fuller light upon this interesting subject.

Electricity and the Alps.

One of the Swiss newspapers, says the London *Electrical Engineer*, makes merry in a good-humored way over the proposal to build a railway up the Jungfrau. "This is no question," it says, "of compressed air. Electricity will afford the means of traction. The tunnels will be lighted by it; there will be stopping places at all the principal glaciers, and two miles up will be seen the notice 'The Eiger Station—ten minutes to wait!' A natural glacier will be provided alongside the railway, and the train then passing around the huge mass of the Eiger will draw up at a plateau that is only clear of snow in summer. Seven and a half miles at £40,000 a mile! That is what this project is to cost. Twenty years ago it would have been considered a chapter out of one of Jules Verne's books. To-day the men of money who were afraid to give half-a-crown for one of Verne's books are willing to advance nearly half a million for the work."

The Influence of the Carbons on the Candle Power of the Arc Light.

WILBUR M. STINE, D SC.

The history of the development of the two existing methods of electric lighting present a marked contrast. In the case of the incandescent lamp, attention and investigation were of necessity directed toward the source of illumination, or the susbtance, which heated to a condition of incandescence, emitted the light. Since common usage adopted the carbon filament it has been diligently studied with reference not only to its working life but more especially to the quality of the light emitted and the best economic conditions under which a filament should be operated. At present the leading consideration in the selection and operation of incandescent lamps is not so much life in hours, but watts absorbed per candle power. In bringing this about an influence has been at work which is not ordinarily considered. The incandescent lamp had to compete directly with both oil and gas flames of approximately similar candle power. The public was, in a sense, accustomed to use the eye as a rough photometer and could form quite accurate estimates of the quality and the quantity of the light emitted by incandescent lamps in comparison with gas and oil flames. With the arc lamp the case has been entirely different. Here the eye is of but slight service in estimating either the quality or the quantity of light emitted.

The arc lamp emits a light which differs materially from all other generally used illuminants. The color of the arc is pale blue or white with a bluish tinge and contains less of the lower or red rays of the spectrum than the oil, gas or incandescent lamp. The light emitted from these sources is strongly yellow in cast. Again, the light of the arc being unusually rich in the upper colors of the spectrum consists of rays of lesser amplitude than other lights, or its penetrating or emissive power is proportionately less. As a consequence, a gas flame or an incandescent lamp viewed from a distance through a fog, looks proportionately brighter in comparison with an arc lamp than when the night is clear. This fact has, doubtless, had some influence in minimizing the brightness of the arc light in the eyes of the public.

Other illuminants possess considerable area of light-emitting surface per candle, but the powerful light of the arc is concentrated into a mere point in comparison. The eye, in short, is too greatly blinded by an arc to be, in any sense, a judge of its brightness. The candle power of the arc, too, so greatly exceeds that of any other illuminant that the public does not generally appreciate the candle power of the arc as a source of illumination. It would seem that these several causes had greatly contributed to the neglect of all considerations of the influence of the carbons burned in an arc lamp upon the quality and quantity of light emitted. Here, it may be stated, lies the contrast in the development of the arc and incandescent systems for lighting.

The arc dynamo has been brought to a high state of efficiency and the lamps for such circuits have received no less attention, so that there now exists the anomalous condition that the perfection of the lamp generally exceeds that of the carbons burned in them. At the outset it would have seemed that the mechanism needed to insure a steady arc under commercial conditions was too complicated to enable it to become successful. Yet patient effort has evolved a number of lamps which leave little to be desired so long as carbons must be burned to produce light. But all the excellence in dynamo and lamps counts for but little when, through ignorance or carelessness, poor carbons are used in the lamps. To bring the incandescent and arc systems into contrast again, the former has been operated with more uniform satisfaction to the consumers than the latter. The reason is not far to seek—every central station manager knows it matters a great deal what incandescent lamp he may select, while few stop to consider the candle power quality of the carbons they purchase. Carbons are too frequently bought on considerations of long life and cheapness, though the same policy would prove ruinous if applied to incandescent lighting. This carelessness seems to be most apparent in the operation of the smaller plants. The extra expense which is incurred by small towns in lighting its streets with arc lamps is a serious consideration. The town council usually debates the question well before making the choice. They are led to believe the new illuminant will make the streets well lighted, and expectation reaches a high point. After the lights have been in operation for a time it is often realized that the lamps are not yielding their expected light. Comparisons are made with other towns similarly lighted, with the conclusion that their own plant is not coming up to contract. But the blame is not placed where it belongs, it usually falls on the dynamo and lamps used. If the system selected be a standard one this blame is rarely merited. It is the common experience of those who have given the matter attention that a particular system has often to meet an unwarranted prejudice. The blame in such cases is to be attached to the manager of the plant, who through false ideas of economy is using a poor grade of carbons. Yet it does not always rest on the manager, for experiments made by the writer have shown that the makers of an arc lighting system, who, to control the whole trade, undertake to make their own carbons do not always furnish these of the requisite quality. The dissatisfaction of town councils can usually be overcome by the intelligent and judicious selection of the carbons used for the lamps.

When studying the physics of the arc with reference to the present subject care must be exercised to distinguish between the simple electric arc and an arc light to be used for purposes of illumination. An electrical arc is due primarily to the interruption of the circuit by an air-gap. With the potential ordinarily employed for this class of lighting the distance over which a spark will pass in air is a very small one indeed. An arc requires to be established by bringing the two points of the circuit in contact and then separating them. The spark no longer passes in *air*, but through the atmoshpere formed by the vaporized ends of the circuit. The electric arc is in most cases but feebly luminous. When a fuse blows or a switch is opened with a heavy current a powerful arc is established, but one of low candle-power.

To employ an arc for lighting purposes presents a problem similar to that met with in the use of flames in general for illumination. A substance must be vaporized in the arc which, at its high temperature, will become intensely luminous, or spend its heat energy in emitting rays which are distributed as far as possible throughout the luminous spectrum. This, in short, is the statement of the problem with which we are dealing. Electrical arcs were things of frequent occurrence and common observation before the time of Davy's experiment. But this classical experiment consisted not in the establishment of an electrical arc but in filing it with a highly luminous vapor. In the year 1800 Sir Humphrey Davy interrupted a heavy battery current passing between two pieces of wood charcoal by separating the carbons, and witnessed the first carbon arc light, an arc emitting a large volume of intensely white light.

There are many points in the physics of the carbon arc light which are by no means definitely settled, yet those influencing its candle-power are pretty thoroughly established. The end of the positive carbon becomes so highly heated that it melts and boils off in vapor. Whether this vapor is carried over to the negative carbon by the action of the current is of but slight consequence. We know that by some means it becomes rather uniformly diffused throughout the arc; some of it burns away in contact with the oxygen of the surrounding air, while a portion is deposited mechanically on the cooler negative carbon. It is this carbon vapor upon which the candle-power of the arc depends. In this function it differs in no respect from the luminous carbon of the ordinary gas or oil flame. The attempts to render gas flames richer in candle-power have an equal bearing on the candle-power of the arc lamp. A high candle-power gas flame is one rich in carbon vapor, and the attempts to introduce solid and liquid hydrocarbons in the gas flame have had their counterparts in similar trials with the electric arc. So far, such attempts to introduce hydrocarbons in the arc by soaking the carbons in them or by injection into the arc through a tube have not proven sufficiently successful to warrant their commercial application, yet they point out a correct principle. The lesson of such facts is that the candle-power of the arc depends upon the amount of the carbon vapor held in it. The mere passage of carbon between the poles of the arc does not insure its operation in increasing its candle-power. The carbon in transit must be in a free molecular or gaseous condition. If it be in little granules, even should they be highly heated, they can emit light only from their surface. The result is that a large amount of carbon passes through the arc without materially increasing its candle-power. Too much stress cannot be laid upon this latter consideration. To the manufacturer and user of carbons as well, it will indicate one of the leading sources of failure of carbons to produce the requisite candle-power. To one versed in these matters, the ordinary arc light is a disappointment and source of vexation. It is usually too blue. It produces a shadow area which often exceeds the luminous. The arc burns on one side of the carbon most of the time, lighting only a portion of the area it should cover. It travels around the carbons with an uncertainty of disposition annoying to those dependent upon it for light. Occasionally the arc is properly centred and meeting with suitable carbon comes up to its required candle-power only to resume a new cycle of vexatious actions. At other times the carbons rapidly vibrate back and forth and the whole lamp seems to whip and pound before it again settles down to steady action. In view of such facts it is little to be wondered at that the arc lamp as ordinarily operated is perhaps the most unsatisfactory means of illumination in use. The globe of such a lamp furnishes an explanation for its erratic behavior. The cup of the lamp is nightly filled with a mass of carbon chunks and granules. But does it ever occur to the manager that this carbon refuse represents a waste of the carbons placed in the lamps? With carbons of the proper quality there would be little, if any, waste, to remove from the globes. The percentage of carbon lost is, however, the least consideration. These granules are evidence of irregularity in the burning of the lamp with consequent diminution of the candle-power.

In this connection may be mentioned another defect often shown by carbons—it is the slight explosions and sudden flaming that accompanies their burning, occurrences which also have their effect in fluctuations of candle-power.

Waiving the question as to the superiority of foreign or American carbons, it will suffice to point out the characteristics of a good carbon. In the first place, a carbon should be uniform in texture to produce steadiness of the arc. The cheaper grades of solid carbons used for outdoor lighting show variations in volatilizing power not only on points on the surface, but throughout the interior mass of the carbon. Of two points on the positive carbon, one hard and the other softer, and equidistant from the negative, the arc will spring mainly from the softer, because it yields more carbon vapor and offers less resistance; such a varying carbon will produce a vacillating arc whose average candle-power is considerably less than if it were stationary, since each change of arc position implies the heating of a cooler mass to the temperature of volatilization. A shifting arc, too, by rapid and unequal expansion will break off large granules from the carbons. Irregularities in shape, even with carbons of the proper quality may produce these same effects. To insure uniformity of texture, carbons must be thoroughly burned throughout, not merely hardened on the outside layer, otherwise gasing carbons will result. There is room here for great improvement in manufacture. Flaring of the arc is too common and should be absent when perfect carbons are used. So far as processes of manufacture can be learned, too much stress is placed on merely high temperatures for baking the carbons. This will either produce a long-lived, low candle-power carbon, or one lacking in uniformity of texture, depending upon how long the carbons have been heated at the highest temperature. Experiments seem to indicate that the best carbons, those of uniform texture, moderate life and high candle-power, are obtained when the kilns are not heated to such a high temperature, but the highest temperature of baking is continued for a longer time than is usual in this country, thus producing a soft carbon and one from which all gasing elements have been removed.

The quality of a carbon can be determined in another way than by burning it. It is a tedious matter to follow the consumption of carbon in an arc lamp by volt and ammeter readings and photometric measurements. The writer has obtained a fairly accurate knowledge of the light-producing qualities of carbons by an electrolytic method. Two carbons are used as electrodes in a 25 per cent. solution of KOH or NaOH. If the cementing substance has not been thoroughly burned out from the carbons, it will diffuse in a short time through the liquid. The positive carbon should be examined from time to time. The action of the liberated oxygen is to consume the positive carbon, and if any variation in hardness is present it will be shown in elevations from which the softer carbon has been eaten away. As the outer layers disappear the rapidity of removal of the inner layers will furnish an indication of the character of the centre of the carbon. A current of two or three amperes will prove sufficient for the test.

Manufacturers have so far paid too little attention to the fusibility of the crude carbon which they employ. It has been a current belief that fineness of grain of the material before moulding was the leading consideration. But uniformity of grain, rather than fineness should be sought. A carbon which volatilizes readily will yield good results within certain limits independent of the grain, provided this be uniform. The candle-power of a carbon is not determined by the fineness of the carbon flour from which it has been moulded, Bearing in mind that the finished carbon should have all the cementing substance thoroughly carbonized, the carbon must remain sufficiently soft to properly volatilize in the heat of the arc. Another fact is that the nature of the crude material influences this condition as well as the processes of manufacture.

It has already been pointed out that the candle-power of an arc lamp depends on the amount of carbon vapor which it contains. Two carbons of uniform texture but unequal hardness may show, when burned in the same lamp, and at the same watts, as great a difference in candle-power as 50 per cent. The condition of the same watts is stated, for in a given carbon the candle-power varies almost directly as the watts. This has been fully shown by a number of reported tests in Europe, and some recently published by the writer. My experience has demonstrated that the carbons of the same grade, obtained from a reliable maker, are practically uniform in candle-power. When the similar grades of carbons by different manufacturers are compared a wide discrepancy is found in the candle power yielded, and this, too, with nearly the same length of life of the carbons. Manufacturers can then produce a fairly uniform product, but, as a rule, few seem able to obtain the maximum candle-power. When selecting carbons the manufacturer as well as the grade should be considered.

If a good grade of carbons be purchased there are still two considerations influencing the choice of their quality. A carbon may be purchased for high candle-power or for long life. In the same grade of carbons made by a given manufacturer these two conditions are directly opposed. We will suppose the carbons to be of proper quality so as not to waste away meçhanically, then the softer the carbon the higher the candle-power per watt obtained, but the shorter the life. These two properties follow very closely a reciprocal relation. The softer carbon will volatilize readily and maintain the arc rich in carbon vapor, but will only burn, say 10 hours. Another carbon will burn 14 or 15 hours, but will yield a bluish light, be less emissive, and of much lower candle-power. In the economics of central station management the use of a carbon purchased simply because it is long-lived is a piece of extravagance. No matter how excellent the generating plant, the line and lamps may be, the long-lived carbon with its blue light and low candle-power renders the whole system inefficient. Since it has repeatedly been shown that the quality of the carbon may influence the total candle-power output of a plant by as much as 50 per cent., it needs no further calculation to show that over 30 per cent. of the total cost of maintenance of the plant is simply thrown away if bad carbons be used. Looked at in the proper light, the added cost of suitable carbons, not too hard, nor too long-lived, and the added expense of trimming is but slight in comparison with a possible total waste of 30 per cent. in maintenance. The frequent use of poor carbons can only be excused through the ignorance or false ideas of economy of the station manager. A grade of carbon is represented to them as cheap and long-lived, and is accordingly purchased. To such people carbons are simply carbons. They seem to think the light is yielded by the electrical current, and anything which will maintain the arc will produce the proper light. They entirely ignore the fact that the current is really secondary and has but little to do with the candle-power of the arc in itself, forgetful that the light is due to the incandescent carbon vapor which it holds.

In many respects all this applies to incandescent arc lighting as well as series, only in series lighting the faults may be more aggravated, since a bad carbon will burn more continuously in a series than a multiple lamp. Incandescent arc lamps are now excellent and reliable if the proper quality of carbons be used in them. Faults and variable carbons have given more difficulty to lamp designers than any other cause. Any ordinary length of arc will produce hissing if the current be strong enough. A lamp adjusted to a given grade of carbon will often hiss when another is used in it. The electric arc has also been shown to have a certain critical point with relation to length of arc and current. Near this critical point the arc will be extremely sensitive and unsteady. Unless the adjustment of the lamp be changed as often as the quality of the carbons it will prove unsatisfactory.

The cored carbon is necessary to such a lamp because the proper softness is not yet obtainable in solid carbons. The lines along which solid or cored carbons should be selected have been pointed out above. In passing, it may be said that the incandescent arc lamp has been largely instrumental in directing attention to the influence of the carbons on the regulation and candle-power of the arc.

If these matters are clearly understood by the central station manager how will he be able to apply them when purchasing carbons? The test by electrolysis is not only easily made but quite conclusive in its indications if supplemented with careful observations of the behavior of the carbons in the lamps. The quality of the light should also be considered; if bluish, the carbons should be rejected in favor of those burning with a white light. Current and potenital readings on a lamp should be taken and the results plotted in the usual way. The contour of the curve will be a great aid to the decision. If possible, these tests should be supplemented by photometric readings. These may be so readily made that they should present no serious difficulty. As the tests are comparative, the light-value of the standard is not of such moment. A home-made Bunson photometer and a standard candle or a standardized incandescent lamp will be all-sufficient. These measurements of different carbons should be made with the same lamp at the same angle and at equal watts, or several readings on one carbon be made and reduced to standard watts as already alluded to. Such an examination will bring out the quality, life and candle-power of the carbons compared.

A New System of Electric Lighting.

The Moore Electrical Company on Tuesday evening, Feb. 12, gave an exhibition at its laboratory, Harrison, N. J., of a new system of producing the electric light, the invention of Mr. D. McFarlan Moore. Among those present at the invitation of Mr. E. J. Wessels, the vice-president of the company, were representatives of the electrical press, Prof. W. A. Anthony, and several other gentlemen interested in electrical science.

Mr. D. McFarlan Moore before exhibiting the new light gave a lecture in which the principles involved were explained and the great modifications pointed out which its application would introduce into interior illumination. Mr. Moore then showed numerous forms of lamps embodying the invention and operated from conductors leading from a distant part of the laboratory where the generating apparatus was installed. Near the close of the lecture some of the lamps were also lighted from a Grenet and from a small dry battery.

The experiments were followed with much interest by the audience, who were particularly impressed by the great variety of effects produced by Mr. Moore in lamps of different construction. While the invention has not yet assumed a practical shape, yet, in the short time of three months during which it has been in process of development, much has been done, and it is thought that by the time patents now pending are issued the invention will have been advanced to the commercial stage. Owing to patents not yet issued the Moore Electrical Company cannot at present divulge any of the details of Mr. Moore's work, the exhibition of Tuesday having been a confidential one.

Another invention of Mr. Moore's that is in a more advanced state is a method of controlling the candle power of incandescent lamps, and equally applicable to continuous and alternating circuits. The attachment for this purpose is simple and inexpensive, and the lamp socket containing it does not differ in external appearance from the usual form. It was shown that by means of this very simple device the light of a lamp on an ordinary continuous current circuit can be varied through its entire range of candle power; in one form exhibited, by turning the usual key a quarter turn beyond its usual "on" position, the candle power is reduced by an amount determined by the adjustment when installed. The same socket may also be adjusted, so that a lamp of given voltage can be used at will on circuits of any voltage.

At the close of the exhibition Mr. Moore was warmly congratulated by his auditors, who were much interested not only in the beauty and variety of effects produced, but also in the character of the novel principle to which they are due; much credit was also accorded to the inventor upon the great amount of experimental work he had accomplished in the short space of three months.

Popular Science.

An electrician in an article in the columns of the Washington *Post*, describing the advances of electrical science, informs the public that "some cities even now have entirely adopted the trolley system, *i. e.*, overhead electric wires by means of which the cars run." He further enlightens them with the intelligence that "by the vibration of tremors of sound in a peculiar instrument attached to a sounding box and electric wires or current, one can actually converse with another person miles and miles away," and in a burst of enthusiasm asks "where would our telephone, telegraph and cable be were it not for electricity?"

The Electrical Transformer.

BY CARYL D. HASKINS.

THROUGH considerations of economy, high pressures must be employed where electricity is to be distributed over a large territory with its lighting centres widely scattered, as is the case in most rural or suburban districts. With this as with water power, or, in fact, almost any known means of power transmission, the greater the pressure used the less the volume needed to transfer a given amount of energy from one point to another. With this reduction in volume, a reduction in the size of the conductor naturally follows, whether it be pipe or wire.

The economy resulting from the use of high electrical pressures through a scattered territory is therefore obvious. It amounts practically to the difference between a comparatively large or a comparatively small investment in copper wire, or, to put it yet more plainly, the use of say, 22 pounds of wire where 360 odd might have been required.

Unfortunately, however, these high pressures cannot under the ordinary arrangement be directly applied to incandescent lamps, since the making of these for pressures greatly exceeding, say 100 volts, is attended with grave difficulties, while the high pressures already referred to frequently amount to 1,000 or 2,000 volts, or more.

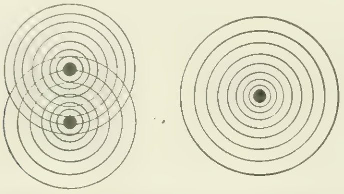


FIG. 1.—LINES OF FORCE ABOUT A CONDUCTOR CARRYING A CURRENT.

It is obviously necessary, therefore, if these high pressures are to be used, that some intermediate piece of apparatus be placed between the lamps and the wires carrying current at high pressure, which shall reduce it to the relatively low pressure needed at the lamps, without serious loss of energy.

This intermediate piece of apparatus is called a *transformer*, or less commonly a *converter*.

The principle of the transformer is based on the law of electrical induction.

When an electric current springs into existence it induces other currents in surrounding conductive masses, and when it ceases to flow it again induces a flow of current in neighboring conductors. While flowing in uniform quantity, however, it has no inductive effect. This action can be most clearly explained by dealing with the matter from a purely theoretic standpoint.

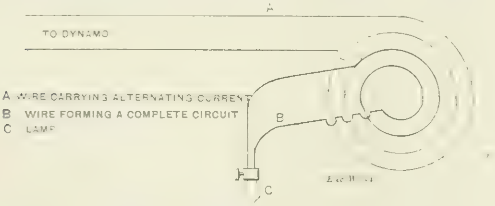

A
TO DYNAMO
A WIRE CARRYING ALTERNATING CURRENT
B WIRE FORMING A COMPLETE CIRCUIT
C LAMP
B
C

FIG. 2.—SHOWING PRINCIPLE OF TRANSFORMER.

It is assumed that all active electrical conductors are surrounded by a field of magnetic force, as shown in the second cut of Fig. 1. The black centre here represents a section through a wire forming part of a complete circuit carrying an alternating current. The concentric rings surrounding the wire indicate the imaginary lines of force, little ripples of *energy*, extending equally in all directions, and becoming less and less intense as they become more remote from their source. There is a certain graphic analogy between these lines of force and the ripples that follow the throwing of a stone into still water. The theory on which inductive law is based is: That when a conductor cuts through "lines of force," or vice versa, when "lines of force" cut through a conductor, a current is set up in that conductor provided it be part of a complete circuit.

Turning to the first cut of Fig. 1, suppose that a current springs into existence in the upper conductor; lines of force are immediately projected from it, and these cut through the second conductor, causing therein a momentary flow of current. On the cessation of flow in the upper wire its lines of force immediately contract upon it, again cutting through the lower wire in so doing, and again causing current to flow in the secondary.

This is the action which goes on constantly and with enormous rapidity between the windings of the transformer.

From this it will be seen that a transformer cannot be used on circuits whose current flows constantly in one direction; and for this reason high pressure distribution is ordinarily accomplished by means of the "alternating system," the current in this system changing its direction of flow many times each second.

We see, therefore, that by reason of the law of induction a wire carrying an alternating current and stretched or wound close to another wire forming a complete circuit (through lamps or otherwise), will induce a flow of current in this second wire, commonly called the "secondary" (see Fig. 2). That is, the first wire, or "primary" will transfer a greater or less part of its energy to the "secondary," more or less power being, of course, lost in the process.

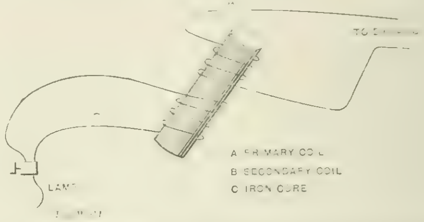


FIG. 3.—OPEN MAGNETIC CIRCUIT TRANSFORMER, IN DIAGRAM

The immediate presence of iron greatly aids this inductive transfer of energy, since average iron, roughly speaking, is some 700 times better as a medium for such transfer than any other known substance, by reason of its magnetic character. Iron is, therefore, practically indispensable in transformer construction, and forms one of the three elements which together make what is, perhaps, the very simplest piece of electrical apparatus at present manufactured.

These "elements" are the "primary coil," the "secondary coil" and the "core," which is, of course, the iron.

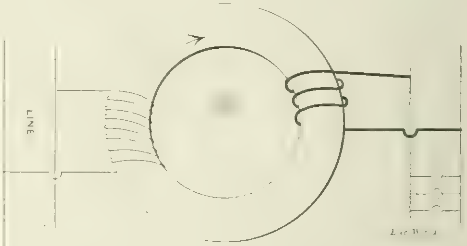


FIG. 4.—CLOSED MAGNETIC CIRCUIT TRANSFORMER, IN DIAGRAM.

A very crude transformer might indeed be made of but three pieces of metal—two lengths of insulated wire and an iron rod, as shown in Fig. 3. Such a transformer would, however, be extremely crude, and a large portion of its energy would be wasted in the form of heat.

To transform electrical energy from a distribution pressure of 1,000 volts to a lamp pressure of 100, for example, almost exactly 10 times as many turns of primary wire would be placed about the iron core as there would be turns of secondary. In fact, to state it roughly, we might say—As Number active turns primary: Number active turns secondary:: Pressure of primary: Pressure of secondary.

The two coils would, however, weigh about the same; for, if the primary coil with a pressure of 1,000 volts were carrying one ampere then the secondary coil would be carrying at a pressure of 100 volts (1-10 the primary pressure) almost 10 times the *volume* of current of the primary, or 10 amperes. (The discrepancy representing the amount lost in transfer.) The *pressure* multiplied by the *volume* of current equals the *power;* therefore, it will readily be seen that 1 ampere × 1,000 volts is really the same thing, so far as power is concerned, as 10 amperes × 100 volts.

The number of turns of primary and secondary wire, and the amount of iron in a transformer depends mainly upon:

1. The amount of energy to be transformed.
2. The relative voltage of the primary and secondary.
3. The frequency of alternations; that is, frequency with which the flow of current changes its direction.
4. The quality and arrangement of the iron and wire.

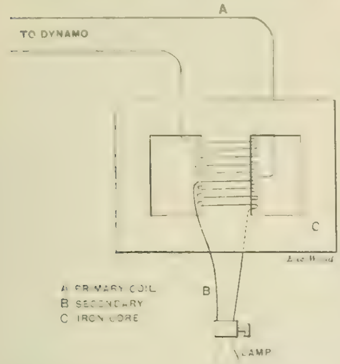


FIG. 5.—COMMERCIAL TRANSFORMER, IN DIAGRAM.

To give the best results the iron core should not be in the shape of a bar, as shown in Fig. 3, but should have its two ends joined together in some way, as, for instance, in the shape of a ring, as shown in Fig. 4, or as in Fig. 5, which is, perhaps, the commonest form of core.

Neither should the iron be in a solid piece; if it were so constructed it would be highly inefficient and cause a serious amount of heat waste, for reasons to be presently explained. It should be built up of thin layers of very soft malleable sheet iron or "low steel," each sheet being insulated from its neighbor by a piece of tissue paper or other non-conductive material, the whole core when built up looking about as shown in Fig. 6.

It is of importance, of course, that all of the wire be as near to the iron as possible, since the iron is the medium through which the transfer of energy is accomplished. In practice, therefore, the holes through the core, as shown in Fig. 6, are completely filled with the two coils (see Fig. 7), which are wound up and wrapped with tape before being placed in position, the entire transformer when ready for casing looking about as shown in Fig. 8.

One of the most important considerations in the construction of a transformer, or, in fact, of any piece of electrical apparatus which is to be used upon high pressure, is the question of insulation. It is vitally important that all three portions of a transformer should be absolutely isolated electrically each from the other, and it is the common practice to make the resistance of the insulation sufficiently high to withstand at least *twice* the pressure to which it is expected the transformer will be exposed.

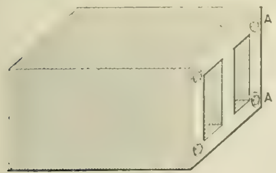


FIG. 6.—TRANSFORMER CORE.

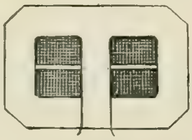


FIG. 7.—SECTIONAL VIEW OF TRANSFORMER.

Some manufacturers carry this safeguard yet further and insert insulation sufficient to withstand a pressure three, four, or even five times greater than that on which the apparatus is to operate. The process of manufacture of a transformer is peculiarly simple.

The sheet iron for the core, which is selected with great care and only after elaborate tests to determine its magnetic qualities, is passed, one sheet at a time, into a power punch which cuts out the plates of the size and shape required. By referring once more to Figs. 6 and 8, it will be seen that if the core plates were cut in one piece without a break it would be very difficult, if not impossible, to put the coils and core together, as it would be almost beyond human ingenuity to wind the coils into the core and quite impossible to properly insulate them.

The plates are usually cut in two or more pieces so that the coils can be inserted without inconvenience. There are two general methods of joining the two sections of the core. One is to punch the two halves of the core in separate pieces, as is shown, for instance, in Fig. 9.

The other differs from this method in that the punchings are so proportioned as to overlap one another at their junction, making the magnetic joint in the iron dependent on the lapping contact of plate to plate rather than upon the butt contact as in the first method. When this class of punching is used the core cannot, of course, be built up in two solid pieces before the insertion of the coils. The plates are instead built up around the coils, being laid in alternately and their ends lapped, first right and then left.

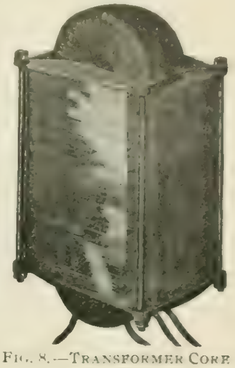


FIG. 8.—TRANSFORMER CORE WITH COILS.

There is a third method of building up transformer cores which provides for punchings in but one piece, but of a discontinuous shape. Such a punching is shown in Fig. 10. In building up the core around the coils with this class of punching, the central flap is bent back a sufficient distance to permit it to spring into position in the coils; or the side flaps may be bent back, a similar result following in either case.

The method used in building up a core out of plates of this type is clearly shown in Fig. 11. It will be noted that the break in the plates is placed alternately to right and left, thus reducing to a minimum the magnetic resistance at the point of juncture. The magnetic "resistance" of a piece of iron is dependent quite largely upon its continuity, and all manufacturers endeavor to so build their cores as to make the magnetic junction in their plates as solid and perfect a contact as mechanical necessities will permit. Whether the core be built up in two solid pieces or be of the overlapping type, or of the single punching type, each plate must be insulated from its neighbor, either by a layer of tissue paper—the oxydizing of the plates' surfaces—or some other similar means. This is to prevent the generation of eddy or foucault currents in the core, which, were the plates uninsulated one from another, would cause a serious loss of energy.

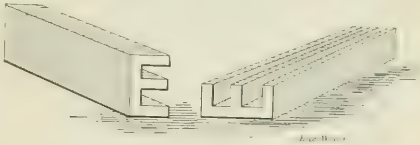


FIG. 9.—ONE FORM OF TRANSFORMER CORE.

We may now consider briefly the various causes of loss which together go to make up the discrepancy between the energy put into the primary and the energy taken from the secondary of a transformer at various loads. The energy passing through the primary coil might, for example, be divided up into various unequal parts, each part performing a different function and expending its energy in a different manner. A certain portion of the energy of the primary is expended in keeping the iron of the transformer magnetized. A certain portion of the energy is wasted in heating the wire of the primary coil by passing through it, a certain portion is wasted in hysteresis, and a certain portion in the generation of foucault currents. By far the greater portion of the energy is, however, transferred to the secondary coil to do useful work. So small in fact is the sum of the waste factors that in a modern high grade transformer of average size, operating upon full load, but 4 or 5 per cent. of the total energy put into the transformer goes to waste, the remaining 95 per cent. being transferred to the secondary as useful current.

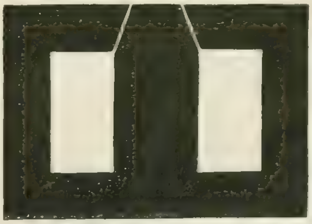


FIG. 10.—CORE STAMPING.

The loss in a transformer, due to waste energy expended in heating the primary, is, of course, due to and dependent on the ohmic resistance of the primary coil, and, of course, a certain amount of energy is lost in the secondary coil in a similar manner.

The energy wasted in foucault or eddy currents is that energy which is expended in inducing in the iron core (and sometimes in the winding themselves if they be of heavy wire) minute waves or eddies of current circulating in the substance of the iron. It is to prevent such waste that the cores of all commercial transformers are laminated.

The eddy currents in a transformer of ordinary shape tend to take somewhat the course indicated by the arrows, as shown in Fig. 12. It will readily be seen that the insulation of the plates one from another almost absolutely prevents the passage of these currents, since they are necessarily of excessively low potential. Where the insulation of the plates of a transformer is properly accomplished, eddy currents in the core are almost eliminated, and the energy wasted by this particular factor is reduced to a figure so small as to be almost negligible.

The loss by hysteresis is perhaps the most difficult to correct and to determine with which the transformer manufacturer has to deal. It represents that energy which is expended in constantly reversing the direction of magnetization within the core. Probably the most graphic method of explaining the hysteresis loss in a transformer is based on the theory of molecular friction. It is assumed that all iron is made up of an infinite number of separate molecules, each molecule having a given magnetic polarity. When a piece of iron is magnetized these molecules are shifted in position, arranging themselves with their poles pointing systematically in one direction.

Let us for a moment assume that these molecules, instead of being so infinitely small and close together as to be beyond the detection of the most powerful lens, are of relatively large size, and but loosely associated, as would be the case, for instance, with a mass of iron chips. In Fig. 13 is shown a portion of an iron bar supposed to be constituted of large and loosely associated particles of iron. On the passage of current through the winding around this bar these particles of iron will naturally arrange themselves with a systematic and uniform direction of polarity. On the reversal of the direction of current flow in the coil surrounding the bar, each of these molecules must turn half round to accomplish a reversal of polarity. In doing so it is obvious that a certain amount of friction must result by the rubbing of the particles one against another, and if this reversal were to take place many times each second, as, indeed, in the case in a transformer, the constant friction must of necessity result in heat. This is the theory generally accepted as accounting for the loss by hysteresis.

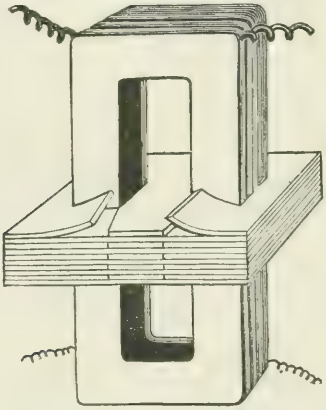


Fig. 11.—Building Up Transformer Core.

Both the hysteresis and foucault current losses express themselves in heat, and are generally considered together, the energy wasted by these two losses being determined by the amount of heat generated in the core apart from that resulting from radiation from the windings.

The separation and the determination of the value of the hysteresis loss, and the foucault current loss, individually, is seldom attempted, and is difficult of accomplishment, almost to the verge of impossibility.

In considering the merits of a transformer there are five factors, each of which is of importance and worthy of investigation.

The first and probably the most important consideration is safety to life and property. Too much stress cannot be laid upon the high quality of the insulation separating the primary coil from the core and from the secondary winding. Any connection between the primary and secondary coil necessarily menaces human life, as does also the grounding of the primary coil upon the core. It is vitally important also that a transformer shall not overheat even at full load. The overheating of a transformer indicates an excessive waste of energy (due to core losses and the like), increases the fire risk, rapidly impairs the insulation, and is detrimental to the good operation of the transformer in every way.

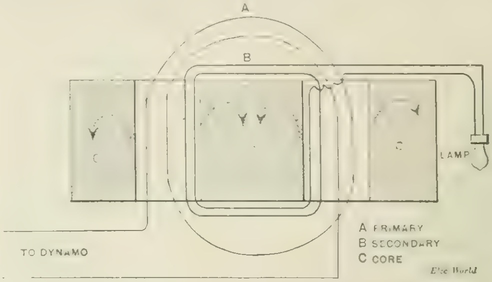


Fig. 12.—Section of Core Showing Eddy Currents.

The consideration of next importance is the question of efficiency. It is scarcely necessary to point out that that transformer which shows the least loss of energy between the primary and secondary terminals is the best transformer to use, provided such efficiency is not accomplished at the sacrifice of other important considerations. Over anxiety for high efficiency has, however, in some cases caused the neglect of the third consideration, which is that of regulation.

A transformer of perfect regulation would show absolutely no variation of secondary potential between the points of no load and full load. Absolutely perfect regulation is, however, an impossibility in the commercial transformer, since it would involve the sacrifice of efficiency and other important virtues which are indispensable. The transformer manufacturer endeavors, therefore, to find the most useful intermediate point between extremely high efficiency and extremely close regulation. Regulation which secures a variation of potential on the secondary circuit not exceeding 2½ to 3 per cent. between no load and full load is generally accepted as the most satisfactory.

The other two considerations which go to make up the general merit of a transformer are respectively, durability and convenience in installation and maintenance.

The question of durability is dependent, first, upon good mechanical construction and quality of material, and second, upon the cool running of the transformer.

That transformer which is best protected from storm and rain, and which is manufactured from the highest grades of materials, properly combined, is, generally speaking, the most durable, provided it does not overheat, and by so doing rapidly deteriorate the insulation, for it is the strength and permanence of the insulation on which durability is chiefly dependent.

The question of convenience for installation is one which the eye quickly determines. The presence of convenient connection blocks with a minimum number of screws so placed as to be most speedily available, suitable means for prompt re-fusing, and the like, constitute considerations which the eye of a practiced central station man immediately appreciates.

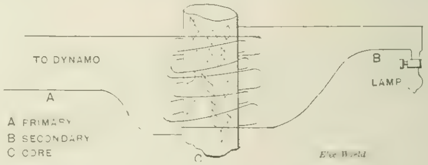


Fig. 13.

The tendency to-day is toward the use of the larger transformers which are inherently of higher efficiency; and it has become a generally accepted axiom that the less transformers used (provided such transformers are not in excess of the capacity needed) the better for the operation of the system; not only because of the higher efficiency obtained, but also because of the less time needed to care for a small number of large transformers, and because of the better regulation secured throughout the entire system.

Buffalo Electric Lighting Plants.

BY FRANK C. PERKINS

BUFFALO is supplied with current for street arc lighting, commercial arc light and incandescent lighting by the Buffalo General Electric Company, of which Mr. Daniel O'Day is president and Mr. Charles R. Huntley is general manager.

The current for the city arc lighting is supplied by the Elk street station No. 1 (Fig. 1), and the Black Rock station No. 3 (Fig. 2). The commercial arc lighting and the incandescent lights are operated from the Court street station (Fig. 3).

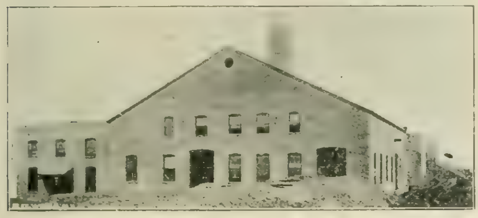


FIG. 1.—ELK STREET STATION NO. 1.

The Buffalo General Electric Company has been very unfortunate in having two serious conflagrations. The first at the Court street station No. 2 of serious proportions, and the last in February, 1893, almost completely wiping out the Elk street station No. 1 and necessitating extensive rebuilding and remodeling.

The steam boiler plant, Fig. 4, of the Elk street station consists of six National boilers of 125 hp each; two Babcock & Wilcox 250-hp boilers, and one 175-hp upright boiler; one 250-hp boiler built by the Oil City Boiler Works, and one 500-hp Scotch boiler, shown in the foreground of Fig. 4, made by the Lake Erie Engineering Works. The steam pressure is 140 lbs.

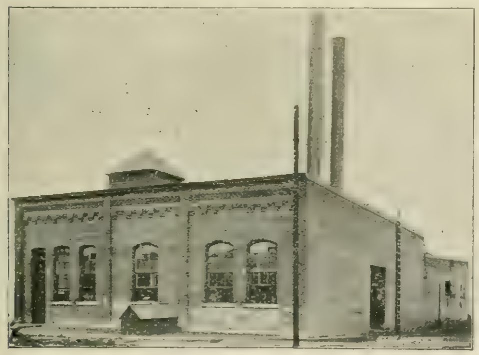


FIG. 2.—BLACK ROCK STATION NO. 3.

The engine room of this station, Fig. 5, contains two large E. P. Allis Corliss engines. The one shown in the foreground is a compound condensing engine, developing 1,500 hp at 68 revolutions per minute. The second engine is also a compound condensing engine, developing 1,000 hp at a speed of 72 revolutions per minute. E. P. Allis & Company's condensers are used in this station. The engines are belted to a long line of shafting located in the dynamo room beyond the brick wall seen in the background.

The arc machines in this station furnish current for all of the arc lights on the streets of the city. The dynamo room contains 39 No. 8 Brush arc dynamos of 50 lights capacity each, making the potential used on these circuits in the neighborhood of 3,000 volts.

There have also been installed five No. 11 Brush arc machines of a capacity of 125 lights each, making the working pressure about 6,000 volts. Mr. Huntley says these machines are working satisfactorily, and believes this to be one of the best arc lighting stations in the country. The Elk street station is about 250 feet long by 140 feet wide, and is a brick structure, having been remodelled in 1893. The original station was built in 1889.

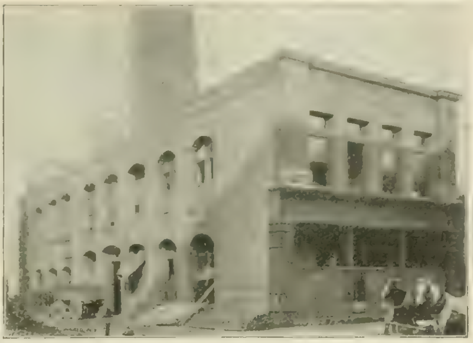


FIG. 3.—COURT STREET STATION NO. 2.

The Black Rock station is also a brick structure, and is 150 feet long by 100 feet wide. The boiler room (Fig. 7) contains four horizontal tubular boilers, each of 100 hp capacity. From this station current is supplied to the arc lights located on the west side of Buffalo and Black Rock. The dynamo and engine room (Fig. 8) contains four 60-light and six 80-light Wood arc machines. They are driven from a countershaft receiving its power from a compound condensing engine built by the John T. Noye Manufacturing Company, of Buffalo. This engine develops 400 hp at a speed of 300 revolutions per minute. Worthington condensers are used in this station, and the plant is said to be giving excellent satisfaction.

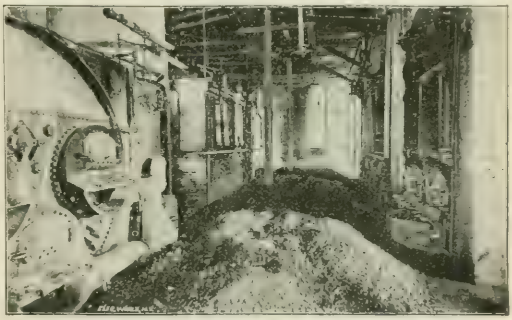


FIG. 4. ELK STREET STATION BOILER ROOM.

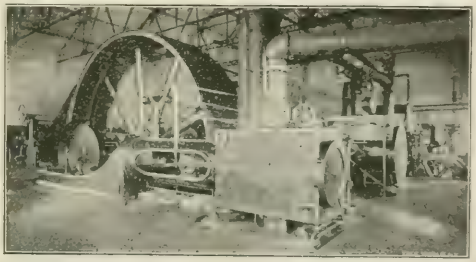


FIG. 5.—ELK STREET STATION ENGINE ROOM.

The Court street station has been re-arranged since the fire, and it is from this station that all the commercial incandescent and arc lighting current is supplied. The dynamo room, as it is at present, is shown in Fig. 9. The power is supplied from eight compound condensing engines built by the John T. Noye Manufacturing Company, ranging in size from 100 hp to 400 hp; there is also a Westinghouse compound engine of 125 hp capacity driving two Thomson-Houston dynamos.

The electrical equipment of this station comprises two 300-kw alternators of 6,000 lights capacity at 1,040 volts potential, three 70-kw alternators of 1,500 lights capacity, and two 60-kw 1,200 light machines, all of which operate at 1,040 volts.

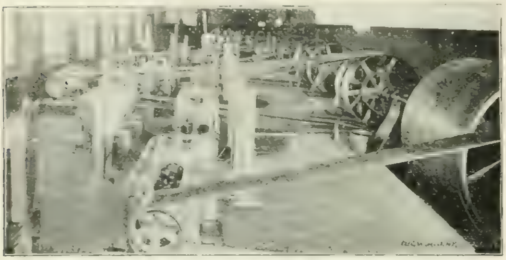


FIG. 6.—ELK STREET STATION DYNAMO ROOM.

There are two direct current General Electric dynamos which supply incandescent lights to customers in the immediate vicinity of the station. These machines operate 400 lights each as a potential of 110 volts.

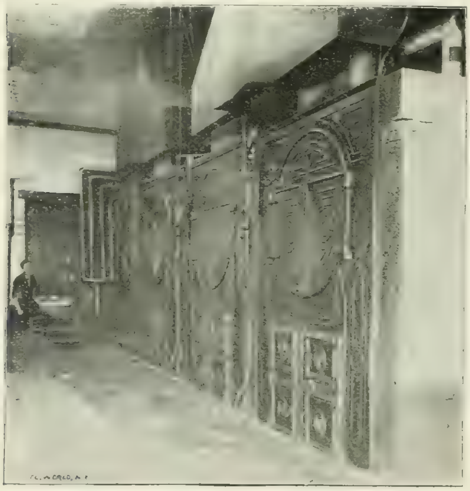


FIG. 7.—BLACK ROCK STATION BOILER HOUSE.

The power circuit is operated by a General Electric power generator, developing 200 kw at 500 volts. The arc lighting dynamos are all Thomson-Houston machines, and several are driven in tandem from John T. Noye high speed engines. There are eleven of these arc machines installed, each furnishing current for 50 lamps.

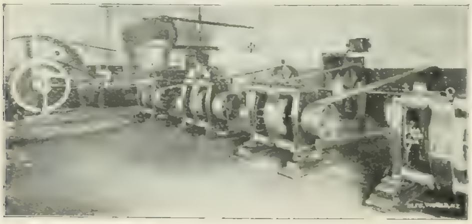


FIG. 8.—BLACK ROCK STATION DYNAMO ROOM.

The Buffalo lighting stations are all generating steam power as economically as almost any station of the size, and while much talk has been indulged in with reference to operating the stations by power from Niagara, this will largely depend upon how much lower than the cost of steam power the price of Niagara power will be placed for users in the city of Buffalo.

In reference to the most practical means to be employed for utilizing the Niagara plant for lighting Buffalo, and the reason why such a low frequency was adopted by the power company, Prof. George Forbes says, in his paper before the Institution of Electrical Engineers, London, England: "Here is one fact which is apt, at first sight, to impress one as almost fatal to the employment of a very low frequency, but which further consideration shows to be of little moment in the case of Niagara Falls; that is, that a low frequency is not suitable for electric lighting directly. But it must be remembered that it is decidedly preferable to use a direct current for arc lamps, and, in fact, in the present position of the art in America, it would be almost a necessity. Hence the natural method of lighting would be to use the alternating current by means of a motor to drive the well-known lighting machines. In the course of the work at Niagara, the first work in connection with arc lighting which will be set up is the lighting of Buffalo. At present this is done by means of steam engines developing about 3,000 hp, and driving arc lighting machines of the Brush, Thomson-Houston and Wood type. There cannot be a doubt that financially and practically the best way of converting this station to enable them to use the power from Niagara Falls is to put in alternating motors in the place of steam engines; and this will be the case in most of the towns which will be supplied with power from Niagara Falls."

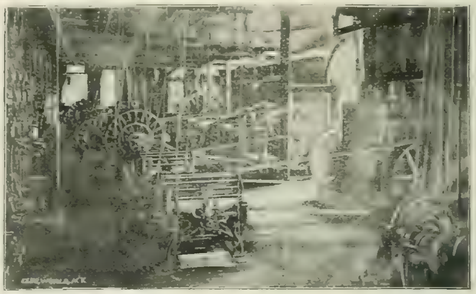


FIG. 9. COURT STREET STATION DYNAMO AND ENGINE ROOM.

It is generally believed that Prof. Forbes' plan will ultimately be adopted, the engines being held in reserve in case of emergency.

The Atlanta Exposition.

H. T. Edgar, secretary and general manager, and Oscar Turner, purchasing agent, of the Georgia Electric Light Company, Atlanta, Ga., will be at the Cleveland Convention of the National Electric Light Association, as representatives of the Cotton States and International Exposition, to be held at Atlanta, Ga., Sept. 18 to Dec. 31. Mr. Edgar and Mr. Turner propose to make a trip through the North, taking in the principal cities, where they will confer with the supply houses and electric companies relative to exhibits at the Exposition. It is purposed to make this Exposition the largest ever held in this country, with the exception of the World's Fair. Most of the European and South American countries will be represented. A separate building has been set apart known as Electricity Building, where electrical exhibits will be shown. The generating plant for the purpose of lighting the grounds and buildings and furnishing power will be located in the machinery hall. These gentlemen will have headquarters at the Hollenden, where they will be prepared to meet electrical people and arrange for exhibits, etc.

Fireworks in an Underground Railway Conduit.

Our special correspondent in Budapest writes us that some time ago a peculiar accident happened to an electric car on one of the main thoroughfares of Budapest. A chain supporting the sliding contact of a motor car fell through the conduit slot and lodged between the two contact rails in the underground conduits, making a dead short circuit. An attempt was made to dislodge the obstruction with a cold chisel, but without avail, and it was only after about one and a half hours' interruption in the traffic that the chain was burned away by the current, making a fine display of fireworks.

Coal Consumption in Central Stations.

BY E. A. MERRILL.

We define *coal consumption* as the total amount, measured by weight, of commercial coal- not combustible- thrown into the furnace for the production of steam to be used either directly or indirectly in the generation of electricity; it therefore includes the coal represented by the steam used in the pumps, condensers, purifiers, heaters, jackets, etc., and the coal rendered commercially unavailable in blowing off and cleaning boilers, getting up steam with new fires and making forced draught; it excludes coal represented by the steam used in heating, ventilating, etc.

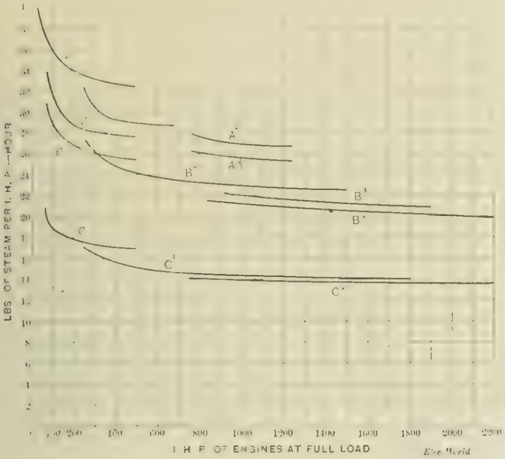


FIG. 1.

We define *central station* as a combined steam and electrical plant for the production of electrical energy to be utilized for lighting or power; this limitation being made arbitrarily to confine the scope of the article.

One of the principal problems that confronts the central station manager is to make the transformation of potential energy of coal into the kinetic energy of electricity with as little loss as possible—in other words to deliver at the switchboard the largest possible output in electrical energy with the least possible consumption of coal; the first step toward its solution lies in the determination of the relation between *input* and *output*; not between the coal scales and the water meter, not between the throttle and the driving pulley, not between the dynamo pulley and the armature terminals, but between the coal shed and the switchboard, including all the intermediate devices with their interdependent causes and effects.

To exhaustively discuss the questions involved would require a treatise, we therefore limit this brief discussion to certain specific cases, outlined in the following table; each column represents the characteristics of what may be termed a type of station, these types having been selected as representing closely enough for comparison the equipment of a large number of central stations.

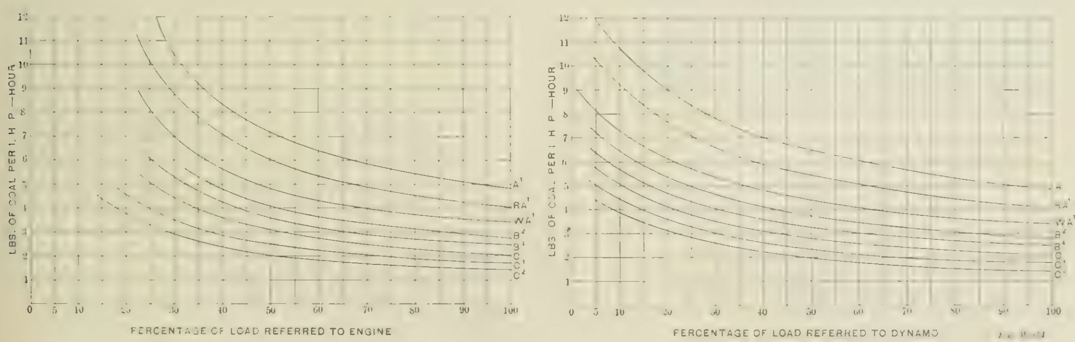
CURVE	A	RA¹	WA¹	B²	B³	C	[illegible]	C²
H. P. of Units	100 to 200	250 to 500	250 to 500	100 to 500	500 to 800	100 to 500	[illegible] to 800	800
Type of Engine	Simple Non-condensing			Compound Non-condensing		Compound Condensing		
Steam pressure	80	80	80	100	140	120	120	[illegible]
Steam i. h. p. and hour	35	30	30	[illegible]	22	17	[illegible]	13.6
Type of boiler	R T	R T	W T	W T	W T	W T	W T	W T
Available B. T. U. per pound coal	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500
Evaporation at given pressure	7.5	7.5	9	9	9	9	9.25	9.5
Eff. boilers—per cent	60	60	72.4	72.4	72.4	72.4	74.4	74.6
" engines—per cent	85	88	88	88	90	88	90	92
" piping—per cent	99	99	99	99	99	99	99	99
" miscellaneous—per cent	97	98	98	98	98	91	92	[illegible]
" belts—per cent	97	97	97	97	98	97	98	98
" dynamos—per cent	91	92	92	92	93	92	93	94
" leads—per cent	99	99	99	99	99	99	99	99

It must be confessed at the start that comparisons are at best faulty and to that degree unsatisfactory, but there is much to be learned from comparisons—experience is essentially comparison—therefore the more carefully and accurately they are made the more extended our knowledge becomes. How, then, can we compare central stations so as best to derive knowledge from the experience of others?

First by classifying them by some easily recognized characteristics and second by dividing and sub-dividing these classes into such small divisions that all stations in the same group can be compared with each other without doing serious injustice to any individual.

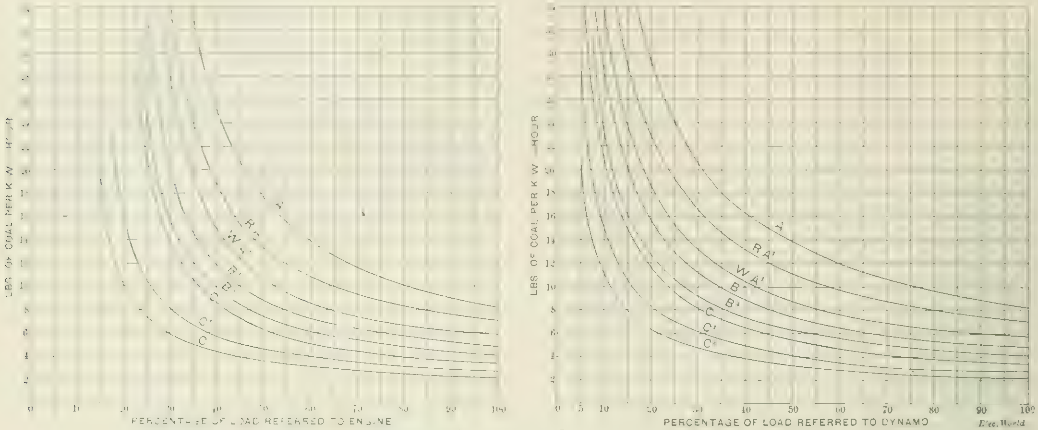
Comparisons between divisions having diverse functions and operating conditions are hardly more than rough generalizations; to call them comparisons is liable to give the results fictitious values and to establish false standards of central station economy. Even comparisons between sub-divisions are far from satisfactory, for they vary widely in their elements.

To go at once to the root of the whole matter, the most essential and valuable comparisons, so far as managers of central stations actually in operation are concerned, are either between stations which can be reduced to a practical equality of equipment and operating conditions, or between actual stations and an artificial standard attainable by a, commercially speaking, perfect station of the same type. When a station is once in operation it is far more to the manager's interest to know that his eight pounds of coal per kilowatt and hour cannot be bettered by any similar station, than to know that his neighbor in the next town with a different equipment and service gets the same output on six pounds, and vastly more satisfactory if he further knows that his neighbor ought to get the same output on five pounds; a good manager is not one who gets a larger output per pound of coal than his neighbor, but one who gets the largest output possible with his station. Comparisons between stations without discrimination as to equipment or operating conditions are responsible for a great deal of unmerited praise and undeserved adverse criticism.



FIGS. 2 AND 3.

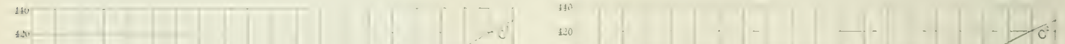
On account of the many variables to be taken into consideration it is by no means an easy matter to determine what output a station should have; take for example the engine—Fig. 1 gives a series of economy curves of engine listed by a single manufacturer; all the engines are of the shaft governor, positive valve motion type, and the smaller ones are of the so-called high-speed class. The A's are single cylinder, non-condensing engines; the B's are compound non-condensing; the C's are the compound condensing. We see that there are wide variations in economy, even among engines distinguished by the same letter; these variations are due to differences in size, valve gear, clearances, steam pressure, cylinder proportions and ratios, speed and minor constructional details.



FIGS. 4 AND 5.

Similar differences, not always so wide, occur in every kind of apparatus that goes to make up the complete station equipment, so that it is necessary in determining the possible output from a given station to explicitly define the quantities involved.

The letters at the top of the table refer to the curves in Figs. 2 to 7 inclusive, and also indicate by reference to Fig. 1 what engine is assumed to be used; the R and W before A¹ indicate that in one case the station is equipped with horizontal return tubulars and in the other case with horizontal water tube boilers, the remainder of the equipment being identical in both stations; the same boiler division is also made by the letters R T, and W T, under "Type of Boilers." The number of available thermal units, 12,500, is taken as the value of a good grade of coal, and is necessarily made uniform for all the stations; the fact that the output is a direct function of the steaming value of the fuel is a point that seems often to escape notice. The efficiencies, with the exception of miscellaneous efficiencies, we believe do not require explanation; the percentage under miscellaneous efficiencies is the ratio of the thermal value of the steam received by the engine cylinders to the thermal value of the steam delivered by the boilers, the difference having been lost through radiation, condensation in piping and jackets, blowing off, etc., or utilized in operating feed pumps, condensers, traps, forced draught, etc.



FIGS. 6 AND 7.

Assuming that the parts are all so proportioned that at full load every part fulfills the conditions laid down in the table, we have the necessary data to determine the full-load economy of the several stations; with an efficiency curve of each part over the range of load selected for each station we have the necessary data for determining the economy at any specified load and all the curves in Figs. 2 to 7 inclusive have been derived in this manner. At best they hold true only for the conditions assumed, nevertheless we believe that they are in the direction of a true measure of the comparative fuel economy of central stations and that a comparison of the figures here given with results from the actual operation of stations somewhat similar in equipment will indicate some of the reasons for the observed wide variations in fuel economies.

In reference to the curves the following explanation must be kept in mind: no curve represents throughout its length a single station. At full load the efficiencies given in the table are used, but for all other loads the curves are intended to show the probable fuel consumption for stations having similar equipments, but the efficiencies of stations that are operated at the percentage of load selected, each curve representing the sum of different portions of the curves of four and sometimes five distinct stations having similar equipments but different average loads and efficiencies. For example, curve A covers four distinct stations each having the units and the equipment specified in column A of the table; it also has the efficiencies there given at full load; as the load decreases, however, we assume that a station that is operated, say, at an average of 60 per cent. of its total dynamo capacity, does not have the same painstaking care and thoroughness in details as a station operated at a higher average load and, therefore, will not have so high an efficiency even at the same load, so that if we should continue the curve of the 60 per cent. station from the 60 per cent. point it would fall below the actual curve for higher percentages of load and rise above it for lower percentages. The extension of all these curves would cause unnecessary and undesirable confusion, and we have therefore carried each station over a moderate range of load and then combined these in a single curve.

The final standards of fuel economy will probably be based largely on practical results rather than on theoretical considerations, but before that is possible many reforms must be initiated and carried out through the active co-operation of station managers, first and foremost among which is the absolute necessity of comprehensive and accurate records reported in detail, together with a complete description of the station and its operation. The initiative should come from station managers, as they are the ones most deeply interested, yet we venture to suggest that if they will proceed at once to define to what part of the station equipment the percentage of load shall be referred, to define between what limits economy shall be measured, and to accompany their reports with a full description of the station, much of the fog of misunderstanding that now surrounds the subject will be dissipated.

Except at full load the percentage of load will not be the same on any two parts of the station equipment but will decrease with every transformation between the furnace and the switchboard, therefore the general term "load" can be applied to the station as a unit only in a general way; if we wish to be specific we refer the load to some particular portion of the equipment and custom has determined that this shall be either the engine or the dynamo—but *whether* the engine *or* the dynamo is a distinction seldom made and much confusion has resulted therefrom. For example, take curve A in Figs. 4 and 5; when the engine is indicating 50 per cent. of its full load the dynamo is delivering but 35½ per cent. of *its* full load, the difference being lost in increased percentages of friction and heat losses between the engine cylinder and the dynamo terminals; going backwards, when the dynamo is delivering 50 per cent. of its full load the engine must be indicating 60 per cent. of *its* full load in order to supply the increased losses between dynamo terminals and engine cylinder. The natural way seems to be to refer the load to the dynamo, as it is with the dynamo output that we are most immediately concerned; the coal consumption per i. h. p. and hour is, nevertheless, of considerable importance and ought to be determined in every station at certain regular times, but rather for purposes of internal economy than for comparison with other stations.

The limits between which economies shall be measured while perhaps not so indefinite is certainly in as chaotic a state so far as uniformity is concerned. We mean by this that if you ask a manager what the proper way to measure the fuel economy of his station is the chances are that he will tell you, if he tells you anything, that the best way is to divide the total kilowatt hours delivered by the total coal used and thus ascertain the kilowatt hours per pound of coal; but if you look over his reports the chances are that his results are in terms of electrical horse-power hours, indicated horse-power hours, ampere hours, lamp hours, in fact anything *except* kilowatt hours; furthermore, if they are in ampere hours he probably has omitted to note the voltage or, still worse, if in lamp hours he probably has omitted the watt rating of the lamps and has assumed a value for arcs and motors connected just as large as his conscience will allow.

Certainly much of this confusion and inaccuracy can be avoided by stating the station load in terms of the dynamo load, stating the output in kilowatt hours and stating the fuel consumption in pounds of coal per kilowatt hour, as in Fig. 5.

While we prefer to state the fuel consumption in terms of pounds of coal per kilowatt hour, yet as an efficiency curve showing the increase in fuel economy with increasing load the curves in Figs. 6 and 7 in terms of watt hours per pound of coal are more graphic but must be used cautiously for the reason stated above, that the curves are not curves of a single station; these curves also emphasize the now pretty generally accepted fact that there is a largely increased profit in business that brings up the average load and that any system which permits a steady load at the maximum economical capacity of boilers, engines and dynamos is worth investigating and trying thoroughly.

But the points we wish here to emphasize most of all are that stations should not be compared indiscriminately, that to make comparisons valuable they must have some common basis, must be comprehensive, must be accurate, and that there is no better method of checking up coal consumption than by comparisons intelligently made.

Iron-Armored Conduit Construction.

BY GEO. T. HANCHETT.

Iron-armored conduit is beginning to reap the benefits of the labor and advertising that have been expended to set it before the public.

The fact still remains that it is almost impossible to get uniform bids on any large contract involving this material, and this would augur that contractors are unfamiliar with it. Closer inquiry shows this to be the case and, therefore, the following description of an iron-armored conduit job may not be amiss.

The second job of this class of any magnitude in New England is that installed in the Broad Street Power Company's office building at Pawtucket, R. I., William R. Walker & Son, architects, Chas. O. Lenz, electrical engineer. A general street view of the building is shown in Fig. 1. Iron-armored conduit has here been put to quite a severe test as to practicability and convenience of installation.

The building is wired on the meter system, every one of the numerous stores and offices having a separate line, finding its terminus at a meter room in the basement. This involves a bunching of tubes as the meter room is reached, and this, with the fact that the building is piped for gas on a similar system emanating from the same meter room, demonstrates that a great number of tubes in a limited space can be readily installed in iron as well as in brass-armored conduit in spite of the great rigidity of the former.

FIG. 1.—BROAD STREET POWER COMPANY'S OFFICE.

The manipulation of this conduit is in no sense of the word a plumber's job, as many contractors are inclined to think. Pipers and plumbers can be trained more readily to do the work, but experience and care only are necessary. The fact that the tube is lined with an insulating and more or less perishable conduit calls for careful work. Especial care should be used in cutting off the conduit. The wheel pipe-cutter may be used on the iron armor but should not be allowed to complete the work.

As soon as the cutter has nearly reached the insulating conduit it should be removed and the work finished with a hack saw; the end should then be carefully trimmed with a knife or reamer. This caution may seem one of the standard rules of conduit installation, but in the case of iron-armored conduit the great rigidity of the work and the difficulty of opening joints once installed imperatively demands that the joints have no burrs or obstructions to fishing.

Of course, it is necessary to test out every run with a fishing snake as soon as it is in place, and it is better to run the spring wire through each piece of conduit before it is used—especially the elbows—as obstructions may exist inside. It should be remembered that in bending iron-armored conduit the insulating tube is rigidly controlled in its position by the iron armor and is therefore more liable to splinter and crack than if it were incased by a yielding brass armor.

The joints should not be too tightly screwed together. The soft insulating material is sure to yield under powerful screw pressure and thus buckle the conduit, as shown in Fig. 2. This would present a serious obstacle to fishing the wire through.

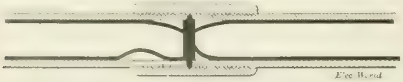


Fig. 2.—Buckled Joint.

The necessarily large size of the iron-armored conduit is somewhat unfortunate; the additional thickness of the armor and the necessity of installing two wires in one conduit contribute to this evil, and there is a resulting temptation on the part of the contractor to cut away and seriously weaken beams to admit the conduit. To the credit of contractors Scannevin & Potter, be it said, this was largely avoided in the construction of the Broad street station building.

It may be added that two wires in one conduit are *necessary* only in alternate current installations, as in that case two conduits would cause a large inductive drop which no amount of copper could eliminate. The advantage of two iron-armored conduits to one run is inappreciable and in no way comparable to the extra cost involved.

The elbow outlets of the conduit are especially in the way where it is desired to screw a switch or crow foot. In the building under discussion the device shown in Fig. 3 has been used and bids fair to be very successful. A wooden box lined with asbestos is set in the wall into which the conduits enter, and is covered with a beveled piece of mahogany on which the switch is mounted. This makes a neat outlet, almost equal to the standard junction box and costing much less. Asbestos-lined boxes have been utilized also for large junction-boxes in the basement for the purpose of relieving the long pulls.

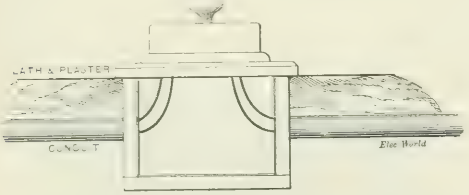


Fig. 3.—Asbestos-Lined Switch Box.

In conclusion, there is one item of interest to be mentioned, namely, the cost of iron-armored conduit construction. The material is a little more than twice as expensive as brass-armored conduit and the labor of installation about twice as great. Two wires in one conduit, however, halves the material and labor, so that the actual cost of an installation is but little more.

A comparison of the largest number of bids obtainable shows that iron-armored conduit construction is about 15 per cent. more expensive than brass-armored. However, the iron conduit has not been long enough on the market to thoroughly settle this figure. The cost per outlet is, of course, a variable figure, but at present, as nearly as may be judged, it is from $6 to $10, according to circumstances.

The fire-proof, nail-proof, and general all-around-proof qualities of the conduit seem to justify the extra expense. It has one other virtue—the care necessary in putting it up so that it will pass inspection is a brake on the workman. The nature of the work renders it slow and deliberate, so that he cannot rush it and botch it.

Consumption of Platinum.

According to *Industries and Iron* about three tons of platinum are used annually in America for the manufacture of incandescent lamps and other electric purposes, while one ton is used "for the more prosaic but no less useful purpose of being made into parts of artificial teeth."

What Shall We Pay Our Firemen?

By J. B. Cahoon.

One of the things that is assuming more and more importance as time goes on and we become more familiar with the operation of an electric light station and see through just what means we can produce electric light and make it pay is the question of firemen and what we shall pay them in order to obtain economical and satisfactory results. If we divide the country up into sections and look each section over carefully with a view to ascertaining what is paid to the firemen in each of those places, we find that in all of them, outside of the larger cities, the pay ranges from $40 to $50 a month. Let us go into this matter a little more in detail and see what this means. Suppose we take the average and call it $45 a month, which the fireman gets for working every day in the week and every week in the month; we may call this $1.50 a day. For this wage a great majority of electric light plants seem to think that they can get a man who will run their fires in an intelligent and economical manner. We know that in any of our cities the day laborer in the streets who does nothing but shovel dirt gets as much as this. We know that shoveling dirt doesn't require a great amount of intelligence, and as labor is supposed to be paid pro rata according to the amount of intelligence entering into it we would naturally look for about the same intelligence in our firemen as we find in the day laborer in a city street; we all know about how much intelligence that is. Is there any reason then for being surprised that the operating expense of many of our electrical plants runs up to 80 to 90 per cent. of the gross income, although it may be said in this connection that in quite a number of good-sized country towns the operating expense often falls as low as between 60 and 70 per cent. of the gross income? In many cases where we find the latter result it is due largely to the fact that the fireman, while not paid so very much, is drawn from the country neighborhood. We may, however, set it down as a general rule that firemen are drawn from the foreign laboring class, it being in many cases practically impossible to get a native-born American to act as a fireman at the wages which are offered.

A few nights ago I stood in an electric light station watching the fireman at work and found that by the way he was firing he was using fully one-third more coal than there was any necessity for. I drew him into a conversation and asked him why he carried so thin a fire and spread the coal on to the hottest part of it without any attempt to coke it, this particular coal being very rich in hydrocarbons, He said he "didn't know of any reason for it except that it was easier to slice up, and very much easier to take care of." He had no idea how much coal he was burning, as he never troubled to weigh it; the bunkers being near the furnace, he simply shoveled the coal from the bunkers into the furnace as the latter seemed to need it. This man was paid $40 a month, and seemed to be satisfied with his work, and thought his pay was very fair. I thought it was for that kind of a man; but that isn't the kind of a man that we want for a fireman. We want men like they have in New York, who can obtain at least $60 a month, and who will get an indicated horse power per hour from a little over two pounds of coal, rather than a man to whom we pay $40 and who gets an indicated horse power running condensing, the same as the other, with 6.8 pounds of coal. These two instances mentioned are quoted from actual figures and are not mythical in the least. It seems to me that if managers of electric light plants would carefully consider this matter they would see that in a great measure it depends on the amount of coal they consume as to whether they are dividend payers or not. The two great items which enter into the operating expenses each month are wages and coal. Suppose now that we are using in a certain station 300 tons of coal per month at $3 per ton, which makes an item of $900; we employ three firemen and pay them $40 per month each, or $120 for the three; we find by actual experience that running condensing these three firemen will use six pounds of coal per indicated horse power per hour. Suppose we change our firemen and put in three at $60 per month each and we find that they furnish us our horse power at the rate of four pounds of coal per indicated horse-power per hour. Let us see how this figures up. Our coal drops to 200 tons at $3 per ton, or $600; our three firemen add $180, making a total of $780, as against $1,020 in the first instance; or in other words, by putting in a much higher grade of fireman, one who exercises an intelligent supervision over his coal consumption, looks after his boilers, sees that they are in proper steaming condition, and that everything inside and outside is as it should be, that the proper depth of fire is carried and proper amount of draught is given, we find that our wage item, while more expensive, has saved us enough in coal to add materially to our dividends. Suppose now we go further than this and establish a base rate of $2 per day for each fireman, and say to the fireman, "We have found by actual trial that you average with this kind of coal four pounds of coal per indicated horse power per hour; now if you will keep up that horse power on a less amount of coal we will pay you $2 per day and one-half of the value of the difference in coal that you actually use and the four pounds which you have been using." In other words, "If you will save one pound of coal and get the same indicated horse-power with three pounds as you have formerly done with four, we will pay you the value of one-half of the difference between three and four pounds." Suppose by careful watching, looking after all the little leaks and keeping things up in first-class shape the fireman does get down to this, it saves us a pound of coal per indicated horse power. We add to their salaries one-half of this and we practically put the other half in our own pockets; or in other words, it is costing us at the rate of three and one-half pounds of coal per indicated horse-power, and we are making by the operation as clear gain one-half pound of coal per every indicated horse power, which reduced to dollars and cents, according to figures above, adds another $75 to our net earnings. By this arrangement it is barely possible that the firemen may make considerably more than the engineer, for as will be seen, by saving a pound of coal they will get as a bonus for distribution among them $75, or $25 each, which, added to their original base-rate of $2 per day, makes $85 per month as their total pay, and we in the meantime have effected by this change a saving of $315 per month in our coal bill and wages of firemen combined.

I fully realize that a good many station managers will be inclined at first thought to disagree with me on this, but I can say in reply that this is not drawn from my imagination but is based on actual facts and principles of to-day. Of course, it is necessary to find intelligent, capable and first-class firemen in the first place, and then time and trouble must be taken to find out the best quality of coal for your particular work, and your engines must be indicated carefully with the different loads, so that you may have a fair idea of what the actual indicated horse power used at different times during the day would amount to, and figure up carefully the amount of coal consumed, based on the indicated horse power per hour as obtained from the indicator cards, and then you will be ready to talk business with your fireman.

It will be remembered that at the Electric Light Convention of last year a report was made on the number of watt-hours obtained per pound of coal from some sixty or more stations, and it may fairly be presumed that inasmuch as the subject attracted considerable attention a great many station managers have looked more closely into this matter since that time and are now keeping a record of the output of their station in total watt-hours. If this be the case, it will then be comparatively easy for them to base the rate of pay of their fireman on the increase in watt-hours obtained per pound of coal. This latter is really a much more reliable method than attempting to form an estimate on the indicated horse power consumed per hour, as this is subject to considerable fluctuations, and it would be too much trouble to many to take indicator cards sufficient to form anything like a very accurate idea of the total indicated horse power developed per hour at different times during the day and night.

In THE ELECTRICAL WORLD of May 5, 1894, the writer presented a diagram of coal consumption and watt-hours by means of which once having obtained the watt-hours per pound of coal or rate at which the coal is used, we can then from a total number of tons per day ascertain the total watt-hours per day, and conversely given the total output of the station in watt-hours and the coal consumption, we can obtain the rate from the diagram. This being a very simple method not involving any great amount of figuring affords a ready means of ascertaining at any time just how the fireman is doing, and I believe that if station managers will once take the trouble to familiarize themselves with this diagram they will find it of very great value. It is certainly more economical to employ first-class firemen in other ways than in the mere saving in the coal pile, for it will be found that with such a man the boilers and steam piping leading therefrom will receive intelligent and careful attention, and everything will be done that is possible for a man to do to increase the economy of the steam plant. There is one point that should receive careful attention from the station manager, and that is the condition of the engines, for if the valves are not properly set there is going to be a loss in steam at this point which will nullify possibly in a great measure the good results obtained from the employment of a first-class fireman. It is not enough to indicate the engines once a year, but the station manager should see to it that they are indicated at least every month, and oftener if he has the slightest suspicion that the engines are not doing their work properly. Another point that needs careful attention, and one which is apparently neglected in a number of stations, is the condenser, where the station is operating condensing. If the station is to be operated in this way every effort should be made to keep the condensing part in thorough repair and first-class condition. Care should be taken to occasionally test the exhaust piping leading from engine to condenser to see that it is perfectly tight. If, after pump and engine are stopped and with all drip-cocks closed, the needle of the vacuum gauge will remain stationary for ten minutes or so, this is enough to show that everything is tight. If it is found that there are leaks in the piping they should receive immediate attention. At least 25 inches of vacuum should be maintained at all times when running, and the condensers should have just as much care and attention toward keeping them clean as is given to the engines.

In these days no electric light plant can be run without scrupulous attention to the minute details and minute economies that we used to formerly overlook.

Given ordinary favorable conditions money can be made in the electric light business if it is given the same careful attention and consideration as the successful merchant gives to his business; but if we let all the little economies slide and do not attempt to stop the leaks as they come along, we will find that the electric light business does not pay.

To sum up, slightly changing the old quotation, we can say that "If we look out for the pennies, the dollars will take care of themselves."

Practical Notes on Dynamo Calculation.—XXVII.

BY ALFRED E. WIENER.

(*c*) *Pedestals and Bearings.*

In the design of the base, especially when the portion of the field frame above the armature centre cannot be lifted off, care should be taken that the armature can easily be withdrawn longitudinally by removing one of the bearing pedestals, which, therefore, should be a separate casting. In machines where the lowest point of the armature periphery is in a considerable height above the base, as for instance in dynamos of the over-types,[1] Figs. 68, 71, 78 and 86 respectively, further, of the vertical double types, Figs. 77, 82, 87, 99 and 104, respectively, and of the radial and tangential outerpole types, Figs. 88 and 90, respectively, it is preferable that the pedestals should be made of two parts, the upper part, which should have a depth from the shaft centre a little in excess of the radius of the finished armature, being removable, while the lower portion, which may be cast in one with the base, will form a convenient resting place for the armature in removal.

In most cases this problem of making high pedestals of two parts can practically be solved by boring out the pedestal seats together with the pole pieces, thus providing a cylindrical seat for the pillow blocks, as shown in Fig. 118. This design is particularly advantageous also for machines in which the base forms one of the pole pieces, as for example, the forms shown in Figs. 73, 79 and 99, as in this case, outside of the finishing of the core seats, this boring to a uniform radius is the only tooling necessary for the base.

If the field frame is symmetrical with reference to the horizontal plane through the armature centre, the frame of the machine is usually made in halves, and the armature, in case of repair, can be removed by lifting it from its bed without disturbing the bearing pedestals. The bearing boxes must for this purpose be made divided so that all parts of the machine above the shaft centre are removable. This design affords the further advantage that the bearing caps can be taken off at any time and the bearings inspected, and it has for this reason become a general practice in dynamo design to employ split bearings, even for types in which the armature cannot be lifted.

It is further of great importance that the bearings should not only be exactly concentric, but that they also should be accurately in line with each other; for large machines it is therefore advisable to effect automatic alignment by providing the bearings with spherical seats. This can be achieved either by giving the enlarged central portion of the shell a spherical shape, Fig. 119, or in providing the bottom part of the box with a spherical extension fitting into a spherical recess in the pedestal, Fig. 120.

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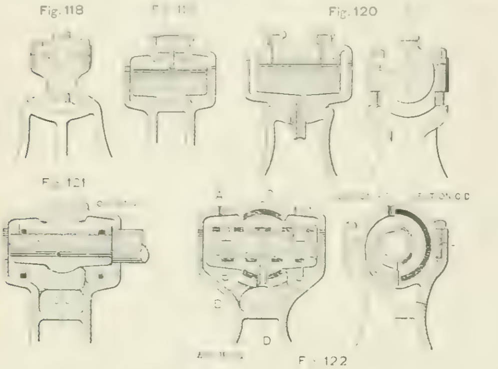
[1] In chapter 41, page 52, the names "*over-type*" and "*under-type*" were accidentally exchanged, the former corresponding to the *inverted*, and the latter to the *upright* single Horseshoe type.

In order to prevent heating of the bearings the shells in modern dynamos are usually furnished with some automatic oiling device, the most common form of which, shown in Fig. 121, consists of a brass ring or chain dipping into the oil chamber of the box and resting upon and turning with the shaft, thereby causing a continuous supply of oil at the top of the shaft. A further improvement of this self-oiling arrangement, patented in 1888 by the Edison General Electric Company, is illustrated in Fig. 122. In this the interior of the shell is provided with spiral grooves filled with soft metal and forming channels for conveying oil from each end of the bearing to a circumferential groove which surrounds the shaft at the centre of the shell, and which communicates with the oil chamber beneath the bearing. These grooves not only effect a steady supply but a continuous *circulation* of oil, the latter being lifted from the reservoir into the shell by the oiling rings, thence forced by the spiral channels into the central groove, from where it flows back into the oil-chamber.



Figs. 118 to 122.—Pedestals and Bearings.

Chapter 40. Joints in Field Magnet Frame.

(*a*) *Joints in Frames of One Material.*

Magnet frames consisting of but one material may either be formed of one single piece or may be composed of several parts. If the frame is of cast iron or cast steel, in small dynamos usually the former is the case, *i. e.*, the whole frame is cast in one, while in large machines it generally consists of two castings; if, however, wrought iron is used, it is, as a rule, much more convenient to forge each part separately and to build up the frame by butt-jointing the parts. In so jointing a magnet frame it is of the utmost importance to accurately adjust and finish the surfaces to be united, so as to make the joint as *perfect* as possible, for, every poorly fitted joint, by reduction of the sectional area at that point, introduces a considerable reluctance in the magnetic circuit. If, however, the contact between the two surfaces is as good as planing and scraping can make it, a practically perfect joint is obtained, and the additional reluctance, which then only depends upon the degree of magnetization, is entirely inappreciable for such high magnetic densities as are employed in modern dynamos. Experiments have shown that at low densities the additional magnetomotive force required to overcome the reluctance of a joint is very much greater, comparatively, than at high inductions, which is undoubtedly due to the pressure created by the magnetic attraction of the two surfaces across the joint, this pressure being proportional to the square of the density. The following Table LVIII. shows the influence of the density of magnetization upon the effect of a well-fitted joint in a wrought iron magnet frame, the induction in the iron ranging from 10,000 to 120,000 lines per square inch, and indicates that the reluctance of the joint becomes the less significant the nearer saturation of the iron is approached.

TABLE LVIII. INFLUENCE OF MAGNETIC DENSITY UPON THE EFFECT OF JOINTS IN WROUGHT IRON.

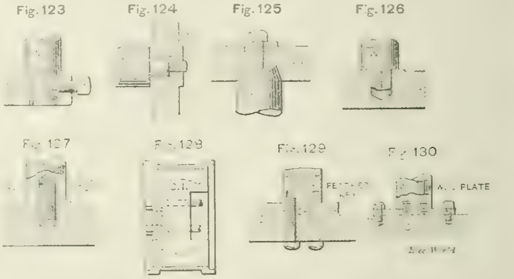
Density of magnetization. $\mathcal{B}$	Pressure on joint due to magnetic attraction $\frac{\mathcal{B}^2}{72,134,000}$	Magnetomotive force required for 1 inch		Difference due to joint $\mathcal{H}$	Equivalent of Joint.	
		Solid $\mathcal{H}_1$	Jointed. $\mathcal{H}_2$	$\mathcal{H}_2 - \mathcal{H}_1$	Air space. $\frac{\mathcal{H}}{.313 \times \mathcal{B}}$	Length of iron. $\frac{\mathcal{H}}{\mathcal{H}_1}$
Lines per sq. in.	lbs. per sq. in.	Amp turns	Amp. turns.	Amp turns.	Inch	Inch
10,000	1.4	1.7	6.7	5	.0016	3.0
20,000	5.5	3.2	12.6	9.4	.00155	2.9
30,000	12.5	5	19.1	14.1	.0015	2.8
40,000	22	7	25.2	18.2	.00145	2.6
50,000	35	9.5	31.4	21.9	.0014	2.3
60,000	50	12.7	38.1	25.4	.00135	2.0
70,000	68	18.3	45.7	27.4	.00125	1.5
80,000	89	27.6	55.2	27.6	.0011	1.0
90,000	112	50.8	76.2	25.4	.0009	0.5
95,000	125	68	91.8	23.8	.0008	.35
100,000	139	90	110	20	.00065	.22
105,000	153	134	150	16	.0005	.12
110,000	168	288	300	12	.00035	.04
112,500	176	391	400	9	.00025	.023
115,000	183	500	506	6	.00016	.012
117,500	192	600	603	3	.00008	.005
120,000	200	700	700	0	.00000	.000

At a magnetic density of $\mathcal{B}$=10,000 lines of force per square inch, each joint in the circuit is equivalent to an air space of .0016 inch, or has a reluctance equal to that of an additional length of 3 inches of wrought iron; at $\mathcal{B}$=100,000 lines per square inch, the thickness of an equivalent air space is only .00065 inch, which corresponds to the reluctance of .22 inch of wrought iron at that density; and at or above $\mathcal{B}$=120,000; finally, a good joint is found to have no effect whatever upon the reluctance of the circuit.

(*b*) *Joints in Combination Frames.*

For magnet frames consisting of two or three different materials the same rule as for frames of one material holds good as to the *nature* of the joint, but since the ordinary butt jointing would limit the capacity of the joint to that of the inferior magnetic material, it is essential in the case of combination frames to increase the *area of contact* in the proportion of the relative permeabilities of the two materials joined. Thus, if wrought and cast iron are butt jointed, the capacity of the joint is reduced to that of the cast iron, whereby the advantage of the high permeability of the wrought iron is destroyed and the permeance of the circuit is considerably increased; and in order to have the full benefit of the wrought iron, the contact area of the joint must be increased proportional to the ratio of the permeability of the wrought iron to that of the cast iron at the particular density employed.

For a density in wrought iron of 100,000 lines of force per square inch, for example, a magnetomotive force of 90 ampere turns is required per inch length of the circuit, and the same specific magnetomotive force is capable of setting up about 40,000 lines per square inch in cast iron; the contact area of a joint between wrought iron and cast iron in this case must therefore be increased in the ratio of 100,000 : 40,000, or must be made 2½ times the cross-section of the wrought iron, in order to reduce the permeability of the joint to that of the wrought iron.



Figs. 123 to 130.—Joints in Magnetic Circuits.

In practice this problem of providing a sufficiently large contact area between a wrought and a cast iron part of the magnetic circuit may be solved either by setting the wrought iron into the cast iron, or by extending the surface of the wrought iron part near the joint by means of flanges; or, finally, by inserting an intermediate wrought iron plate into the joint. In Figs. 123, 124, 125 and 126 are shown four methods of increasing the area of the joint by means of projecting the wrought iron core into the cast iron yoke or pole piece, differing only in the manner of securing a good contact between the parts, the first one employing a set screw, the second one a wrought iron nut, and the third one using a conical fit with draw screw for this purpose, while in the fourth one the threaded projection of the core itself forms the tightening screw. Fig. 127 illustrates a modification of the method shown in Fig. 126, a separate screw stud being used instead of the threaded extension of the wrought iron core. In case of rectangular magnet cores the arrangement shown by plan in Fig. 128 effects an excellent joint; in this the cores are inserted into the base from the sides, thus offering three surfaces to form the contact area. The manner of supplying the necessary joint surface by flanged extensions of the wrought iron core is illustrated in Fig. 129, which shows the method of fastening employed in large multipolar machines, feather keys being used to secure exact relative position of the cores. In Fig. 130, finally, a joint is shown in which a wrought iron contact plate is inserted between the wrought iron core and the cast iron yoke or pole piece with the object of increasing the area of the joint and of spreading the lines of force gradually from the smaller area of the wrought iron to the larger of the cast iron.

(To be continued.)

Electrodynamic Machinery—XXVI.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

125. A given type of bipolar Gramme machine having proved satisfactory as regards efficiency, ease of running and cost, at a full load output of say 10 kw, it may have to be determined whether it would prove advantageous to maintain the same design for a machine of a greater output, say 80 kw. Let us assume that the linear dimensions of the 10-kw machine are doubled, with the same speed of revolution, say 1,000 revolutions per minute, maintained in the larger machine. Then, assuming the same magnetic intensity in the armature, the electromotive force will be four times as great, since the area of cross-section of the armature and, consequently, the total useful flux will be increased fourfold. The resistance of the armature will be halved; for, each turn, though twice as long, will have a cross-sectional area four times greater.

The electrical capability of the smaller machine being expressed by $\frac{e^2}{r}$ (Sec. 6), that of the greater will be $\frac{(4e)^2}{\frac{1}{2}r} = 32\,\frac{e^2}{r}$, or 32 times greater than in the 10-kw machine, and, if the same efficiency is maintained in the larger machine, the output will be 32 times greater. The weight of the larger machine would, of course, be eight times that of the smaller, and the output per pound of weight would, therefore, be four times greater in the larger machine. In reality, however, such a result is impracticable.

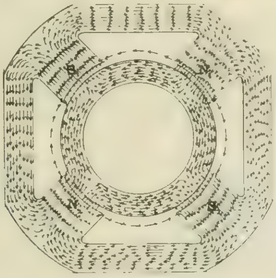


FIG. 111.—DIAGRAM OF MAGNETIC CIRCUITS IN QUADRIPOLAR GRAMME GENERATOR.

126. Dynamo machines are either belt-driven or direct-driven. In the case of direct-driven generators the speed of the generator is necessarily limited by the speed of the engine, and this, for well-known constructive reasons, has to be maintained comparatively low, and the larger the generator, the slower the speed of rotation that has to be practically adopted. Thus, while a 100-kw generator is commonly driven direct from an engine at a speed of about 250 revolutions per minute, a 200-kw generator is usually direct driven at about 150, and a 400-kw generator at about 100 revolutions per minute. In the case of belt-driven generators, the speed of belting is usually limited, except when driving alternators, to about 4,500 feet per minute; and, since larger generators require larger pulleys, their speed of rotation has to be diminished. While no exact rule can be applied for determining their speed, yet roughly, in American practice the speed varies inversely as the cube root of the output, so that, when one generator has eight times the output of another of the same type, the speed of the greater machine would roughly be half that of the smaller.

If no other limitation existed besides efficiency, the effect of doubling the linear dimensions of any generator, even taking the reduced rotary speed into account, would result in producing about 16 times the output for eight times the total weight; but large machines must necessarily possess a higher efficiency than small machines, not only owing to the fact that they would otherwise become too hot, since the surface available for the dissipation of heat only increases as the square of the linear dimensions, while the weight and quantity of heat increases as the cube of the dimensions, but also because large machines are expected to have a higher efficiency from a commercial point of view.

127. Taking into account, therefore, the reduced rotary speed of larger machines, their limits of temperature elevation, and their necessity for an increased efficiency, the output only increases approximately as the cube of their linear dimensions, and, consequently, the output of the larger machine, per pound of weight, remains practically the same as that of the smaller. The output of belted continuous current generators is commonly six watts per pound of net weight, and of direct-driven multipolar generators about eight watts per pound of net weight.

128. We have already seen (Sec. 115) that the E. M. F. generated by a Gramme ring armature is $\Phi n w$ C. G. S. units, or $\Phi\,\frac{nw}{10^8}$ volts, and the resistance of the armature will be $\frac{R}{4}$ ohms, if R be the resistance of the winding measured all the way round. Supposing now, that instead of employing a bipolar machine, we double the number of poles and produce a four-pole or quadripolar machine, as shown diagramatically in Fig 111. If we employ the same total useful flux, Φ, through each pole, the average rate of change of flux through the turns on the armature will be doubled, since the flux through any turn is now completely reversed in one half of a revolution, instead of in one complete revolution as before. The average E. M. F. in each turn will, therefore, be doubled. In Fig. 111, the magnetic circuits of a quadripolar Gramme generator are shown diagramatically by the flux arrows. Here, as will be seen, four distinct magnetic circuits exist through the armature, instead of the two which always exist in the armature of a bipolar generator. In this type of field frame, four magnetizing coils must be used. These may be obtained in one of two ways; namely,

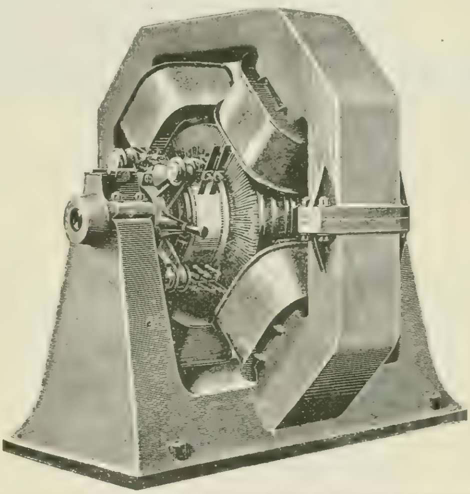


FIG. 112.—QUADRIPOLAR GENERATOR WITH GRAMME ARMATURE.

(1) By placing the magnet coils directly on the field magnet cores, as shown in Fig. 112; or

(2) By placing one coil on each yoke, as represented in Fig. 113.

129. In the same way if we employ a field frame with six magnetic

poles, as shown in Fig. 114, the flux will be reversed through each turn of wire three times in each revolution and, consequently, the average E. M. F. in each turn will be increased three-fold over that on a bipolar armature. In Fig. 114 there are six magnetic circuits through the armature. Considering any segment of the armature underneath a pole as, for example, between n_2 and p_1 the turn occupying the position at n_2 is filled with flux in an upward direction. As the armature advances in the direction of the large arrows the flux through this turn will be diminished, and when it reaches the middle of the pole piece S_2, it will be completely emptied of flux. The E. M. F. in the loop, during this portion of the revolution, will be directed outwards on the ring, as shown by the double-headed arrows. After passing the centre of the pole piece S_2, the flux through the loop begins to increase, but now in the opposite direction, the flux passing downwards through the loop instead of upwards as before, and, as we have already seen, flux entering a loop in one direction produces the same direction of E. M. F. around the loop as flux oppositely directed withdrawing from the loop (Sec. 90). Consequently, the E. M. F. is still directed outwards on the ring, as indicated by the double-headed arrows, until the turn reaches the position as p_1. In other words, the E. M. F. in a loop is similarly directed by its motion towards and from the same pole, or, during its passage past a pole. When, however, the turn begins to approach the pole N_1, after being completely filled with the downward flux at p_1; *i. e.*, as the flux in it begins to decrease, the direction of the E. M. F. in it reverses, as shown by the double-headed arrows, and this direction of the induced E. M. F. continues until the turn reaches the position n_1. By tracing the directions of the induced E. M. Fs. in the various turns of the ring, as shown, it will be seen that the positions p_1 p_2 and p_3 are points at which the E. M. F. is positive or directed outwards, while the positions n_1 n_2 and n_3 are points at which the E. M. F. is negative or directed inwards. There will be no current passing through the armature in the condition represented if the winding of the armature be symmetrical, since the E. M. Fs. in the various segments must be equal and opposite. If, however, brushes be applied to the surface of the armature at the positions p_1 p_2 and p_3, and n_1 n_2 n_3, any pair of these including one positive and one negative brush will be capable of supplying a current through an external circuit.

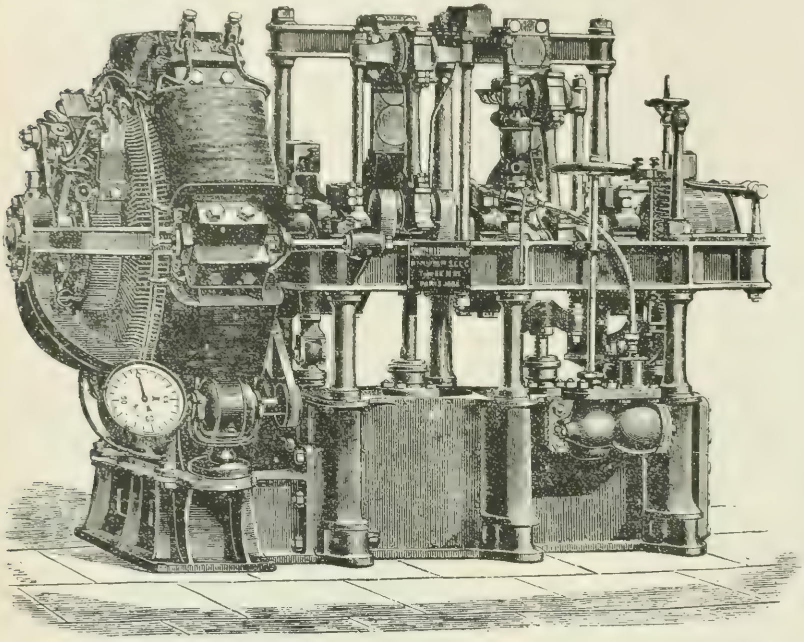


FIG. 113.—QUADRIPOLAR DIRECT-DRIVEN GENERATOR WITH TWO BRUSHES.

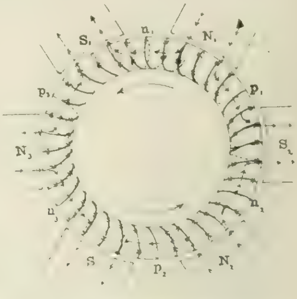


FIG. 114.—DIAGRAM OF SIX-POLE GRAMME RING ARMATURE AND E. M. FS.

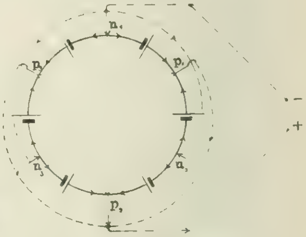


FIG. 115.—DIAGRAM OF CONNECTIONS BETWEEN BRUSHES OF A SIMPLE GRAMME RING WINDING OF A SEXTIPOLAR ARMATURE.

130. When, therefore, an ordinary Gramme ring winding is employed, there will be one brush between each pair of poles or, in all, as many brushes as there are poles. Fig. 115 represents the connections employed to unite the various segmental E. M. Fs. The E. M. F. of the armature is equal to that of one of its segments, but the resistance of the armature is inversely as the number of segments and poles, and if R be the resistance of the entire armature winding, $\frac{R}{p^2}$ will be the joint resistance between brushes, for there will be p sections in parallel, each of which will have $\frac{R}{p}$ ohms, and consequently in a six-pole armature there will be six segments in parallel, each having a resistance of $\frac{R}{6}$, making the joint resistance $\frac{R}{36}$, or $\frac{R}{6^2}$.

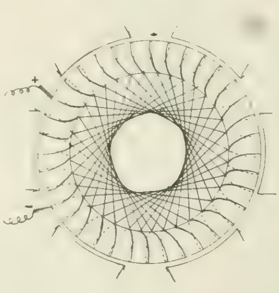


FIG. 117.—ARMATURE CROSS-CONNECTIONS FOR A SEXTIPOLAR GRAMME RING WITH 2 BRUSHES.

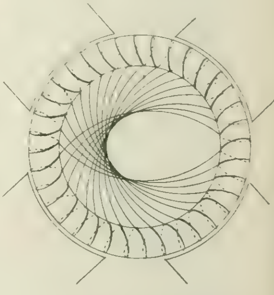


FIG. 118.—CROSS-CONNECTIONS FOR QUADRIPOLAR GRAMME RING WITH 2 BRUSHES.

Fig. 116 represents the mechanical arrangement for rigidly supporting the armature of a direct-driven octopolar Gramme ring generator with eight sets of brushes pressing upon one side of the armature, thus dispensing with the use of a separate commutator. The central driving pulley *PPP*, supports upon its arched face two rings *RR'*. These rings clamp between them the armature core and are clamped together by 14 stout bolts. Where the supports *ss* interfere with the winding of the conductor inside the armature the conductors are carried on the supports as at *a b c* and *d*.

132. It is not absolutely necessary, however, to employ six brushes in a sextipolar machine, for since in a machine of this type the three separate circuits are connected in parallel, connections may be carried within the armature between the various segments, thus permitting of the use of a single pair of brushes. Thus Fig. 117 represents a Gramme ring armature wound for a sextipolar field and with triangular cross connections between its turns. In this case the corresponding points p_1 p_2 p_3 and n_1 n_2 n_3 of Fig. 114, instead of being connected together by brushes externally as in Fig. 115 or 116, are connected together by wires internally. It is not, of course, necessary that every turn on the armature should be so cross connected, but that the coils or group of turns which are led to the commutator should be cross connected, so that each of the 36 turns shown in Fig. 117 may represent a coil of many turns. Although the brushes are shown in Fig. 117 as being placed on adjacent segments, yet they may be equally well placed diametrically opposite to each other.

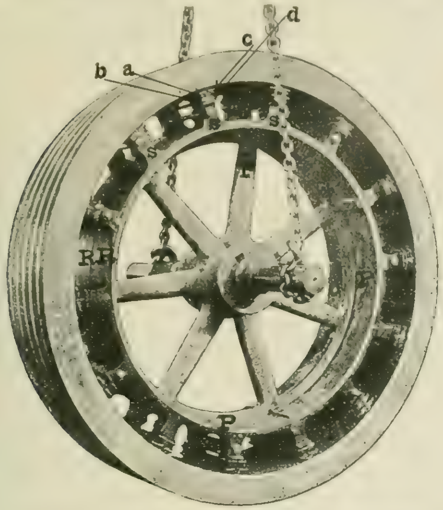


FIG. 116.—GRAMME RING MULTIPOLAR ARMATURE.

Fig. 118 represents the corresponding cross connections for a quadripolar Gramme generator employing a single pair of brushes. The advantage of cross connections is the reduction in the number of brushes. The disadvantage of cross connections lies in the extra complication of the armature connections. In large machines it is often an advantage to employ a number of brushes in order to carry off the current effectively

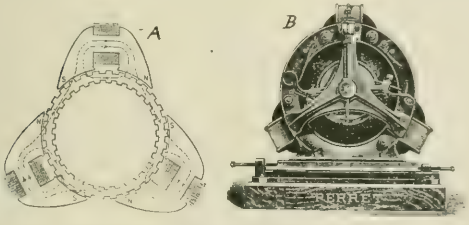


FIG. 119.—SEXTIPOLAR GRAMME RING SUPPLIED BY THREE MAGNET COILS.

133. Fig. 119 is a representation of a sextipolar generator whose magnetic field is produced by three magnetomotive forces, produced by coils placed as shown. The flux paths are represented diagramatically by the dotted arrows at *A*. Each M. M. F. not only supplies magnetic flux through the segment of the armature immediately beneath it, but also contributes flux to the adjacent segments in combination with the neighboring M. M. Fs.

(To be continued.)

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Electrical Power Transmission.—XIV.

BY LOUIS BELL, PH. D.

As an example, let us suppose the case of a 1,000 hp transmission so constituted that the line copper costs $10,000 with 10 per cent. loss of energy in the line, and suppose in addition that the net value of one horse-power at the receiving end is $50 per annum. It is evident that by decreasing the loss in the line to 2½ per cent. there would be available 75 additional horse-power worth $3,750 per annum. The cost of this addition to the line would be $30,000, on which interest at 6 per cent. would be $1,800. So long as the plant is not worked up to 90 per cent. of its maximum capacity of 1,000 hp there will be a steady charge of $1,800 plus depreciation if the additional copper be installed at the start. A few months loss at this rate would more than cover the labor of reinforcing the line when needed, even supposing that the additional copper at the start would not have involved extra labor in construction.

Various formulæ for designing the line so as to secure the minimum cost of transmission have been published, derived more or less directly from Kelvin's law and attempting to take into account all the various factors involved in line efficiency. They all contain quantities of very uncertain value, and hence are likely to give correspondingly inexact results. More than this, they are founded on two serious misconceptions. First, they generally give the minimum cost of transmission, which is not at all the same thing as the maximum earning power on the total investment.

Second, however fully they take account of existing conditions, the data on which they are founded refer to a particular epoch, and hence are unreliable when applied to a permanent plant.

A few years or even months may and often do so change the conditions as to lead to a totally different result. In the vast majority of cases it is impossible to predict even approximately the average load on a proposed plant, the average price to be obtained for power or the average efficiency of the translating devices which will be used. So probable and natural a thing as competition from any cause, or adverse legislation, will totally change the conditions of economy.

For these reasons neither Kelvin's law nor any modification thereof is a safe general guide in determining the proper allowance for loss of energy in the line. Only in a few special cases is it conveniently applicable. Each plant has to be considered on its merits, and very various conditions are likely to determine the line loss in different cases. The commonest cases which arise are as follows, arranged in order of their frequency as occurring in American practice. Each case requires a somewhat different treatment in the matter of line loss, and the whole classification is the result not of *a priori* reasoning, but of the study of a very large number of concrete cases, embracing a wide range of circumstances and covering a large proportion of all the power transmission work that has been accomplished or proposed in this country.

Case I. General distribution of power and light from water power. This includes something like two-thirds of all the power transmission enterprises. The cases which have been investigated by the author have ranged from 100 to 10,000 hp, to be transmitted all the way from one to one hundred and fifty miles. The market for power and light is always rather uncertain, the proportion of power to light unknown within wide limits, and the total amount required only to be determined by future conditions. The average load defies even approximate estimation, and as a rule even when the general character of the market is most carefully investigated little certainty is gained.

For one without the gift of prophecy the attempt to figure the line for such a transmission by following any canonical rules for maximum economy is merely the wildest sort of guesswork. The safest process is as follows: Assume an amount of power to be transmitted which can certainly be disposed of. Figure the line for an assumed loss of energy at full load small enough to insure good and easy regulation, which determines the quality of the service, and hence, in large measure, its growth. Arrange both power station and line with reference to subsequent increase if needed. The exact line loss assumed is more a result of trained judgment than of formal calculation. It will be in general between 5 and 15 per cent., for which losses generators can be conveniently over-compounded. If raising and reducing transformers are used the losses of energy in them should be included in the estimate for total loss in the line. In this case the loss in the line proper should seldom exceed 10 per cent. A loss of less than 5 per cent. is seldom advisable.

It should not be forgotten that in an alternating circuit two small conductors are generally better than one large one, so that the labor of installation often will not be increased by waiting for developments before adding to the line. It very frequently happens, too, that it is very necessary to keep down the first cost of the installation, to lessen the financial burden during the early stages of a plant's development.

Case II. Delivery of a known amount of power from ample water power. This condition frequently arises in connection with manufacturing establishments. A water power is bought or leased *in toto* and the problem consists of transmitting sufficient power for the comparatively fixed needs of the works. The total amount is generally not large, seldom more than a few hundred horse-power. Under these circumstances the plant should be designed for minimum first cost, and any loss in the line is permissible that does not lower the efficiency enough to force the use of the next larger size of dynamo and water wheel. These sizes almost invariably are near enough together to involve no trouble in regulation if the line be thus designed. The operating expense becomes practically a fixed charge, so that the first cost only need be considered.

Such plants are increasingly common. A brief trial calculation will show at once the conditions of economy and the way to meet them.

Case III. Delivery of a known power from a closely limited source. This case resembles the last, except that there is a definite limit set for the losses in the system. Instead, then, of fixing a loss in the line based on regulation and first cost alone, the first necessity is to deliver the required power. This may call for a line more expensive than would be indicated by any of the formulæ for maximum economy, since it is far more important to avoid a supplementary steam plant entirely than to escape a considerable increase in cost of line. The data to be seriously considered are the cost of maintaining such a supplementary plant properly capitalized, and the price of the additional copper that will render it unnecessary. Maximum efficiency is here the governing factor. In cases where the motive power is rented or derived from steam, formulæ like Kelvin's may sometimes be convenient. Losses in the line will often be as low as 5 per cent., sometimes only 2 or 3.

Case IV. Distribution of power in known amount and units, with or without long distance transmission, with motive power, which, like steam or rented water power, costs a certain amount per horsepower. Here the desideratum is minimum cost per hp, and design for this purpose may be carried out with fair accuracy. Small line loss is generally desirable unless the system is complicated by a long transmission. Such problems usually or often appear as distributions only. Where electric motors are in competition with distribution by shafting, rope transmission and the like, 2 to 5 per cent. line loss may advantageously be used in a trial computation.

The problem of power transmission may arise in still other forms than those just mentioned. Those are, however, the commonest types, and are instanced to show how completely the point of view has to change when designing plants under various circumstances. The controlling element may be minimum first cost, maximum efficiency, minimum cost of transmission or combinations of any one of these, with locally fixed requirements as to one or more of the others, or as to special conditions quite apart from any of them.

In very many cases it is absolutely necessary to keep down the initial cost even at a considerable sacrifice in other respects. Or economy in a certain direction must be sought even at a considerable expense in some other direction. For these reasons no rigid system can be followed, and there is constant necessity for individual skill and judgment. It is no uncommon thing to find two plants for transmitting equal powers over the same distance under very similar conditions, which must, however, be installed on totally different plans in order to best meet the requirements.

(To be continued.)

Parabolic Electromagnetic Reflectors.

BY ALFRED G. DELL.

I made a pair of parabolic reflectors, which work fairly well. I can place the reflector, with its focus three or four feet from a piece of sheet zinc three feet by five feet, and the focus of the receiver seven or eight feet from the same, both being inclined to the zinc sheet at about the same angle, and obtain a fair spark at the spark-gap of the receivers. They do not work anything like as well as the vibrator and circles described in The Electrical World of Jan. 12, but well enough to show an angular deflection perfectly. When they are opposite and close to each other the spark in the receiver is very strong; the charge being so strong that if any part of the spark-gap is touched with the hand the physical effect is very perceptible. The following is a description of the construction:

I made the ends of four pieces of one-inch pine board, each 12 inches wide and 34 inches long. After drawing a parabola of five-inch focal distance on one piece, I laid the curve off into one-inch spaces, and with an awl bored holes, making the holes one inch apart along the curve; I then screwed this piece on another of the boards with the curve on the inside and marked every hole by pushing the awl through the holes already bored, and then, separating the pieces, bored the holes through where marked; this makes the sides for one of the pair, particular attention being paid to keeping the inside, when screwed together, on the inside when set up. The other one was worked in the same way, fastening the one having the curve to another board, and marking and boring the holes, and fastening that on to another board, and marking and boring the holes and keeping the inside on the inside when set up.

The hole at the focus in each board was also bored when fastened together. The holes are directly opposite each other on account of the way they were marked off and bored. I then, after sawing off the corners of the boards when fastened together with the screws in the same places where wire holes were marked, screwed on strips two feet long, and fastened copper wires (No. 16) from hole to hole, drawing them tight. In the focus of the one that received the current from the coil I placed two stiff brass wires (No. 16), each extending from the focus to the centre, of such a length that when through the sides there would be a space between the ends, which were rounded off. Around each wire and fastened to it I placed a brass cylinder three-quarters of an inch in diameter and four inches long, and surrounded each cylinder and wire running up to the side with a piece of sheet zinc bent into a cylinder one and a half inches in diameter, open on the back, through which opening the current is let into the arrangement from both sides of the spark-gap; the current wires are fastened to the brass wires and insulated from the zinc cylinders with pieces of gum tubing. It is the same principle as the plane vibrator arrangement. Nothing is seen when looking at the sparking arrangement but the zinc cylinder, spark-gap, and wires passing through the back of the parabolic reflector and through the pieces of gum. There is no current connection with the zinc cylinder.

The receiver arrangement is made of two pieces of straight brass wire one-eighth inch thick, one being fastened at each focus, leaving a space of one inch in the middle; from each wire, an insulated wire passes to the back of the receiver, and to a spark-gap placed in the most favorable position to see it. The spark-gap arrangement is made of a piece of oak, one inch square, with a wide slit sawed out; a piece of brass wire is fastened to each side and passes through a hole near the top of the slit and fine round points are filled opposite each other. A brass screw is arranged so the points can be separated, and also a bolt arranged so they can be tightened up. The spring of the wood will bring the points together by using the one screw; the other can be used to strengthen the spring of the wood. Connected with the spark-gap are two brass knobs three-fourths inch diameter, one on each side. A hole is drilled in each knob, and from each hole there hangs a loose copper wire ten inches long. In trying to get constant sparking, I found I could get only flashes, but that a wire held loosely to each knob would brighten and render steady the spark obtained. I tried screws with nuts, used so successfully with circles, but found they did not do well. I insulated all the connections about the spark-gap with sealing wax. The same battery and coil are used with circles as with the reflector.

Static Electricity and Printing.

To the Editor of The Electrical World:

Sir:—Referring to the recent discussion in The Electrical World in regard to the presence of static electricity in paper, we have in our paper mills been more or less troubled with it, as are all paper-makers. It occurs mostly as the paper leaves the calenders and at times the charge is heavy enough to produce a spark six or eight inches in length, which, it is needless to say, makes it very uncomfortable handling the paper. A steam damper, such as illustrated in the Jan. 26 issue of your paper, will obviate all this. On papers where we cannot use the damper we use a copper wire which touches the top of the sheet, or rather lies on the web of the paper as it passes from the calenders to the reels. This wire must be well grounded to produce good results. We have no trouble with the paper when it is cut into sheets.

Frank L. Stevens.

North Hoosick, N. Y.

DIGEST
OF CURRENT TECHNICAL ELECTRICAL LITERATURE
COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS
BY CARL HERING

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 922 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

Note.—As the present issue goes to press earlier than usual, the abstracting of some of the American journals will be postponed for one week.

DYNAMOS, MOTORS AND TRANSFORMERS.

Dynamos Without Commutators.—Mr. Mengen in "L'Eclairage Elec.," Jan. 19, criticises the article of Mr. Malagoli abstracted in the Digest, Feb. 9, stating that his deductions are not correct and that the current obtained will be alternating and not continuous. "L'Ind. Elec.," Jan. 25, also criticises the article very severely, stating that this would upset the fundamental laws of induction and that his calculations are entirely incorrect.

Calculation of Multiphase Motors.—The concluding portion of the article by Mr. Cahan is published in the "Elek. Zeit.," Jan. 31. Mr. Legrand's article is contained at great length in "L'Eclairage Elec.," Jan. 19, including a large number of characteristics.

First Polyphase Motor.—In the Lond. "Elec.," Feb. 1, Mr. Giorgi states that the priority of invention of the rotary field motor is due to Pacinotti, who, in 1873, advanced a similar and more perfect arrangement than that proposed by Mr. Baily (see Digest, Feb. 2 and 9); it consists of a fixed ring-wound armature divided into sections and connected with the bars of a commutator in the usual way; a pair of brushes was moved around the commutator producing a rotating field; it was intended for transmitting signals in a quadrant telegraph; the continuous rotation of a magnetic field obtained by means of alternating currents, however, was discovered by Prof. Ferraris. In reply to this Dr. Thompson states that it lacks the essential feature, namely, the driving by induced currents; in its production of a revolving field it was anticipated by several, as by Wheatstone about 1849; Baily not having alternating currents in quadrature imitated them artificially by a commutator.

Direct Connected Dynamos.—"Cassier's Mag." for February contains an article by Mr. Smith, in which he describes and illustrates quite a number of direct engines and dynamos, including also the Willans engine (England). He also discusses at some length the relative advantages of direct vs. indirect connection.

LIGHTS AND LIGHTING.

The Electric Arc.—Mrs. Aryton's paper (see Digest, last week) is continued in the Lond. "Elec.," Feb. 1. Regarding the discrepancy between the results which she gave and the statement of Dr. Thompson, it is stated that he meant that the area and not the diameter of the crater was proportional to the current, the discrepancy is, therefore, not as great; she intends to measure the true areas of the craters more accurately to see how far this is correct; a table is given containing the measured and calculated diameters, which show that for all currents between a comparatively small one and the largest that will give a silent arc, the diameter of the crater may be expressed with surprising accuracy as a linear function of the current (containing a constant term). All the curves connecting the voltage with the length of the silent arc for various currents close up into a single curve for hissing arcs. It is shown at some length, including examples, how the curves may be employed to calculate the resistance of the extra resistance used with an arc lamp (when run in multiple arc) and the voltage which will produce a silent arc of given length with a given current; the curves also show that such resistances, besides preventing too great a current, perform the very important function of making it possible for a solenoid to regulate the length of the arc.

Incandescent Lamp Tests.—A Physical Society paper by Prof. Ayrton and Mr. Medley is abstracted briefly in the Lond. "Elec. Rev.," Feb. 1. They found that with the newer lamps tested, the candle-power, current and candles per watt, all rose as the lives increased; they satisfied themselves that this surprising result was correct; the Edison-Swan lamps showed hardly any blackening even after 1,300 hours; the candle-power was always accompanied by a rising current which, however, was proportionally much smaller, so that the consumption of power was less after 50 hours than at the beginning; the 100-volt lamp of this make required 4.3 watts per candle; the maximum increase of light recorded was 45 per cent.; with lamps of the type examined there is no point at which it becomes economical to discard a lamp before its filament breaks; no marked economy can be gained by overrunning such lamps. Prof. Ayrton first attributed this improvement to a better vacuum, the more a lamp was used the better the vacuum became; but he found later that although the improvement in the vacuum was equally marked, the increase in candle-power varied between very wide elements, being very considerable in some and hardly perceptible in others; the lamps in the tests were kept running during the night and discontinued during the day.

Electric Light Photography.—Mr. Swan, in the Lond. "Elec. Rev.," Feb. 1, points out the advantages of the incandescent light which, although less rich in violet rays than the arc light, is much better as the color misrepresentation, which is so marked when the arc light is used, is rectified to a considerable extent.

The Electric Arc.—An abstract, including some of the illustrations, of the paper by Mrs. Ayrton (see above) is published in the "Elec. Eng.," Feb. 13.

Arc Lighting.—A brief abstract of Prof. S. P. Thompson's second lecture, mentioned above, is reprinted in "El'ty," Feb. 6.

Fredureau Diffusing Globes.—The translation in abstract of a French Academy paper by Prof. Potier, describing these globes, is published in the "Elec. Rev.," Feb. 6. (These globes were described and references given to very complete descriptions in the Digest, 1893, March 25, May 27, Dec. 2, and 1894, Feb. 10; a very similar globe was described Nov. 10, see also Dec. 1, 1894, and Jan. 5, 1895.)

Welsbach Light.—The recent editorial in the Lond. "Elec. Rev." (see Digest, Feb. 9) on the report of the Lancet Commission is reprinted in "El'ty," Feb. 13.

POWER AND HEAT.

Large Three-Phase Plant.—"Cassier's Mag." for February contains a well illustrated article by Dr. Bell on "Electricity in Textile Manufacturing," in which he describes the three-phase plant installed at the works of the Columbian Cotton Company, South Carolina, which has now been running over eight months; it is said to be the largest multiphase plant now in operation and the first sweeping application of the motor for driving machinery for textile manufacturing. Two generators of 500 kw are each connected to horizontal turbines, besides being coupled together with a positive coupling so that they can be run in parallel; the weight of each armature is about 16 tons and that of the complete machine 50 tons; the armature is 10 ft. in diameter, the voltage 575 and the frequency 36; there are 20 induction motors of 65 hp each arranged to be secured to the ceiling; the specification required that the change of speed should not exceed 3 per cent. between friction load and full load; the greatest variation was found to be from 2.2 per cent. down to 1.5 per cent in the different motors; the speed of the motors is 535; a starting resistance is placed within the armature spider and cut out by a long level which slides a ring along the shaft until it short-circuits the resistance; each motor drives short, light shafts; the net efficiency of the whole system from the shaft of the generator to the shaft of the motor is not less than 82 per cent. The wires from the power house to the factory are underground, the system used being illustrated and described; it consists of a heavy wooden conduit 12 inches square, coated inside and outside with pitch and having about every 3 ft. a crib work of insulated conduit tubeing through which pass similar conduit tubes in which the cables are laid, the whole conduit being then filled solid with pitch; where the lines cross a bridge the conduit is sealed with sulphur for about 2 ft. and the separate tubes are then carried across insulators on an iron structure; "it would be most extraordinary if there should be any signs of leakage or a short circuit in a structure so constituted."

Folsom-Sacramento Transmission—The "Elec. Eng.," Feb. 13, contains a description by Mr. Guy of this projected plant; it is said to be second only to the Niagara plant in magnitude and of equal interest in many respects; 5,000 hp of water power obtained by means of a dam across the American River near Folsom, will soon be available; the electrical data is given only very briefly; there will be four three-phase generators of 1,000 hp each coupled directly to the shafts of the water wheels; these generators weigh 40 tons each and are the largest ever built except those for the Niagara Falls plant; the current will be transformed up to 10,000 volts at which it will be transmitted to Sacramento, a distance of about 24 miles on six bare, hard drawn No. 0 wires, 1,000 hp will thus be transmitted to Sacremento.

Power Transmission in Sweden.—Some data regarding the very large proposed plant described in the Digest, Aug. 4, is given briefly in the "Elec. Eng.," Feb. 6 (more complete data will be found in the Lond. "Elec.," July 13, the reference given in the Digest).

Electric Plow.—A brief description of the one described in the Digest, Dec. 15, is given in the "Elec. Rev.," Feb. 6.

Rolling Lift Bridge.—The motors of the new bridge in Chicago, which is operated electrically with 200 hp, are described and illustrated with some good illustrations in the "West. El.," Feb. 9.

Electric Fire Engine.—In an article by Mr. Sachs, in "Cassier's Mag." for February, he gives a brief descriptive history of the fire engine; the latter part is devoted to electric fire engines. Stationary electric fire pumps are to-day used in many establishments; he describes several portable forms; those using storage batteries will not be practical until the storage battery is made lighter, stronger and more efficient than it is to-day; he mentions one made in England in which the current was to be supplied through underground feeders connected to boxes at regular intervals; another devised by Mr. Wheeler gave very good results and is now used at a factory in Ampere; the city of Lynn, Mass., is to have an electric fire engine; electric fire engines would be efficient and thoroughly practical were the question of current supply settled and if the outlay were not so great; he thinks a separate system of mains for this purpose would be best. (Why not use the trolley wire current, and pay for it by meter; it exists on most streets in many cities; the cars are usually stopped during fires and the extra load would therefore not be felt.)

TRACTION.

Traction.—The complete Institution papers by Messrs. Wilkinson, Blackwell, Dawson and Preller, all of which have been abstracted in the Digest recently, are published in full with the illustrations and the discussion, in the "Jour. of the Institution of Electrical Engineers" for January. References to a number of American reprints of some of these papers have been given in the Digest.

Electric Traction.—In a continuation of Mr. Dawson's serial in Lond. "Engineering," Feb. 1, he gives, among other things, the conclusion of the table of electric lines in Europe, which table includes columns of data for each line; the operating expenses of some of the lines are also given.

Light Railways.—The report of the committee of conference of the Board of Trade is published in the Lond. "Elec.," Feb. 1.

Electric Cable Railways.—A well illustrated article by Mr. Preller is begun in Lond. "Engineering," Feb. 1; he shows the advantages of operating cable mountain railways by electric power, transmitted to the upper end from a distance and over the older systems of loading the descending car with water; he gives a well illustrated description with data of the Bürgenstock mountain line in Switzerland.

Accumulator Line in Hagen.—A translation of an abstract of the article by Mr. Feldmann, abstracted in the Digest Feb. 9, is published in the Lond. "Elec.," Feb. 1.

Accumulator Cars in Vienna.—The regular running of a portion of the lines began Jan. 15; the Waddell-Entz copper-zinc accumulators are used.

Electric Carriage.—The data regarding the Tommasi accumulators used on an electric carriage in Paris is given in the Lond. "Elec. Rev.," Feb. 1.

Trolley System Applied to Steam Roads.—The "Elec. Eng.," Feb. 13, gives the views of several authorities on how it shall be applied. Mr. Leonard believes in electrical locomotives rather than motor cars; he does not believe in the use of the three-wire system for railways; he thinks that the E. M. F. should not be less than 200 volts per mile of transmission of the power; he thinks it should be transmitted as an alternating current reduced before reaching the trolley wire and transformed on the locomotives into a continuous current. Prof. Elihu Thomson believes that it should be begun by placing motor cars on the tracks where it is desirable to do so, taking the current from an overhead wire; this would not interfere with the use of the ordinary locomotives for the hauling of the usual trains; such lines might traverse only a portion of the existing road with branches for the electric cars to more or less remote points; in this way the advantages of the trolley might be used to form feeders which "may for some time to come preserve the character of a steam line." If a long train is to be drawn it may be well to use locomotives, particularly if the grades are not great, or, perhaps, a compromise in having one or more extra heavy motor cars at the head of a train of trailer cars; 1,000 volts would be feasible: the overhead system would be the best except on elevated roads; the three-wire system would not necessarily be applicable in all cases, but would probably be desirable for certain types of double track roads. For heavy work over long distances it is probable that transforming systems must be used at 5,000 to 10,000 volts, transformed by machines, to sections of the trolley line or low pressure feeders; it may be possible to use alternating current motors of low potential carried directly on the driving axles, particularly where high speeds are attained; means are now in existence for controlling the speed and obtaining variations of speed with high economy where several such motors are employed to drive a train. Messrs. Houston and Kennelly prefer motor cars to locomotives, as it enables more cars to be run at more frequent intervals, to which factor, as much as any other, the popularity of the trolley system is due; they recommend 1,000 volts and the three-wire system, which may afterwards be raised to 2,000 without any change in the line construction; they recommend the overhead wire and single trolley; they recommend following the present system of trolley roads rather than attempting radical innovations.

Supplementary Wire.—In the "Elec. Eng.," Feb. 13, Mr. Henry criticizes the recent statements of Mr. Wynkoop (see Digest, Jan. 26). The most important object of this wire is to insure a metallic return around defective rail joints, should any occur; he believes that to do without it opens thousands of chances for failure which do not exist at present. There are numerous solutions to the railway problem referred to; regarding the double trolley wire system he believes "if a few of the modern roads were to adopt it the others would follow like a flock of sheep." If the track rails are used the supplementary wire should be a well insulated one, and where the copper is exposed it should be carefully painted with paraffin paint; it should contain switches at intervals for the insertion of an ammeter, so that the current in it can be measured as an indication of the condition of the rail joints; by simultaneous readings at different points defective joints can be located with ease and certainty.

Power Consumed on Electric Railways.—A translation of a part of the article by Mr. Pellissier, mentioned in the Digest, Dec. 8 and 25, is published with some of the tables, in the "St. Ry. Jour." for February.

Brooklyn.—The power house of the Nassau Company is described and illustrated in the "St. Ry. Gaz.," Feb. 9.

Low Rail Joints and their Prevention.—An article by Mr. Amstutz on this subject is published in "El'ty," Feb. 13.

Electric Carriage.—The one described in the Digest, Feb. 16, is illustrated in the "West. El.," Feb. 9.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Single-phase vs. Multiphase Systems.—A long paper by Mr. Goerges on a comparison of the two systems from an industrial standpoint is reprinted in the "Elek. Zeit.," Jan. 17. He enumerates the various systems but limits himself to a comparison between the single and the multiphase, and under the latter, between the three-phase and the two-phase systems; he compares them with regard to the first cost and cost of operation on the one hand and the simplicity and application on the other. Theoretically the multiphase system is the best, chiefly for the reason that the heat generated for the same amount of wire is considerably less, the currents should therefore be combined as much as possible, which is done best by the three-phase system. In the generators and motors it may be said that other things being equal, the armature reaction and the dispersions of the lines of force may be said to be proportional to the current strength; for an equal amount of energy the currents for the single, double and three-phase systems are as 100 to 50 to 57.8. If the armature contains an iron core without pole projection, it has been shown repeatedly that the materials are used more economically in the multiphase than in the single-phase system, which he discusses by numerical examples; when the armature has pole projections the multiphase machines also give a considerably greater output. At the switchboards the multiphase currents required somewhat more expensive apparatus, but this is hardly of any importance. Regarding the weight of the leads for an equal output, drop and voltage the figures are as follows: for single-phase, two wires 100, three wires (the neutral wire being one-half that of the others) 31.35; for two-phase currents, four wires 100, three wires 72.8; for three-phase currents, three wires 75, four wires 29.2, the latter system being somewhat troublesome, especially when cables are used; these figures apply to the low tension circuits, in which the voltage is no criterion, but for the high tension system the voltage must be considered; with the two-phase system, with three wires the voltage between the lines which are not combined is 1.41 times as great as the working voltage; reducing the voltage to the same amount the weights are as follows: Single-phase, two wires 100; three-phase, three wires 75; two-phase, four wires 100, three wires 145.5. The construction of the lines is more expensive for multiphase currents; the transformers when small are in favor of the single-phase current, but when large the costs will be about the same; for the two-phase system they will be more expensive than for the three-phase. Considering everything, the calculations for numerous projected plants show that when there is a secondary circuit the three-phase current with three wires is cheaper than the single-phase current with two wires and somewhat more expensive than the single-phase current with three wires. He discusses at considerable length the subject of motors, including a discussion of the torque and heat in the armature; in practice it is found that a single-phase motor has about 70 per cent. of the output of a multiphase motor of the same price and weight, and at the same time an efficiency 6 to 10 per cent. less, besides this the range of the high efficiency is not so great; as regards cost, the multiphase motors, especially the smaller ones, have the advantage. He discusses whether the multiphase system has any inherent objections; it has been stated frequently that it is not possible to keep the voltage in the three-phase system constant when the branches are unequally loaded and that complicated apparatus is required for regulating this; he states that this is only a question of the construction of the machine, all objections being completely overcome in the machines by having a small armature reaction; motors on the three-phase circuits exercise a regulating action; with greatly unequal loads a motor will even supply energy to one of the circuits; besides this they reduce the percentage drop. The attendance in a three-phase station is the smallest possible and no separate regulation of the three branches is required; two-phase currents can be regulated independently only when each machine contains two separate armatures, which makes them much more expensive. Same modifications have been suggested; in the railway station installation at Dresden the three-phase machines are connected for the star winding, but the lamps are all connected to only one pair, the third wire being used only for motors; in another system the third wire is used only for starting the motors, but this he considers not as good, for if the wire is laid, why not use it continuously? He summarizes his conclusions as follows: The three-phase system is better from a commercial standpoint, especially for greater distances, the regulation offers no difficulties, multiphase motors are cheaper, more economical, more convenient and cause less irregularities in the light. In the discussion Mr. Roos called attention to the fact that Mr. v. Dobrowolsky showed a number of years ago that three-phase transformers act to a certain extent as regulators for the three circuits. Mr. Kapp differed in a number of points; he believes that Mr. Goerges did not attribute to the three-phase motor all the good properties which it possesses; for motors of equal weight, if those of two-phase currents give say 100 hp, those for three-phase currents will give 111 hp; he differs regarding the cost of single and three-phase ransformers; one three-phase transformer for a 100 hp surely does not cost more than three single-phase transformers of 33 each. He believes that to make the armature reaction small in order to improve the regulation is somewhat dangerous, as a certain amount of reaction is an advantage because the machine will not suffer so much by short circuiting; a practical machine should not give more than three or four times the normal current when it is short circuited, and in that case it must have an appreciable loss of energy, the proper choice therefore is in the nature of a compromise which he believes is more unfavorable for the star connection than for the triangle connection. In reply Mr. Goerges stated that in Chemnitz (see Digest, last week) the machines have a drop of 7 per cent. at constant excitation and with an inductionless external resistance, and when short circuited they gave three times their normal current; when driving motors the drop may be four times as great; he believes that the differences between the two ways of connecting the circuits are quite small, both methods being used; in the triangle connection, if the current is not of the sine form then there may be a circulation of current, thereby increasing the heat; he believes that it would be much better to adopt one kind, and for this he prefers the star connection; in Chemnitz the triangular connection has been adopted, which is better when cables are used, as they then require only three wires; when the star connection is used the neutral wire need not be brought back to the machine, but only back to an equalizer consising of a transformer; in this case the results are very good, when 100 lamps were inserted in one branch, 20 in the other, and 1 in the third there was no noticeable difference in the voltage.

Capital Invested in Central Stations.—The Lond. "Elec.," Feb. 1, publishes a list of the central stations in Great Britain, giving the capital invested in each one; the total capital actually expended is as follows: By companies about $9,600,000, and by local authorities $26,200,000.

Central Station Statistics for France.—"L'Ind. Elec.," Jan. 25, publishes its annual table in the form of a supplement; it is like those published by that journal near the beginning of each year, and is undoubtedly the most complete of its kind published for France; no general deductions or details are given.

Continental Stations.—A report by Mr. Metzger containing brief descriptions and comments on some stations in Germany is published in the Lond. "Elec.," Feb. 1.

England.—A description accompanied by a number of illustrations of the stations at Halifax, Nottingham and Dewsbury are given in the Lond. "Elec. Rev.," Feb. 1.

Amsterdam.—A description of this station is published in Lond. "Engineering," Feb. 1; the load diagrams for each of the first six months of the year are given; the maximums of all are nearly alike, and they nearly coincide from the maximum down, but differ greatly in the rise from the minimum up.

WIRES, WIRING AND CONDUITS.

Explosions in Conduits.—The Lond. "Elec.," Feb. 1, states that mere ventilation of the conduits may or may not afford adequate protection; it suggests using covers made of wrought iron in the form of a gridiron, so as to afford no obstacle to the air in case of an explosion; there would have to be a plate some distance below to catch the rain and dirt leading it to a suitable trough.

The subject is discussed by Mr. Jenkinson in the Lond. "Elec. Rev.," Feb. 1; he thinks it ridiculous to condemn bare copper as was done recently; it is not necessary to have a short circuit to cause a spark, as a slight leak is quite sufficient; he believes there would be little difficulty in properly draining and ventilating existing conduits; he suggests finding the lowest points and then building drain pits there.

Another installment of the opinions of central station managers is given in the Lond. "Elec. Rev.," Feb. 1.

Conduits.—An illustrated description of the conduits and subways of the Nottingham station is given in the Lond. "Elec. Rev.," Feb. 1; it is said that this is the first town in that country where any attempt has been made on a fairly large scale to use subways for the mains.

Underground Wires in Paris.—The article of Mr. Monmerque (see Digest, Jan. 26) is continued in "L'Eclairage Elec.," Jan. 19.

Telephone Cables with Dry Air Circulations.—The "Jour. of the Institution of Electrical Engineers," for January, abstracts at some length an article by Mr. Barbaret, from the "Ann. Telegraphiques," Vol. 21, May-June. He describes the Fortin-Hermann cables in which paraffined wooden beads are strung on the wires which are then incased in a lead pipe; he describes the case, apparently the same as that referred to in the Digest, Jan. 26, in which a leak in one of the cables was repaired completely by circulating dry air through the cable; he describes this process, which is now used frequently; the apparatus is also described.

Cable Connections.—A new method for which a number of advantages are claimed is described and illustrated by Mr. Feussner, in the "Elek. Zeit.," Jan. 31, in the form of a contribution from the Imperial Reichsanstalt. A ferule is placed around the strands and a conical wedge is then driven between them; the ends are then filed off and soldered as a butt joint; a method of connecting the cable to a flat terminal having a hole through the centre is also shown; the cable is flattened and inserted in a slot, after which it is soldered.

ELECTRO-PHYSICS AND MAGNETISM.

Mirrors of Magnetism.—The recent Physical Society paper, by Prof. S. P. Thompson and Mr. Walker, is published in full with illustrations in the "Phil. Mag.," for February. Reprints of the paper were referred to in the Digest, Dec. 22 and Jan. 11; the phenomenon on which it is based was described in the Digest, March 24, 1894. If a coil carrying a current is placed with its end against a large plate of iron a field is obtained on one side of the plate, of the same shape, as if the coil were continued to double its length, that is, there is a magnetic image produced analogous to the optical image produced by a mirror; this refers only to the space in front of the iron plate, as there is no effect behind it. A number of interesting experiments are described, as for instance, removing the coil slightly from the iron or placing it in an inclined position, and in each the effect was analogous to that in optics; there is one difference, if the pole toward the plate is a north pole, for instance, the magnetic image has its south end pointing towards this pole. They consider the possibility of a magnetic kaleidoscope, also the effects of curved plates which are discussed mathematically, applying the formulas relating to electric images.

Values of Magnetic Quantities.—In "L'Ind. Elec.," Jan. 25, Mr. Culmann publishes a large table covering two full pages containing the values of the intensity, the induction, the susceptibility and the permeability, for each of about 500 gradually increasing values of the magnetizing force; they are based on the recent experiments of Roessler, and refer to a very soft, well annealed wrought iron. (It is of use for that particular quality of iron only; it is a question whether such great accuracy is warranted by the data on which it is based.)

Change of Length in Soft Iron Wire in a Magnetic Field.—In a brief communication by Mr. Rosing in the "Phil. Mag." for February, he gives some results which agree in general with those of Mr. Nagaoka published in the "Phil. Mag.," No. 224.

Earth's Magnetism.—An Academy paper by Mr. Moureaux, giving the constants for the first of the year near Paris, is reprinted in "L'Ind. Elec.," Jan. 25, and "L'Elec.," Feb. 2.

Propagation of Electric and Magnetic Perturbations.—Mr. Boudin's article is continued at some length in "L'Eclairage Elec.," Jan. 19.

High Frequency Experiments.—A description of the experiments of Dr. Toepler with large influence machines (see Digest, Dec. 29 and Jan. 12) is published in the Lond. "Elec. Rev.," Feb. 1.

Thermo-Electric Power of Electrolytes.—The paper by Mr. Lussana, from the Italian, is abstracted briefly in the "L'Eclairage Elec.," Jan. 19.

New Constituent of the Atmosphere—An interesting abstract of the recent Royal Society paper by Lord Rayleigh and Prof. Ramsay, concerning the new element argon is given in the Lond. "Elec.," Feb. 1.

Electrodes Sensitive to Light.—The "Elec. Eng.," Feb. 6, abstracts briefly the paper by Mr. Luggin, which was abstracted in the Digest Dec. 15.

Spectrum of Discharge in Liquid Oxygen, Air and Nitrogen.—The "Elec. Eng.," Feb. 6, abstracts briefly from the paper in the "Phil. Mag." for August, by Profs. Liveing and Dewar, which was mentioned in the Digest, Sept. 15.

Modern Theories of Electricity.—The discussion of Prof. Rowland's recent article (see Digest, Jan. 12) by Prof. Lodge, which was abstracted in the Digest, Feb. 9, is reprinted in full in "El'ty," Feb. 6, and discussed editorially. It is reprinted also in the "West. El.," Feb. 9.

[illegible].—The recent editorial from the Lond. "Elec. Rev.," mentioned in the Digest, Feb. 16, is reprinted in "El'ty," Feb. 13, and is discussed in an editorial in which attention is called to some investigations of Mr. Perry, in which almost identical results are said to have been obtained.

[illegible] Metallic Films to Cathode Rays.—An article from the Baltimore *Sun* describing briefly Mr. Lenard's recent discovery, which it is claimed is the most striking original work which was done during the past year, is reprinted in "El'ty," Feb. 6. (A description of these experiments was given in the Digest, April 14; references to other articles on Lenard's discovery were given March 24, April 21, May 19, June 16 and 30, July 21, Sept. 15, Nov. 24 and Dec. 22.)

Magnetic Mechanism.—The first part of an article by Prof. Stine on this subject is published in the "Elec. Age," Feb. 9; in the present portion he describes the nature or theory of magnetism with the aid of some novel and interesting diagrams.

Future of Electricity.—Mr. Walker's article, mentioned in the Digest, Jan. 26, is reprinted in "El'ty," Feb. 13.

ELECTRO-CHEMISTRY AND BATTERIES.

Borchers' Battery.—The Lond. "Elec.," Feb. 1, contains a communication by Messrs. Barnes and Veesemeyer, in which they give the results of some investigations on the lines indicated by Dr. Borchers (see Digest, Feb. 9 and 16, under Electricity Direct from Coal, where further references are given), which, however, differ widely from those he obtained; copper and carbon were used; the results are given in a table which, however, is not very clear; but whether the figures given stand for the voltage, current, or are only relative, they show that without air they are very low, with coal gas and air somewhat higher, but highest of all with air alone; a hydrochloric acid solution gave better results than one in ammonia or sodium chloride. The voltages were greatly influenced by the velocity of the admitted gases and more especially by the unavoidable process of the oxidation of the solution; it was impossible to prevent this rapid oxidation from spoiling the remaining solution; the copper plate was invariably attacked and various salts formed; no carbon dioxide whatsoever could be detected in the escaping gases from any of the elements nor was any carbonate found in the ammoniacal solution. "In defence of Dr. Borchers it must be said that the poor results obtained when both electrodes are of carbon are not decisive, as the action of copper might possibly fall under the head of a phenomenon similar to catalysis, and play an important part without a loss of weight in the plates. However, the above results point most decidedly to oxygen and copper as sole current generators, and if Dr. Borchers remains silent much longer it will seem as if he, too, had been forced to give up the ideas originally advanced."

Local Action in Accumulators.—In the Lond. "Elec. Rev.," Feb. 1, Mr. Epstein gives the results of a test in which it was found that the loss of a charge during about three months' rest amounted to only 20 per cent.

Zincing Process.—The Lond. "Elec. Rev.," Feb. 1, publishes some large illustrations accompanied by a brief description of several installations in which the Cowper-Coles electro-zincing process is used, in one of which the capacity of the tanks is 14,000 gallons; one of the interesting features is that the bath is kept up to its proper strength by means of finely divided zinc kept in suspension in the electrolyte.

Purification of Acetic Acid.—The "Zeit. f. Elek." Jan. 15, abstracts some statements from a Russian electrical journal concerning a process of Mr. Eremin for purifying it electrically; the process is not described as it is about being patented, but it is stated that it has been in use for several years and is so satisfactory, cheap and rapid, that it has replaced the usual distillation apparatus, which cannot compete with it; an objection to the older process was that some of the acetate of copper was also distilled, while in the present process it is removed.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measurement of Resistance.—In an article by Mr. Schuster, published in the "Phil. Mag." for February, he discusses the question of the limit of accuracy of the measurement of resistances; the sensitiveness is always increased by increasing the E. M. F., but the heating of the conductors puts a limit to it; he discusses the question mathematically and arrives at the following conclusions: "With a given resistance and galvanometer the ratio of the smallest change of resistance which can be detected to the sum of the given and galvanometer resistance is equal to the ratio of the smallest current which can be detected by the galvanometer to the maximum current which can be sent through the resistances." "With a given conductor and type of galvanometer, the smallest change per unit-resistance which can be measured is given by twice the ratio of the smallest current which can be detected by means of a galvanometer having the same resistance as the one to be measured to the greatest current which can be sent through the galvanometer." "The highest percentage accuracy with which a given resistance can be measured is directly proportional to the square root of the maximum electric work which can be done on it without overheating." From a table of factors he shows that if, for instance, the galvanometer resistance is 5 times too great or too small the sensitiveness is reduced 25 per cent.; he thinks sufficient consideration is not usually paid to the proper choice of the galvanometer resistance; he recommends using galvanometers with a number of coils which can be variously connected; with three galvanometers each having four coils respectively of 0,01, four and 1,000 ohms, resistances could be measured varying between 0.0005 and 20,000 ohms, being always within 25 per cent. of the greatest obtainable sensitiveness as far as the galvanometer is concerned; if there is only one galvanometer a useful combination is obtained by choosing one of four coils of about 10 ohms each for measuring between 0.5 and 200 ohms with considerable accuracy. He discusses how closely the theoretical value may be approximated by each of the known methods, and concludes that there is really no theoretical advantage of the Wheatstone bridge over any other balance method, as he obtains for all of them the same limiting value; he believes that for very accurate measurements the differential galvanometer deserves more attention than it has so far received. In referring to platinum thermometers he shows that if small differences of temperature are to be detected there would be an appreciable advantage in substituting steel wire for platinum, but there are obvious disadvantages which in most cases would counterbalance the greater sensibility.

Student's Apparatus for Determining the Mechanical Equivalent of Heat.—The recent Physical Society paper by Prof. Ayrton and Mr. Haycraft is reprinted in full in the "Phil. Mag." for February; the illustration shows the complete apparatus; the paper was abstracted in the Digest, Jan. 12. In conclusion they give a recent history of the practical electrical units.

Determining the Electromagnetic Capacity of a Condenser.—The Physical Society paper by Mr. Womack, mentioned in the Digest, Dec. 22, is reprinted in full in the "Phil. Mag." for February; the method used is a modification of the ballistic galvanometer method.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone System Without a Central Station.—A system which has been in use in Prague for a number of years intended apparently for domestic telegraphy, is described in the "Zeit. f. Elek.," Jan. 15.

Origin and Development of the Telephone Switchboard.—A reprint of Mr. Kingsbury's Institution paper is begun in the Lond. "Elec.," Feb. 1, and "Elec. Rev.," Feb. 1, the latter containing a number of illustrations.

Vienna Telephone Installation.—A brief description without illustrations is published in the "Elec. Tech.," Jan. 15.

Telephonic Disturbances.—A paper by Mr. Pierard abstracted in the Digest, Feb. 9, is reprinted in abstract in "L'Eclairage Elec.," Jan. 19.

MISCELLANEOUS.

Educational.—The Lond. "Elec.," Feb. 1, contains a communication by Dr. Fleming on this subject (see Digest last week); it is clear and to the point. The student has to make a departure from some accepted facts in every piece of experimenal work and if he must calibrate his home-made ammeter with a copper voltameter you have to let him assume the received electro-chemical equivalent of coppef; the question of the point from which he is to be started must be determined by what he is supposed to be able to do, that is, whether his goal is to teach physical science or to become a practical electrician; as the chief object of their education is to enable them to earn a living, the best system is the one which teaches certain things as an art, and afterward if he has time consider them as a science; his experience is that students take more interest in their work when they know they are working with the real thing and can get good quantitative results; much educational work would be far better conducted if the abstract were approached through the concrete, than vice versa; the character of the teaching must be to a large extent determined by the end in view.

Electric Siren.—A new form recently shown at the French Physical Society is briefly described in "L'Ind. Elec.," Jan. 25, and "L'Elec.," Feb. 2; the perforations are perpendicular to the plate and the rotation is produced by an electric motor; a number of important advantages are claimed; the pitch and the intensity are then independent, a low intense note or a sharp high pitched note can then be produced.

Electric Anemometer.—An Academy paper by Mr. Richard describing a new instrument is abstracted briefly in "L'Ind. Elec.," Jan. 25, and "L'Elec." Feb. 2.

Electric Log.—A translation of part of the article mentioned in the Digest, Feb. 2, describing the Fleuriais log, is given with illustrations in the Lond. "Elec.," Feb. 1.

Abstracts.—The "Jour. of the Institution of Electrical Engineers" for January contains a large number of abstracts of recent papers on electrical subjects, all of which have been noticed in the Digest, although in most cases more briefly.

Electrical Education.—In the "Elec. Eng.," Feb. 13, Prof. Kidwell discussed at considerable length the recent paper of Prof. Stine, with whose views he differs.

Biographical.—Some reminiscences of the late Rudolph Eickemeyer are given by Mr. Lain in the "Elec. Eng.," Feb. 13.

New Books.

AMERICAN ELECTRIC STREET RAILWAYS. THEIR CONSTRUCTION AND EQUIPMENT. By Killingworth Hedges. London: E. & F. N. Spon. 201 pages, 201 illustrations. Price, $4.50.

The author of this work is a prominent English electrical engineer who recently made an extended tour through this country and Canada, and gives in the volume before us the result of his observations in the field of electric traction. While the American electrical engineer may find but very little material in this volume with which he is not more or less familiar, it will certainly be a revelation to Europeans who are but slightly acquainted with the practical development of the electric street railway in this country.

Mr. Hedges has certainly gathered a vast amount of information on the subject, and while the book is merely a compilation of various material descriptive of practical results obtained, and apparatus employed, in American electric street railways, it has a distinctive value even to those who are familiar with American practice. Not considering it necessary to dwell upon the electrical principles, the author, after two very short chapters, takes up the roadbed, giving several of the more promising methods of track instruction, rail bonding, etc.; following are descriptions and illustrations of various plans of current distribution and supply, including the apparatus and methods employed in overhead construction. Several conduit systems which have been tried are described, but nothing is said about the many trials in this country of storage battery traction. Quite an extended account is given of the Siemens & Halske Budapest road. Succeeding are several chapters on the construction and equipment of cars, showing and describing different forms of trucks, motors, controllers and accessories, with discussions of the advantages of different motors, methods of control and gearing. Generators, boilers, engines and power house equipment follow, with descriptions of several important American electric street railways, among which are the West End and Niagara Falls roads; very few instances, however, of the most recent construction, using direct connected power units, are shown. Chapters on the comparative cost of traction by cable, electricity and animal power, on English electric tramways, on commercial considerations, Board of Trade rules and various formulæ and definitions, form the remaining material.

Many interesting and useful tables, curves and illustrations are included in the work, among which are some tables on the cost of steam and electric plant, arranged by Dr. Emery and Messrs. Crosby and Bell. Various data are also given relating to the cost and operation of electric street railways and a large number of diagrams and illustrations, most of which, however, are taken from various catalogues and periodicals. The author notes the fact that in most of the early stations "the old-fashioned belt or more modern rope-driven arrangements are still in vogue instead of the direct coupled engines and generators which are the rule in almost all the larger European central stations." As this is, however, not the case in the more recent stations, the author should also have stated that we have profited by our experience. Another point to be noted is the cost of operating the English tramways which, from the data given, is somewhat below American figures.

While the book, as a whole, is fairly complete, various recent features of the American electric street railway are omitted, but as a general description of the apparatus now in use the book serves its purpose. Although it contains no new or original matter the compilation describing the various machinery and appliances used in the construction and operation of the American electric street railway and the various data relative thereto, make it a most useful book to those who are not thoroughly familiar with the art, and the American electric railway engineer will also find many interesting and valuable tables embodied therein. Mechanically and typographically the book is excellent.

THE LIFE AND INVENTIONS OF THOMAS ALVA EDISON. By W. K. L. Dickson and Antonia Dickson. Boston: T. Y. Crowell & Co. 362 pages, 158 illustrations. Price $4.50.

A great deal of the material embodied in this book had previously appeared in a series of articles by the same authors in *Cassier's* and the *Century Magazine*, and with many additions and elaborations now forms a volume whose mechanical and typographical execution is worthy of the highest praise. The same, however, can hardly be said of the text, whether considered from a scientific, technical, or even literary point of view. The book is written in what might be called an exaggerated popular style, abounding with the most enthusiastic expressions of praise and admiration for the subject, and containing numerous passages of flowery rhetoric rather out of place in unfolding the biography of a great inventor. The authors appear to be entirely carried away with their subject, having but one thought—Edison—and they put forth, with every possible verbal decoration their utmost efforts to induce the reader to join them in their conclusion—that Edison is "the greatest genius of this or any other age."

In the first part of the work we are made acquainted with the early life and unconventional experiences of Mr. Edison, many new and interesting incidents and anecdotes being recounted; although we are more or less familiar with a great deal of the matter, yet the collection of Edisonia here given is the most complete yet published, and should abundantly satisfy those who admire the Froissart and Weems style of biography. Gradually we are brought to the various changes in his life; his personal qualities and indomitable love for invention are enlarged upon, and his inventions described in their order, most attention being paid to the incandescent lamp, phonograph, and kinetograph. The descriptions of most of these, however, though adorned with most flowery language, are very deficient even in a popular scientific sense. Nearly two chapters are given to the phonograph, but very little is said as to the principles embodied in its operation, and other inventions are treated in more or less the same manner. Several chapters are also devoted to the expeditions made by Mr. Edison's agents in the search for a suitable material from which to make the incandescent lamp filament, and other matter is treated at great length which has only a slight connection with the story.

The authors have in the preparation of the book had the personal assistance of Mr. Edison, who is frequently quoted, as are also many of his assistants and associates. Intimately knowing and being associated with the inventor for many years the authors have written as admiring friends and may, therefore, be perhaps pardoned for the vast amount of laudatory enthusiasm which pervades the book, whose inspiration, however, is certainly very creditable to the subject. A book treating of Edison's eventful life in more sober terms and describing his numerous inventions in a scientific manner still remains to be written. The present volume can only be considered as an elaborate and popular story written in a manner to exalt the popular sentiment according to which Edison and electricity are synonymous. As such it will serve its purpose with the general public, and is superior to the several other biographies of Mr. Edison which have made their appearance, surpassing them in completeness, while in mechanical execution there is no comparison. The glorified Edison we see through its pages, however, is not the keen and practical-minded inventor known to the electrical public, to whom, moreover, his inventions will scarcely be recognizable in the rhetorical dress in which they are here presented.

The *Current* is the name of a new journal devoted to the interests of telegraphers, of which the first copy appeared Feb. 1. The journal will be published semi-monthly by Robert Morton and Edward Delaney, from 73 Jerolemon street, Brooklyn. The editors in their announcement state that they believe there is a field for a telegraph' paper containing essays, poems and general literary matter written for the entertainment of telegraphers and their families, and it is to cover this field that the paper is offered to the telegraphic public. Although the first number consists of but eight small pages it is the intention to enlarge it and make it all that a literary telegraph journal should be. The contents of the initial number includes several clever poems and some historical matter of interest to telegraphers.

The General Electric at the Convention.

The exhibit which will be made by the General Electric Company at the Cleveland Convention will be one of exceptional interest to all engaged in the electric light and power field and interested in the progress which has been made in the art during the past year. The headquarters of the company will be located at the banquet room of the Hollenden, and its interests will be under the care of the following gentlemen, members of the company's staff: From Schenectady: Messrs. S. D. Greene, J. R. Lovejoy, E. W. Rice, Jr., W. L. R. Emmet, F. O. Blackwell and H. C. Wirt; Boston: Messrs. F. M. Kimball, C. D. Haskins and H. A. Harthen; Cincinnati: Mr. W. F. Hays; New York: Mr. T. Beran; Nashville: Mr. H. H. Corson; Chicago: Messrs. B. E. Sunny, Dr. L. Bell and F. N. Boyer; St. Louis: Mr. G. F. Rosenthal; Harrison, N. J.: Messrs. A. W. Page and John S. Howell.

The exhibit will be located at the Canal Street Station of the Cleveland Illuminating Company, which company has kindly consented to furnish the necessary facilities for the operation of the machinery. The exhibit will consist, first, of a working demonstration of the new monocyclic system of electric light and power distribution recently developed by the General Electric Company. In detail, this will consist of a 230-volt four-pole, fifty-kilowatt, 575-revolution direct current motor of the latest type, which will be run by current taken from the Cleveland Company's circuits, and has been installed to operate the plant hereafter described. Belted to this motor will be a monocyclic eight-pole, sixty-kilowatt, 900-revolution, sixty-cycle generator, the current from which will operate a 15-kilowatt induction motor making 900 revolutions per minute. This in turn will be belted to a four-pole, nine-kilowatt, 850-revolution direct current dynamo, furnishing current to a load of incandescent lamps and Thomson '93 incandescent circuit arc lamps.

The current for the induction motor at 1,040 volts primary will be taken from the monocylic generator to two of the General Electric recently designed "Type G," 60-cycle transformers of 7½ kilowatts capacity each, and will thence be brought to the motor. In addition, the monocyclic generator will have as a load a 1,000-watt and a 15,000-watt "Type G" transformer, with the secondaries connected to a suitable lamp load.

To the 1,040-volt primary circuit taken from the generators of the Illuminating Company will be connected a 20-kilowatt, 125-cycle transformer. A three-wire secondary will run from this and furnish current to 104-volt lamps. In the primary circuit a station primary Thomson recording wattmeter will be connected. The secondaries will be loaded to their capacity with incandescent lamps, Thomson '93 alternating arc focussing lamps, Thomson induction fan motors, etc. The current on the secondaries will be measured by Thomson three-wire and two-wire meters. Current from the 1,040 volt circuit will also be taken for an exhibit of the General Electric alternating street system consisting of fifty series lamps of 3½ amperes, the sockets of each being provided with the automatic paper cut-out.

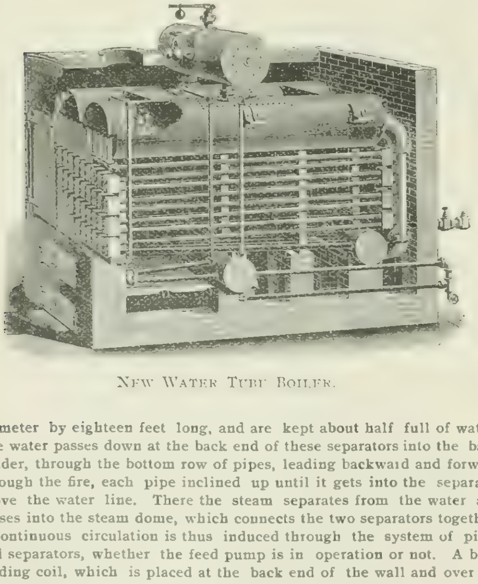
The working exhibit will be further augmented by a twelve-inch hand controlled search light, which will probably be operated on some near-by roof. The appliance exhibit will consist principally of samples of the latest devices put out by the General Electric Company. These will comprise cut-outs, switches, insulators, etc., showing the excellence of the porcelain of its own manufacture; a full sample board of the new punched clip switches, showing, among others, those devised for 500-volt circuits with samples of the new key and keyless sockets.

Circulating Pipe Boiler.

The boiler we illustrate, manufactured by the inventor, J. C. Stead, 63 Kent street, Greenpoint, Brooklyn, N. Y., is based upon a well considered system of circulation which will also assure the entire deposition of sediment where it can be easily removed.

This boiler is usually seven pipes high, one row over the other, each end of a pipe being connected together by a return bend header with hand-hole plates in it, so that tubes or pipes can be put in or taken out at will in case of any damage occurring to a tube or pipe. The boiler has two steel drums; one is used as a steel bridge wall, the other used for a back header and mud drum, where the system of pipes is connected. Each coil of pipe is connected, one end to the bottom header and the other end above the water line. As these are from eight to twelve rows wide in the boiler, and as all the rows of pipes are connected in the front of this bottom header, the latter acts also as a mud drum. The mud drum is also connected with the separators which lie on top of the system of circulating pipes. These separators are usually three feet in diameter by eighteen feet long, and are kept about half full of water. The water passes down at the back end of these separators into the back header, through the bottom row of pipes, leading backward and forward through the fire, each pipe inclined up until it gets into the separator above the water line. There the steam separates from the water and passes into the steam dome, which connects the two separators together. A continuous circulation is thus induced through the system of pipes and separators, whether the feed pump is in operation or not. A back feeding coil, which is placed at the back end of the wall and over the top of the separators, where the escaping gases come in contact with it, heats the water to the boiling point. When feeding, the automatic valve is closed and prevents the water going into the boiler directly; but when not feeding, the valves open, and let the water out of the boiler, circulating it through the feeding and heating coil up into the top of the separator, in the form of steam and hot water. There are about 250 lineal feet of this feeding and heating coil.

It is claimed that this inclined system of circulating tubes in the pipe boiler cannot close up with scale, dirt, or sediment, as each row of pipes, seven in number, placed one above the other, is so inclined that one end is above the water line, the other below it, and there is one unbroken line of circulation from the bottom to the top. As these pipes contain 135 lineal (and superficial) feet, if the water moves only one foot in the row of tubes, the total distance moved is 135 feet, and by the water and steam moving together no sediment or scale can remain in these tubes, but is carried off by the force of the water and steam into the mud drum and can be blown off.

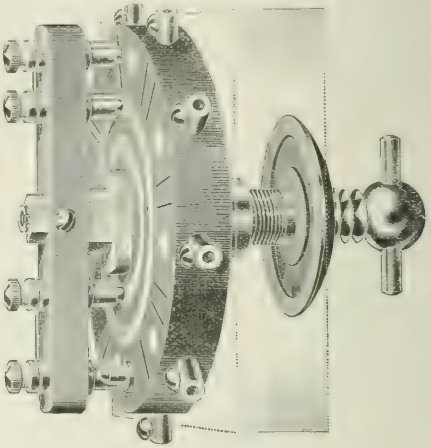


New Water Tube Boiler.

Voltmeter Switch.

Among new switchboard appliances manufactured by the Electric Engineering and Supply Company, Syracuse, N. Y., is a voltmeter switch, which we illustrate herewith. When the switch is in position on the switchboard nothing is visible in front but a two and one-half inch dial plate similar to that of a safe lock, and upon which are numbered gradations corresponding to the respective number of circuits. A moveable dial carrying a pointer is rigidly fastened to a fibre or hard rubber cross bar that sweeps over the surface of the switch base. Embedded in the base are two metallic rings to which the voltmeter leads are electrically connected. The line contact points are spaced around the outer edge of the base. All wire connections of contact points and both rings radiate from the edge of the base, the connector of the inner ring being insulated by a hard rubber tube where it passes through the outer ring. The cross bar carries on each radius two plungers, connected together in pairs with fuse wire held under thumb nuts, to protect the voltmeter against any possible raise in potential. This combination completes the circuit between the voltmeter and the lines terminating in the diametrically opposite contact points, upon which the outside plungers rest.

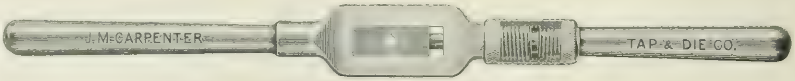
The standard size of switch is adjustable to boards varying in thickness from three-fourths to one and five-eighths inch. To eliminate accidental short-circuiting of contact points through wiping of plungers over the base, two cuts are made in the base between each pair of contacts and in the path of the plungers. The chief merit claimed for this switch is that it is compact and self-contained while the only labor necessary in applying it to a switchboard is that of boring an inch hole, screwing the parts together and making the electrical connections at the back of the board.



Voltmeter Switch.

A New Tap and Reamer Wrench.

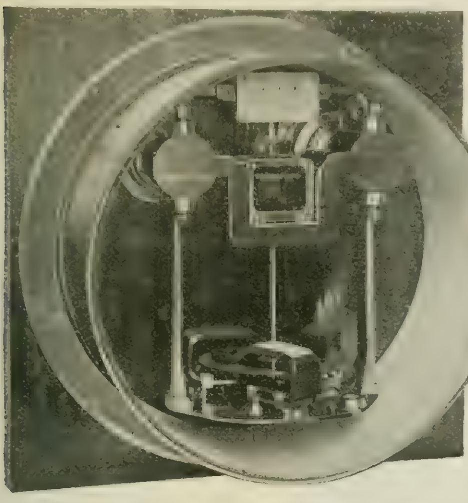
Much inconvenience has been experienced in the practical, everyday handling of tap wrenches by reason of the necessity for using a pin or small wrench to tighten the jaws of the tap wrench. The J. M. Carpenter Tap and Die Company, of Pawtucket, R. I., appears to have eliminated this disadvantage in the construction of its new tap wrench, herewith illustrated. The cut is almost self-explanatory. The neck of the stock is provided with a right-hand thread and the handle has a left-hand thread, the two threads being embraced by corresponding threads on the interior of a knurled sleeve, shown broken away in the illustration. A right-hand turn of the knurled sleeve tightens the jaws, a turn in the opposite direction loosening them. It is claimed that ample power is obtained by the use of the hand alone to grip the jaws sufficiently hard to preclude all chance of loosening while at work.



A New Tap and Reamer Wrench.

Station Output Recording Wattmeters.

In order to furnish a mathematically correct instrument to measure the full output of a station, and at the same time to automatically record the result, the meter department of the General Electric Company has devised a new recording wattmeter known as "Form G," which, though a much heavier instrument, is a development of the well-known Thomson recording wattmeter, and retains all the principles of this efficient type of recording meters.



RECORDING WATTMETER FOR HEAVY CURRENTS.

The "Form G" recording meter is a series instrument, and takes the whole current through its field. This allows the elimination of all errors which might arise were a high capacity shunt employed. As an instance of the value of this fact, these meters, constructed for 7,500 amperes, work accurately and give excellent results, even under the comparatively small current of 500 amperes.

The field of the meter consists of a one-half turn made of copper of high conductivity, forged in the form of a wide winged yoke, the wings being of sufficient size to permit of the insertion of the supporting studs. Within the U-shaped part of this yoke revolves the armature actuating the dial mechanism. The shaft of the armature is, as in the other meters, prolonged, and carries a copper disc which revolves between the jaws of three magnets set at the bottom of the meter. The resistance in series with the armature is external to the meter. It is installed at the back of the switchboard and is there out of the way.

The meter is mounted directly on the switchboard, and is supported entirely by large studs which pass through the material of the board and are secured by heavy nuts to the connections behind. The studs thus form the mechanical support and the electrical connections. The cover of the instrument is of bevelled plate glass set in a burnished brass flange and rim fitting snugly against the board, and is provided with a felt packing to exclude dust. All the metal parts of the instrument are brightly polished, and impart to it a very handsome appearance.

As mentioned, these meters have been devised for the measurement and record of the station output. They are intended for connection with each machine or each feeder, or a single large meter may be connected for recording the total output of an entire power or lighting station.

They are manufactured for pressures of 100 and 500 volts and in capacities of 2,500, 3,750, 5,000, 6,250 and 7,500 amperes, the first, third and last being considered the standard sizes. .

The 100-volt instruments have been designed for use on the three-wire system, one meter being placed on each side of the line. The 500-volt meters are for use on railway systems or in stationary power plants.

In addition to the meters described above, an arc station wattmeter for measuring the total output of an arc machine has also been devised. In this instrument, the principles of the Thomson recording wattmeter have been retained, modifications being introduced to adapt it for use in connection with constant current circuits of high potential. The rheostat used with this arc station meter is a separate piece of apparatus mounted on a marble base, and to be installed in front or behind the board. It is designed for use under extremely high pressures, especial care being given to the insulation. The arc station meters are made in four sizes: 35 and 50 lights each for 6.8 amperes and 10 amperes, and measure the output with accuracy.

The meters complete the line of General Electric station recording instruments. For the alternating system, there are the primary meters in capacities ranging up to 600 amperes at 1,000 volts, or about 10,000 lamps. For the direct current systems for light, railway and power the "Form G" meters, or larger meters of standard form are employed, and for arc systems the arc station meter.

A Northwestern Electrical Supply House.

Among the number of successful supply houses of comparatively recent birth is the Michigan Electric Company, of Detroit, Mich., which was incorporated about two years ago. From the start its business has grown rapidly, requiring frequent additions to room and stock, until to-day its quarters, here illustrated for the first time, are a credit to the electrical business.

Owing to the ability and standing of the members of this company its services have been considerably sought after by various manufacturers, and the list of specialties now handled, in addition to a general line of supplies, embraces the product of many of the largest and best manufacturers of this country, including the Simplex Electrical Company, Siemens and Halske Electric Company (of America), Walker Manufacturing Company, Detroit Electrical Works, Buckeye Electric Company and the Automatic Switch Company. The Michigan Electric Company also controls a complete line of street railway overhead equipment, which it manufactures itself.

A NORTHWESTERN ELECTRICAL SUPPLY HOUSE.

The pronounced success of the company during the two years of its existence is undoubtedly due to the energetic and sagacious management of its president, Jos. E. Lockwood, and treasurer, Geo. A. Mansfield, of whom we give a brief sketch elsewhere.

The Handling of Coal and Ashes at the Third District Station of the Edison Electric Illuminating Co., Brooklyn, N. Y.

We illustrate herewith the coal-handling apparatus installed by the C. W. Hunt Company, 45 Broadway, New York, in the Third District Station of the Brooklyn Electric Illuminating Company. This station is situated at some distance from the coal wharves and coal is delivered by wagons. It was necessary to take the coal from the wagons, carry it to the furnaces and also to remove and dispose of the ashes. The arrangement of the machinery installed for this purpose is shown in Figs. 1 and 2.

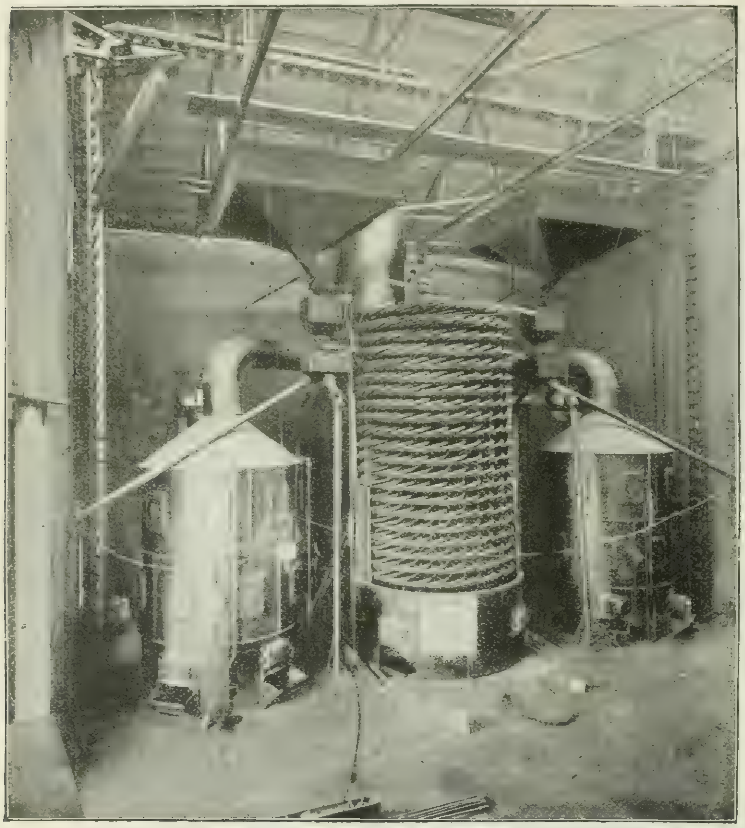


FIG. 1.—COAL-HANDLING MACHINERY IN BOILER ROOM.

The coal is carried from the hopper underneath the sidewalk to the coal tanks above the boilers by a conveyor which upon its return, passes underneath the ash pit of the furnace and carries the ashes to a bin from which they can be drawn at will for removal. The conveyor consists of a series of gravity buckets pivoted in a double chain, and the whole system is carried on self-lubricating wheels. The buckets are so pivoted in the chain that the force of gravity keeps them always in an upright position whether full or empty and regardless of the track over which they are drawn.

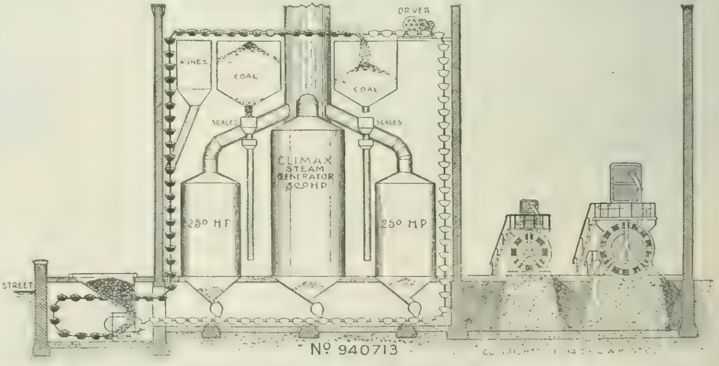


FIG. 2.—SECTIONAL VIEW SHOWING ARRANGEMENT OF HUNT COAL-HANDLING MACHINERY.

The material is carried to its destination by a single conveyor in a horizontal, vertical or angular direction, all of which were utilized in this station. The change in the direction of the conveyor is made by running around curves instead of over sprocket wheels, and the whole machine is noiseless in its operation. The chain is driven by pawls instead of by sprocket wheels, avoiding the destructive wear heretofore inherent in conveyors, as the material does not come in contact with any working part of the conveyor to cause wear. The conveyor is moved slowly, the capacity being obtained by the size of the buckets and not by the speed of the chain. In this station the necessity for a special method of filling the buckets under the sidewalk will be apparent when it is considered that the buckets swing freely on pivots and might oscillate to a harmful extent or might be loaded on one side and remain at an angle during the trip. The loading is accomplished by a continuous filler which guides the coal into the buckets, filling each one evenly as it passes.

The power for driving the conveyor is located at the top line and is furnished by a ten horse power electric motor. The operating switches are placed below on the boiler room floor for convenience in starting and stopping the machinery. At this station when receiving coal at its full capacity, the power required to operate the conveyor is 4½ hp, measured at the switch. The coal is drawn from the storage bins above the boilers into weighing hoppers, from which it is spouted to the floor of the boiler room at such a distance as to be easily shovelled directly into the furnaces.

Handling ashes, either wet or dry, has heretofore been considered one of the most difficult objects to accomplish, and one of the most destructive to machinery, but in this station it is accomplished so completely by the use of a special filler placed under each boiler that it appears to be as easy to handle the ashes as the coal.

Fuel Economizers and Electric Generating Plants.

Two large Green economizers, made by the Fuel Economizer Company, Matteawan, N. Y., are used with the Babcock and Wilcox boilers at the plant of the Union Street Railway Company, Providence, recently described in the columns of THE ELECTRICAL WORLD by Mr. G. T. Hanchett as one of the best designed street railway plants in the United States. These economizers contain 9,000 square feet of heating surface and are placed immediately behind the boilers. The furnace gases pass through the economizer before entering the chimney, and impart to the feed-water—which is fed from the hot well through the economizer into the boilers—a temperature considerably above the boiling point. Independently of the saving in coal effected by the use of economizers in electric plants they have a great advantage on account of the large reserve of hot water at the evaporative point they hold in readiness to be delivered to the boiler on any sudden demands for power, thus enabling the fireman to keep an even pressure of steam, notwithstanding variable loads. The water takes about half an hour to pass through the economizer and consequently the sediment and soluble matter contained is precipitated in the apparatus where it can be easily blown off. This is a great consideration in plants where the water is at all muddy or gritty, as the surfaces of the boilers are thereby kept comparatively clean.

An Important Addition to Cleveland's Industries.

A little over a year ago The Elwell-Parker Electric Company (of America) was organized by Cleveland men, and purchased all the American patents, rights, franchises, etc., from the English Elwell-Parker Company, called the Electric Construction Company of London and Wolverhampton, England. It is now in a position to place upon the market all the various types of these celebrated dynamos, motors, and apparatus used in conjunction therewith.

These well known machines have been in use since 1881 in all parts of Great Britain, on the Continent of Europe, in South Africa, India, Australia and other countries, where large and important installations are in very many cases composed of Elwell-Parker machinery. We may specially call attention to the Liverpool Overhead Railway, the Manchester Corporation, the London Metropolitan Electric Supply Company the London General Post Office, the Liverpool Electric Supply Company, Oxford Electric Company, Oxford, Eng., etc., all of which are large and very efficient generating and distributing plants. The Liverpool Overhead Railway Company's electric generating and traction plant has established a reputation for efficiency and all-around reliability.

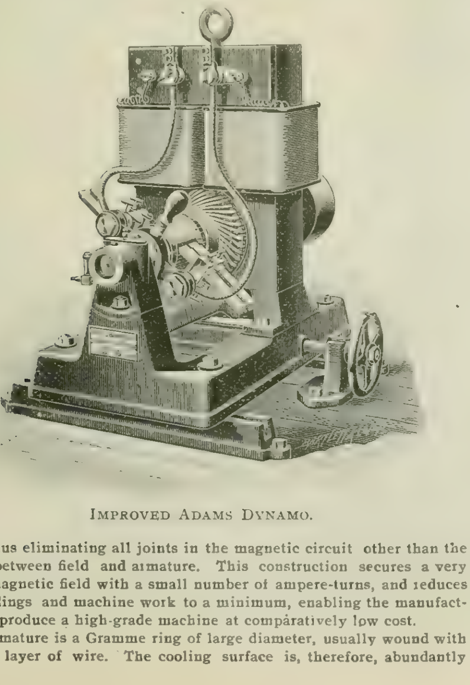
This company's generators are now doing the majority of the electrolytic work in Great Britain, and its system of long distance transmission and distribution by direct currents is in successful operation in a considerable number of places.

The American company is prepared to manufacture generators of 1,000 hp and under; motors, transformers, automatic switches and all other appliances necessary to the industrial application of electricity, including long distance transmission and distribution by both alternating and direct currents. It also has facilities for the manufacture of the large generators and gearless motors for heavy electric railway work, of which it makes a specialty. The highest degree of perfection in electrical and mechanical design, materials and workmanship, and an extremely high efficiency are claimed for all its machines.

The officers are at present as follows: F. C. Phillips, president; E. B. Phillips, vice-president; Alex. E. Brown, secretary and treasurer, and E. S. W. Moore, superintendent. Mr. F. C. Phillips has had a very large and varied experience in every branch of electrical engineering abroad and especially in England, and Mr. Moore has had a similar experience but confined to Great Britian. Mr. E. B. Phillips has had fourteen years' experience in electrical work in this country. Mr. A. E. Brown is the inventor and manufacturer of the Brown hoisting and conveying machines that have done much to revolutionize the handling of large quantities of ore, coal, pig iron and other like raw materials.

Wrought Iron Field Dynamo and Motor.

We illustrate below the improved Adams dynamo and motor, manufactured by the E. G. Bernard Company, Troy, N. Y., which possesses the distinctive feature of a wrought iron field magnet forged in a single piece, thus eliminating all joints in the magnetic circuit other than the air-gap between field and armature. This construction secures a very strong magnetic field with a small number of ampere-turns, and reduces the windings and machine work to a minimum, enabling the manufacturers to produce a high-grade machine at comparatively low cost.

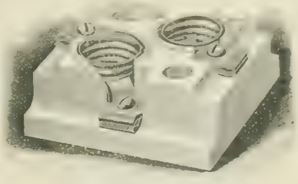

Improved Adams Dynamo.

The armature is a Gramme ring of large diameter, usually wound with a single layer of wire. The cooling surface is, therefore, abundantly large, conducing to low heat losses and smooth running, and the resistance of the armature winding is very low, thus enhancing the efficiency of the machine. Mica insulation is used exclusively.

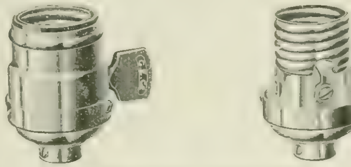
The commutator is of the usual high-grade construction, tempered-copper and mica being used. The journals, brush-holders and other details conform to the latest and best engineering practice. Nothing particularly novel is attempted in the type of the machines, the aim being rather in the direction of high-class designing and workmanship. The dynamos are compound-wound to regulate for all loads from zero to maximum; the motors are plain shunt wound.

New Cut-Out and Lamp Socket.

We illustrate a new cut-out and socket recently placed on the market by the General Electric Company, which embody several interesting improvements. The former, a double pole single or double cross-over branch plug cut-out, is so constructed as to facilitate its attachment to wires already placed, holding them well apart where they cross. It is a very compact device, of the well-known plug fuse type, the fuse being held in a brass-covered screw plug, inserted in the female screw shell secured to the porcelain. Replacement of the fuse entails no further labor than is involved in the unscrewing of the fuseless plug and the insertion of a perfect one, which feature renders the cut-out of especial value in residences and places where fuses have to be cared for by unskilled persons.


New Plug Cut-Out.

The lamp socket is the outcome of a well-founded knowledge of the conditions which should be fulfilled by a first-class socket, and while containing the best features of the older sockets, embodies also improvements which ensure the best results in practice. It is smaller than the well known Edison socket, and in construction is extremely simple. The entire base is formed of one porcelain piece of conical shape, and so ridged perpendicularly that there is practically no possibility of a short circuit between the working parts. The key may be turned in either direction. The central connection for the lamp base is a well-tempered contact spring against which the lamp is screwed and a good contact made, while the spring serves to prevent the lamp from working loose. The wires are connected as directly as possible, needless joints being avoided. The insulating collar between the screw shell and outside shell is firmly locked in place and extends one-sixteenth of an inch beyond the shell.


New Key Lamp Sockets.

Every precaution has been taken to produce an appliance the usefulness of which cannot be impaired by the ordinary carelessness of wiremen or fixture fitters. The porcelain used in these appliances is manufactured by the General Electric Company in its own porcelain works at Schenectady, which were especially constructed for the production of porcelain possessing the high insulating qualities for which the stringent conditions of the government specifications and insurance rules call.

The Power Plant of the Baltimore & Ohio Belt Line Tunnel.

The Baltimore & Ohio Railroad tunnel plant in Baltimore is approaching completion, and will go far toward deciding definitely the question as to whether electric traction is adaptable to steam railways as a substitute for steam locomotives.

The Belt Line Road, as it is termed, is but a short cut connecting the main tracks of the Baltimore & Ohio Railroad at two points, and its object is to avoid a long detour about the city. This is calculated to save from twenty minutes to half an hour in the running time between New York and Washington, and it will besides enable the Baltimore & Ohio Railroad Company to place one station near the present Union Station of the Pennsylvania Railroad and a second one in the very heart of the business centre of the city. The Belt Line Road is about seven miles long. It begins near Bayview, to the east of the city, runs several miles through deep cuts along the northern edge of the city until it swerves around to the Jones Falls embankment, west of Oak street; it crosses the valley of this stream, the tracks of the Pennsylvania Railroad and the Baltimore & Lehigh Railroad on a large bridge, and a short distance beyond this it enters the tunnel which follows Howard street through the city to the present Camden station. This tunnel is 7,430 feet long, and cost the Baltimore & Ohio Railroad Company between $7,000,000 and $8,000,000.

The motive power is furnished from one station located near the end of the tunnel. This power house was equipped throughout by the General Electric Company, which is making the test of electric traction at its own expense, and if the result is in every way satisfactory the Baltimore & Ohio Railroad Company will purchase the plant complete.

In addition to the traction plant an electric lighting plant is installed to supply about 2,000 incandescent lamps, which are placed throughout the tunnel. As there will be no smoke in the tunnel it is intended to paint its interior white, so that when illuminated by incandescent lights it will not be necessary to light the lamps in the cars of passing trains. The generators will be driven by Armington and Sims engines, and the steam will be furnished from improved Root water tube boilers. The boiler room of this plant is most interesting and includes the most modern appliances. Twelve Root boilers are arranged in six batteries, three batteries on each side of the room. Each of two flues which run along the opposite walls back of the boilers carries the heated gases to economizers which utilize part of their heat to raise the temperature of the feed water. The gases then pass into a Sturtevant pressure fan which expels them through a short stack into the air. This fan establishes an induced draft, causing the air to pass rapidly through the grate bars and coal, thus promoting combustion more or less rapid according to the speed of the fan, which is regulated according to the demand for steam.

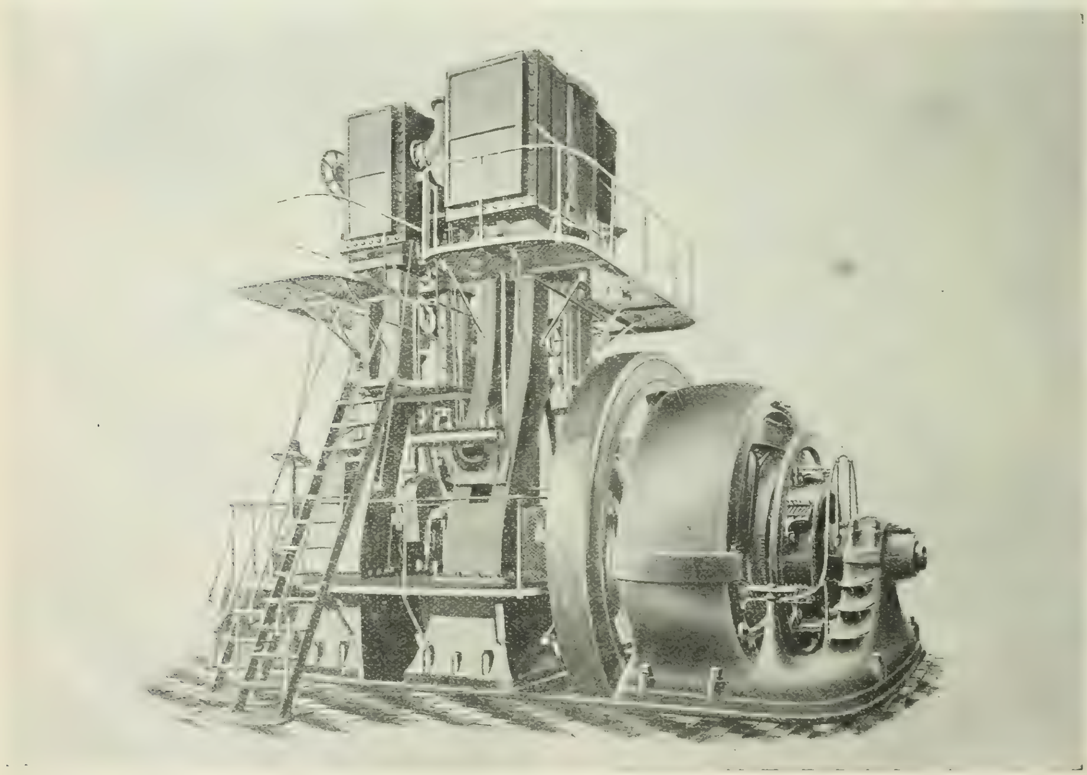
A coal and ash handling device, made by the C. W. Hunt Company, New York, carries the coal direct to each of the boilers and also carries the ashes away from the ash pits.

As the General Electric Company is relying entirely upon the success of this plant for the sale of it to the Baltimore & Ohio Railroad Company, the greatest care was necessary in the selection of all the appliances, and to illustrate this point the order was not placed for the boilers until after the General Electric Company had thoroughly tested them in two of its Lynn plants.

A Representative Industrial Plant.

The Walker Manufacturing Company began operations in the field of electrical manufacture in February last, and the first electrical apparatus produced—the now well-known railway motor—was put in service the following May. Although new in the electrical field, this company has enjoyed for several years a most enviable reputation in the construction of cable railway equipments, power transmission plants and all kinds of heavy machinery. Notwithstanding the fact that the character and quality of its electrical apparatus was entirely unknown, and in spite of the severe commercial stringency of the past year, the company has done a business beyond its expectations. It has achieved a very encouraging and almost unlooked-for success with its street railway equipments, and has also been furnishing apparatus for traveling cranes, swinging bridges and power transmission plants. Contracts are on hand for a number of large direct-coupled railway generators—three 500-kw and two 750-kw, besides a number of smaller ones. It is also furnishing dynamos for incandescent lighting, which are particularly well adapted for direct-coupling for isolated work in large office buildings and factories, and an arc-light dynamo of 125 2,000-cp lamps capacity is being perfected, and will be placed upon the market very shortly. The older arc-light plants throughout the country are beginning to require renewal of machinery, and the universal demand is for more efficient and larger units than formerly used, and the arc dynamo of the Walker Manufacturing Company is intended to meet these requirements. Its design is based on a long experience in arc light work. It will run at a speed such as to make it available for either direct-coupling or belt driving, and will regulate perfectly up to its full capacity of lamps without requiring an external regulator. It will supply its full complement of 125 2,000 cp lamps with a consumption of but 90 hp. The company is also contemplating taking up in the near future the manufacture of an improved form of arc lamp.

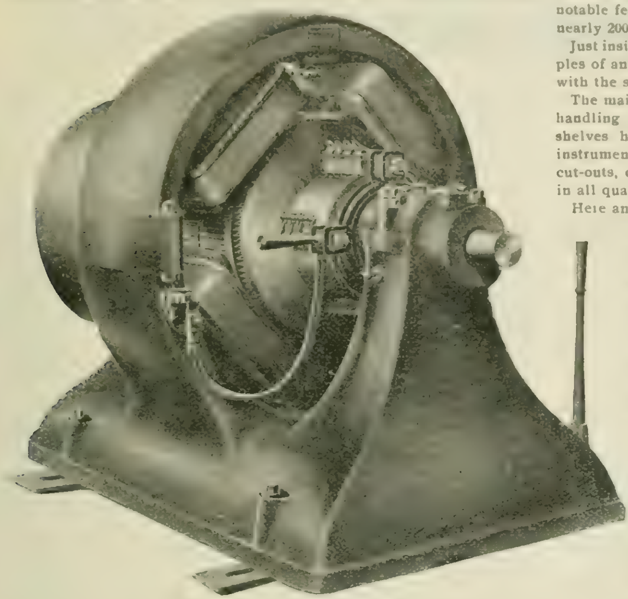
The works of the Company are situated on the lake at the foot of Waverley avenue, in Cleveland, O., about twenty minutes' ride from convention headquarters. The plant is modern in all its appointments, and is one of the largest and most complete in the country. The machine shop consists of three bays, each 57 feet wide by 430 feet long, and contains a 30-ton traveling crane which moves its entire length. Iron galleries at either end are fitted up for some of the lighter work. The testing department occupies one end of one of the machine shop



Walker Direct-Connected Generator.

bays and is fitted up with all necessary appliances for testing the apparatus turned out. The tracks of the L. S. & M. S. Railway enter the testing room below the floor level, so that machinery can be loaded by the large cranes directly from the testing room on to the cars.

The company's two large foundries are perfect in their equipment, containing several large cupolas, spacious core ovens, and a number of traveling cranes of from five to thirty tons capacity. Fifty tons of iron can be poured at one heat into a single mould. The company is, therefore, fully equipped to make castings of any size or grade. The pattern shops occupy a large two-story building, well supplied with modern wood-working machinery. The works have a present capacity for the profitable employment of from 3,000 to 4,000 men with plenty of room for increase when necessary.



Walker Belt-Driven Generator.

A Typical Supply House.

Whenever one is called upon to speak of Chicago or any of its remarkable establishments, the first thing he has to guard against is the use of superlatives, for the reason that the inhabitants in other sections of the planet are likely to ascribe to what is simple fact the rather always to be avoided quality of "brag." In and about the city itself, however, the visitor finds nothing that does not partake either of the colossal, or of the marvelous, when compared to the usual degrees through which things material develop into perfection.

In the ordinary sense there is nothing specially interesting in a "supply house," so-called; but in the unique establishment of the Electric Appliance Company, of Chicago, there are many elements of genuine interest.

But a few years ago this name had never been heard of. To-day it is one of the best known in the country wherever electric lighting and railway systems have been installed.

The exterior bears the ear-marks of the originality that has been a notable feature of the company's existence. It is a three-story building, nearly 200 feet deep.

Just inside the spacious door is arranged an exhibit board holding samples of anything you want, and so displayed as to instantly impress one with the superiority of the Appliance Company's line of specialties.

The main store, shown in the illustration, is admirably arranged for handling the immense trade daily transacted there. The well-filled shelves hold everything known to modern electrical science—testing instruments, knife switches, snap switches, arc and incandescent lamps, cut-outs, cleats, sockets, annunciators and house goods of all kinds and in all quantities.

Here and there a reel of O. K. weatherproof wire, for which the company is Western agent, and everywhere coils and reels of well-known "Paranite," with which brand of insulated wire the name of the Electric Appliance Company is so intimately associated.

Back of this main room the always-busy officers are located. This part of the store is a hive of industry at all times.

The shipping room—the nerve centre of a mercantile house—is another scene of unceasing activity. Through this department scores of orders, large and small, are daily filled.

The basement forms a great store house for the company's goods. Here is kept at all times ample stock to fill every order.

The success of the Electric Appliance Company has been gradual, and for that reason all the more certain. Each new customer has been handled as though he were the only one; thus the company has gained strength through the very people with whom it has dealt—a high compliment to its integrity.

The officers of the company displayed good judgment at the start by selecting only those specialties that would stand hard pushing. A good thing cannot be too well advertised; a poor thing meets death in the light of publicity and competition. The Electric Appliance Company early appreciated this fact, hence their selection of such leaders as the Packard transformer, the Packard incandescent lamps, "O. K." weatherproof wire, "Paranite" insulated wire cord cables, the Allen soldering stick, and other specialties which their hustling qualities have brought into prominence.

For each of these the company has repeatedly claimed great economic features, and practical experience has justified the claims.

During the World's Fair and the period of depression that linked itself with '93-4, the company was one of the few that pushed aggressively forward. It lost no opportunity to supply the trade with just what it wanted, and at prices that pleased. Now its volume of business is enormous and daily growing, so that it will soon have to seek more commodious quarters.

It is always a pleasure to record every honest success. It is a double pleasure to present at this time the reason for the claims of the Electric Appliance Company on the patronage of every one from whatever section of the country—namely, that it has won its success on the merit of its goods, the absolute integrity of its dealings and the popularity of its officers and salesmen.

Packing Room. The Electric Appliance Company. Main Store Room.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Feb. 15. 1895.

ELECTRICAL STOCKS do not improve much. The speculative community continues to take an unfavorable view of the general situation, and a lower range of prices is freely predicted. There is a good deal of general selling, but it is in about the proportion of two-thirds short, and only one-third long. Nonetheless, even this is discouraging, and tends to increase the dread of further depression in prices.

GENERAL ELECTRIC, however, does not look high enough to warrant fears of a serious decline in its quotation. With no floating debt to look after and impede its progress, the company is easily holding its own, and the management scouts the idea that it is in danger of such a collapse as has occurred in several other industrials. There is, according to officials, nothing in connection with its affairs to bring about any such disaster. It is being managed with the utmost care, and on the same basis as a purely private enterprise. Naturally, it is absolutely impossible to tell to what low level its market quotation may descend, but it is not hard prophesying to declare that those who hold General Electric stock the longest will not regret their steadfastness. True, the company is now passing through a period when earnings are smaller than its management should like to see, but goods are being sold at a profit, and a small amount of money is being made every month. One recent good deal was the closing of a contract with the New York, New Haven & Hartford Railroad Company for the electrical equipment of its Nantasket branch; this involves $70,000, and the General Electric Company met with practically no opposition. This is a very important transaction, in that the New York, New Haven & Hartford Railroad Company as already stated in these columns contemplates introducing trolley equipment on many of its shorter branch lines and much of its suburban trackage, and the success of the first line, as equipped by the General Electric Company, means the placing of further profitable orders with it.

WESTINGHOUSE ELECTRIC issues maintain their own with ease. The company this week came into complete possession of what is probably the most complete and extensive manufactory in the world, the last of the group of seven buildings having been turned over by the contractors. There are now 600 men at work in the new factory, and in the erection of the new machinery and tools, and the care of the materials arriving from the Pittsburgh and New Jersey works. The extent of the plant can be judged by the size of the main building, which is 754 feet long, and 231 wide, and can easily hold two trains of cars. When in full operation the various buildings in the establishment will require the presence of 3,000 to 4,000 operatives. The machine tools are among the finest ever made in this country. All shafting and machinery are driven by Telsa alternating current multiphase motors, and the whole plant in full operation furnish one of the best illustrations of electric power distribution to be found in the country. The possibilities of the new plant for economical and profitable manufacture are practically unlimited, and great things in the way of money making are expected in the near future. It is not strange, then, in view of these bright prospects that the preferred and common stock should not be more affected by adverse business conditions, and it is reasonable to expect that better prices will soon obtain when the company's strength of position is more fully appreciated.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	128	130
Edison Electric Ill., New York	100	96½	97½
" " " Brooklyn	100	108	110½
" " " Boston	100	125	127
" " " Philadelphia	100	120	125
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	32	34
General Electric	100	28⅛	29
General Electric, pref	100	61	66
Westinghouse Consolidated, com	50	30¼	32½
" " pref	50	48½	49
BONDS.			
Edison Electric Ill., New York	1 000	108	109
Edison Electric Light of Europe	190	75	85
General Electric Co. deb. 5s	1,000	88⅛	89
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	191½	192½
American District Telegraph	100	45	49
American Telegraph & Cable	100	92	93
Central & South American Telegraph	100	117	120
Commercial Cables	100	135	140
Erie Telephone	100	46	46½
Gold & Stock Telegraph	100	104	110
Mexican Telegraph	100	190	195
Mexican Telephone	100	75	80
New England Telephone	100	67	69
New York & New Jersey Telephone	100	97½	99
Postal Telegraph-Cable	100	55	58
Western Union Telegraph	100	87⅛	88

WESTERN UNION TELEGRAPH has been rather freely sold of recent days, the "street" theory being that it was too high around 87 for a stock on which dividends will come down sooner or later. That time, however, with the big surplus and the company's prestige, is likely to be a good long time a-coming, and it would seem that the bears, with the scorchings they have received in prior attempts to down the stock, should by this time know the danger of assailing a stock which, by reason of the small floating supply, can be so easily cornered. Western Union has not as yet suffered much from the bear campaign. Several old buying orders have appeared to discomfit the down grade operators, and they have not as yet succeeded in demoralizing quotations.

ELECTRIC STORAGE stock, that of the Consolidated Company, is easily commanding its old figures, the reports concerning the company being of a consistently flattering character. The latest is to the effect that President Gibbs is conducting an important deal that will prove of the same favorable character as the recent amalgamation. In this event Electric Storage can be depended upon to greatly appreciate in value.

EDISON ELECTRIC ILLUMINATING, of New York, is now selling ex-dividend. January earnings, just reported, show that the same good progress as previously reported is being continued. Gross earnings were $166,953, an increase of $31,768; operating expenses, $73,249, an increase of $14,909; net earnings, $93,703, an increase of $16,859.

POSTAL TELEGRAPH remains unchanged in quotation, but the company is making a good record for efficiency of service. During the recent heavy storms its service by dint of hard effort was harldy interfered with. The company is projecting various extensions. An important line soon to be constructed will extend form Massillon, O., to Chicago, a distance of 400 miles. A number of cities, of 10,000 and 12,000 population, not now in the Postal Company's lines, will then be connected with it.

BELL TELEPHONE remains about the same as last week. The 3,368 shares not taken by the stockholders under the recent offer of treasury stock, was sold at auction this week. The first bid was 185, and the first sale was 761 shares at 191. The next sale was at 190, the third sale at 190⅛, and the remaining 1,748 shares were disposed of at 189¼ for the account of a pool of investment orders from half a dozen houses. The directors of the company state that the result of the auction sale was very satisfactory, all things considered, but they have not as yet acted on the question of selling more stock in similar fashion. The annual meeting of the company will be held on March 26 next, and some action will then be taken looking to the determination of the company's future financial policy.

ELECTRIC TRACTION stock, outside of New York stocks, are quite active. Philadelphia advices have it that the continued strength of the traction stock is the only feature of the local market, the railroad shares and the unlisted specialties being absolutely neglected in their favor. The prediction is circulated there that Baltimore traction will begin by the payment of dividends by January, 1896. There is renewed talk in Boston of lively times in West End on developments in connection with control.

ELECTRIC TRACTION STOCKS.

	Bid.	Asked.
Union Ry. Co. (Huckleberry)	115	125
Brooklyn Traction, com	10	12
" " pref	54	58
Long Island Traction	8¾	9
Rochester St. Ry	36	38
Columbus St. Ry	48	50
Louisville St. Ry. com	37	39
" " " pref	87	88
Cleveland Electric Ry	59	60
Cleveland City Ry	68	70
North Shore Traction	23	25
New Orleans Traction	15	16
New Orleans Traction pref	55	58
Worcester Traction com	11	13
" " pref	78½	80
Metropolitan Traction, Philadelphia	98¼	98½
Philadelphia Traction	88¼	88½
People's Traction	47¼	48
Binghamton R. R. common	100	—

BONDS.

	Bid.	Asked
*Union Ry. 1st. mtge 6s.	105	108
*Westchester Electric 1st. mtge. 5s.	98	101
Rochester St. Ry. 1st. 5s.	95	97
*Columbus St. Ry. 1st 5s.	95	97
Columbus Crosstown 1st. 5s.	95	97
*Binghamton Railroad Co. 5s	99	100

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* With accrued interest.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD.
253 Broadway, NEW YORK, Feb. 18, 1895.

H. B. COHO AND COMPANY, of 203 Broadway, New York, have sold to the Conduit Wiring Company two 50-kw direct-connected Mather generators for the Lauderdale Building, Providence, R. I. Messrs. Pattison Brothers are the engineers on this work.

JARVIS B. EDSON, 87 Liberty street, New York, has received a copy of a report made by a board of Italian naval officers, in which the Edson pressure recording and alarm gauge is strongly endorsed. As a result an initial order for gauges from the Italian Government has been received.

A BILL has been introduced in the New York legislature by Assemblyman Fitzgerald requiring the appointment of an electric meter inspector for New York State, at an annual salary of $2,500, to be paid by the electric light companies. The bill also provides for deputy inspectors at works where meters are made, and prohibits electric light companies from charging rent for meters.

THE INTERIOR TELEPHONE COMPANY, of New York, (which handles the Colvin system) on Feb. 12 brought suit in the United States Circuit Court for the Southern District of New York, against the Tucker Electrical Manufacturing Company and against James R. Strong, president, and Thomas McCoubray, as individual co-defendants, for the infringement of patents Nos. 513,305 and 524,524, granted to Frank R. Colvin, and owned by the Interior Telephone Company.

THE J. C. AYER ESTATE will erect a 9-story, fire-proof building on the corner of Broadway and Franklin street. Frederick A. Southack & Co. are agents for the property. The 13-story buiding going up on the corner of Broadway and Broome street, the 9-story Baudoine building, corner of Grand; the 12-story building to be put up by Havemeyer at Broadway and Prince, and the 9-story building to be erected at Broadway and Howard street by Boehm and Coon, are all to be equipped with electric lighting plants.

THE BROOKLYN STRIKE continues to afford spasmodic bits of divertisement of a slightly sensational character. It is reported now that the Grand Jury has indicted President Norton and Superintendent Quinn, of the Atlantic Avenue Railway Company, on charge of violating the ten-hour law. Several of the strikers swore to having been made to work for the company eleven and eleven and a half hours within a period of twelve consecutive hours. Mr. Quinn expresses himself as entirely able to successfully refute the charge.

MR. EDWARD BERGTHEIL, of the firm of Bergtheil & Young, electrical engineers and contractors, of London, England, is now visiting the States with a view to arranging increased facilities for their English and European customers in connection with some American specialties which they introduced to those markets, and encouraged by their previous success, is prepared to negotiate for other first-class agencies. He can be communicated with at 35 Pine street, this city, or seen there on his return from the Cleveland Convention, which he is attending.

General News.

NEW INCORPORATIONS.

THE GARRETT ELECTRIC LIGHT COMPANY, Indianapolis, Ind., capital stock $20,000, has been incorporated.

THE KRAMER ELECTRIC MANUFACTURING COMPANY, Chicago, Ill., capital stock $100,000, has been incorporated by Edward Kirch, Frank A. Kramer and Max C. Krueger.

THE BLOOMINGTON GAS, ELECTRIC AND STEAM HEATING COMPANY, Bloomington, Ill., capital stock, $50,000, has been incorporated by Sam. P. White, R. T. McDonald, Jacob P. Smith, John J. Patterson, George McIntosh, John Eddy and A. E. Demanges.

THE ELECTRIC CONSTRUCTION COMPANY, Wilmington, Del., has been formed to carry on a general construction and electrical engineering business, make and sell dynamos, motors, electrical instruments, lamps and general electrical supplies. J. Wesley Morris, and Herman Devenney are the organizers.

THE MARION WATER COMPANY, Jersey City, N. J., capital stock $250,000, has been formed to construct, maintain and operate electric light works, gas works and water works, in Marion, O., and elsewhere, etc. Alfred C. Brown, Lewis Halleck, Jr., Robert B. Dillingham and Herbert F. Hatch, East Orange, and Chas. N. Brown, Jersey City, N. J., are the promoters.

TELEGRAPH AND TELEPHONE.

CORDELE, GA.—D. H. Ledbetter will establish a telephone system.

MARTINSVILLE, IND.—A telephone exchange will soon be established.

PARIS, TEX.—The Anthony Telephone Company will construct a system.

ARGENTILE, KANS.—A petition has been presented by G. W. Simons, Wm. McGeorge, T. M. White and others, leading business men, asking for a franchise to establish a telephone exchange. It is proposed later on to connect the local exchange with the two Kansas Citys.

SNOW HILL, MD.—The Snow Hill Telephone Company has been organized by G. S. Bridges, who will construct a system. He wants from 100 to 150 telephones, 50 miles of copper or iron wire, 1,500 brackets, 1,500 insulators, seven miles (two conductors) submarine cable, 1,500 poles (cypress or chestnut) 20 to 25 feet long.

ELECTRIC LIGHT AND POWER.

SHELBYVILLE, ILL.—The Council is taking steps in the direction of purchasing an electric light plant.

ALBANY, N. Y.—Address the City Clerk concerning a municipal electric lighting plant to be established.

HUMBOLDT, TENN.—A bill is before the State legislature authorizing the issue of $15,000 water and light bonds.

PROCTOR, VT.—Bids will be asked soon for an extensive electric plant to be used for lighting and quarrying purposes.

KENTON, O.—Municipal lighting is being strongly agitated here, and it is very probable that the city will put in a plant.

GERMANTOWN, PA.—The George Nugent Home for Aged Baptist Ministers, on West Johnson street, will be lighted by electricity.

GUTHRIE, OKLA.—St. Louis capitalists have purchased the Guthrie electric light plant. They will add more incandescent lights.

MOORESTOWN, N. J.—Elwood Hollinshead, Jr., is building a fine residence on Chestnut street. It will be fully equipped with electric lights.

BROOKLYN, N. Y.—The Kings County Wheelmen will erect a new club house on Bedford avenue which will be lighted by electricity. Cost $35,000.

SILVER LAKE ASSEMBLY, N. Y.—The Silver Lake Railway Company will build a pier out into the lake on which a band pagoda is to be built decorated with electric lights.

GALESVILLE, WIS.—D. M. Benton & Co., recently granted a 20-year franchise by the City Council, are making arrangements to extend the electric light lines all over the city.

BROCKTON, MASS.—The Edison Electric Illuminating Company, of Brocton, capitalized at $100,000, became the property of the Industrial Improvement Company, of Boston, on Feb. 6.

RAHWAY, N. J.—The Rahway Electric Light and Power Company has been organized. Capital, $200,000. Stockholders, Capt. W. Boynton, of Woodbridge, Jackson Jacques, of Rahway, and others.

NORWICH, CONN.—In the legislature at Hartford Gardiner Greene, Jr., of Norwich, presented a resolution to allow the city of Norwich to establish and maintain an electric light and gas plant.

WELLSVILLE, O.—The Wellsville electric plant, which was purchased a few days since at receiver's sale by Mr. Homer McLaughlin, of East Liverpool, O., it is understood will be enlarged and improved by the addition of a new engine, new dynamos, etc.

TECUMSEH, MICH.—The Common Council will receive proposals for furnishing, operating and maintaining from 35 to 40 double arc 2,000-cp electric lamps on the streets of the village for a term not exceeding five years. Address W. J. Ingersoll, clerk.

WESTCHESTER, PA.—A shirt factory, with electricity as motive power, is one of the possibilities of the near future for Westchester. L. B. King is one of the prime movers in the matter, and he in now looking for a suitable building for such an establishment.

BALTIMORE, MD.—Sealed proposals will be received by the Construction Committee of the Underground System of the Police and Fire Alarm Telegraph and Police Patrol, until March 1, 1895, for the complete electrical equipment of the electrical subways of the police and fire alarm telegraph system of Baltimore City. Copies of the agreement and specifications under which the work is to be performed can be obtained at the office of the engineer by depositing $500, which will be returned.

THE ELECTRIC RAILWAY.

MANCHESTER, N. H.—The Manchester Electric Railway has placed bonds to the amount of $250,000 with George A. Fernald & Company, of Boston.

HARTFORD, CONN.—At a meeting of the Council the street committee reported favorably on the petition of the Central Railway and Electric Company to extend its tracks to the city lines.

WASHINGTON, D. C.—The Washington and Baltimore electric line, 27 miles long, will be operated by the block signal system, and the distance covered in 35 minutes. The entire cost will be $1,000,000.

PORTSMOUTH, VA.—The street committee, to whom was referred the application of the Portsmouth Street Railway Company for extension of lines and use of certain streets, recommended that the petition be granted.

CHESTER, PA.—The People's Railway Company expects to build its trolley road between Chester and Rockdale during the coming summer, and is asking for an extension of time on the franchise granted by Upland Borough Council.

ATCHISON, KANS.—The Atchison Electric Street Railway Company has decided to make improvements to the plant to the extent of $20,000. Several new engines and dynamos will be put in and the line will be extended several miles.

LORAIN, O.—A. R. Reynolds and Henry Randall, of Cleveland, have made a proposition that if the Council will grant at once a franchise they will complete by July 1 an electric street railway from Broadway to the extreme eastern limits of the city.

BRADFORD, PA.—Promoters of the electric railway to run from Bradford to Scottdale expect to include a branch to Mount Pleasant, and to continue the line to Huff City, where connection will be made with the Greensburg & Hempfield Street Railway.

CHARLEROI, PA.—The eastern part of the county will have an electric railroad built during the coming summer. Agents of the Charleroi, California & West Brownsville Electric Railway have succeeded in getting grants for the entire lower end of the line.

WHITE PLAINS, N. Y.—The New York, Elmsford and White Plains Railway Company has been granted a franchise to construct and operate an electric railway through Railroad and Central avenues, Broadway and Lake street. The company forfeits $2,500 if the road is not completed by Aug. 1.

LA SALLE, ILL.—The General Electric Company on Feb. 25 sold the Ottawa Electric Street Railway to a home syndicate represented by Mayor Schoch for $40,000 in bonds, the condition of the contract requiring the local men to invest $20,000 additional in improvements. The property will be transferred March 1.

MONTGOMERY, ALA.—W. B. Rommee has been appointed receiver for the Seelye electric line on application made by the Westinghouse Electric Company and Wright & Lindsley, of New York, who are creditors. The operation of this road was recently suspended, but the receiver expects to commence running cars in a few days.

PERSONAL NOTES.

WILLIAM BROOKFIELD, the recently appointed Commissioner of Public Works, of New York City, is well known to the electrical public as the owner of the Bushwick Glass Works, and manufacturer of glass insulators for electrical purposes, which he was the first to successfully make with a screw thread. The Bushwick Works was started by Mr. Brookfield and his father in 1864, and have been continuously in operation ever since. Mr. Brookfield has been president of the Eastern Association of Glass Manufacturers, and is now a member of the Union League, Downtown, Fulton and Lawyers' clubs, the New York Chamber of Commerce, Board of Trade, and the Produce and Consolidated Exchanges. He has also taken an active interest in politics for many years, and was a charter member and one of the presidents of the Republican Club, president of the Republican County Committee for several years, and chairman of the Republican State Committee during 1892, 1893, and 1894. His whole career has been marked by high integrity and an energetic business policy, which have combined to make him the successful and highly respected man he now is.

A REPRESENTATIVE CHICAGO HOUSE is the Electric Appliance Company, which recently has attracted a great deal of attention in electrical circles in the West as well as in all sections of the country, and enjoys the distinction of having two of the ablest men in the supply business at its head. Mr. W. W. Low, president of the firm, is universally known among central stations, street railways and the fraternity generally. He was first connected with the old Detroit Electrical Works in the capacity of clerk; later he came to Chicago and entered the supply business, and in 1891 embarked with Mr. Stacey in his present company. Formerly Mr. Low traveled extensively for the company, but of late has attended to the business in Chicago, where he has made his home. Thos. I. Stacey, secretary and treasurer of the Appliance Company, has made a great reputation for himself. Although but 25 years of age, youth has proved in his case the boon that so many ascribe to age and experience alone. Entering the supply business as long ago as 1887, Mr. Stacey early determined upon his career, and showed a natural inclination for the business in which he engaged. In the capacity of stenographer he thoroughly mastered every detail of the business, and learned the essentials of success. Promotions came rapidly, so that when the Electric Appliance Company was formed, Mr. Stacey was well qualified to guide the infant aright. Day after day, month after month, and year after year, he has paid the closest attention to the business and financial department of his business, and his efforts have crystalized into unusual success. Mr. Stacey enjoys the distinction among those who know him as being one of the shrewdest and ablest business men in harness, a reputation rarely attained by a man of his age.

W. W. LOW.

THOS. I. STACEY.

ONE OF THE PIONEERS in the introduction of electric lighting is Jos. E Lockwood, whose portrait we present herewith, he having entered the employ of the United States Electric Lighting Company in January, 1880. Soon after this he perfected the first carbon filaments used in the Maxim incandescent lamp. He installed the first incandescent electric light service in New York City at the Equitable Building and vicinity, next introduced the Maxim incandescent and Weston arc systems into Europe, and in 1881 represented the United States Company at the first International Electrical Exposition held in Paris. He afterwards installed and put into operation a factory in Barcelona, Spain, for the manufacture of the Maxim incandescent lamp, and introduced incandescent electric lighting into Holland by installing the Maxim system in the gas works of DeBruyn and Zonen, Amsterdam. After his return to America, in 1882, he represented the United States Company at various expositions, including those held at Cincinnati, Louisville, Charleston, etc. In 1887 he severed his connection with this company and located in Detroit as general manager, first of the Thomson-Houston Electric Light Company and later of the Brush Electric Light Company, which latter position he held until 1890, when he entered the electric railway field in the service of the Detroit Electrical Works, of which company he was elected secretary a year later. He held that position until the organization of the Michigan Electric Company about two years ago, of which company he is president. Mr. Lockwood is a regular attendant at the conventions of the National Electric Light Association and the American Street Railway Association, and his face is a familiar and welcome one to the members of both associations. Geo. A. Mansfield, who is associated with Mr. Lockwood as treasurer of the Michigan Electric Company, is a graduate of the Michigan Military Academy and afterwards attended lectures at the University of Michigan. During the past two years he has been an indefatigable worker in the electrical supply field, in which he has acquired an influential position.

JOS. E. LOCKWOOD.

GEO. A. MANSFIELD.

Trade and Industrial Notes.

MR. H F. TATE has been appointed Western manager of the National Conduit Company, New York, with an office at 542 The Rookery, Chicago.

THE ADAMS ELECTRIC MANUFACTURING COMPANY, Elkhart, Ind. reports night work a necessity in order to meet the increasing demand for its transformers.

ERNEST F. ROBBINS, Burrville, Conn., in a 116-page catalogue describes a number of lathe attachments and tools of his manufacture, designed to facilitate operations and cheapen cost.

THE GISHOLT MACHINE COMPANY, Madison, Wis., in a nicely gotten up pamphlet of 16 pages entitled "Modern Turret Lathe Practice," issued monthly, describes and illustrates its own manufacture.

ANY COMPANY contemplating underground work will do well to call on Mr. McQuaid or Mr. Tate, of the National Conduit Company, at the Hollenden Hotel during the convention, and get some "interior lining.

THE PHILADELPHIA ELECTRICAL AND MANUFACTURING COMPANY, corner Twentieth and Jones streets, Philadelphia, has issued a very neat pamphlet and price list illustrating a number of arc light specialties which it is putting on the market.

THE C. W. HUNT COMPANY, 45 Broadway, New York, reports eminent success in the equipment of lighting and power stations with coal-handling machinery. Those interested in the economical handling of coal and ashes will do well to obtain some of the useful literature on the subject published by this company.

WARREN WEBSTER & COMPANY, Camden, N. J., are distributing copies of a handsome illustrated catalogue of the Webster "Vacuum" feed-water heater and purifier, Webster steam-separator, and Webster oil-separator. The book also contains numerous testimonials from parties using the Webster specialties. It is of convenient size and substantially gotten up.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., has finished the new gas house for the Bay State Gas Company in Boston. The building is 51 feet wide, 146 feet long, iron floor, iron roof, trusses, and iron purlins covered with slate. The same company has also lately completed for the Aqueduct Commissioners of New York City two iron bridges, one at reservoir M, the other at reservoir D.

THE ABENDROTH & ROOT MANUFACTURING COMPANY, 28 Cliff street, New York City, the sole makers of the Root improved water-tube boiler, will be represented at the convention by Mr. P. M. McLaren, and those of the electrical fraternity desirous of becoming better acquainted with the merits of the Root boiler for this special class of work will find him ready at all times to aid them in the matter.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has just published and distributed a copy of the rules and regulations of the National Board of Fire Underwriters in neat and convenient form for ready reference. Inasmuch as these regulations are now required in all the large cities, and a majority of the smaller ones, it is very necessary that every one in the electrical business should be famliar with them. It has also just completed a catalogue of electric railway supplies and will be pleased to furnish copies to the trade on application. In preparing this catalogue the Electric Appliance Company has made it consist wholly of electric railway supplies, not considering it necessary to pad it out with material which comes regularly under the head of electric light supplies.

THE FISHKILL LANDING MACHINE COMPANY, of Fishkill-on-the-Hudson, N. Y., is meeting with much success with the improved "Fishkill-Corliss engine," where close regulation and noiseless operation is desirable, as for electric lighting and power plants. Representing in its construction the highest development in the "Corliss" type of engine it has the indorsement of the leading manufacturers and corporations in the United States.

THE ROYAL ELECTRIC COMPANY, of Peoria, Ill., reports the following sales of alternators, with an equal capacity in transformers, for the past month: Columbus, Neb., 1,250 lights; Roanoke, Ill., 500 lights; El Paso, Ill., 1,250 lights; Morton, Ill., 650 lights; Cambridge, Ill., 650 lights; Grand Haven, Mich., 1 000 lights; Raymond, N. H., 500 lights; Havana, Cuba, 500 lights; Los Angeles, Cal., 500 lights; Warsaw, Ill., 1,000 lights; Iowa Falls, Ia., 1,250 lights. A steady increase of transformer sales is also reported.

THE STANDARD PAINT COMPANY, at 2 Liberty street, New York, reports a steady demand for its P. & B. compounds, which have been favorably known to the trade for many years. The company also calls attention to a point frequently overlooked, namely, that the disagreeable odor emitted by these compounds when first applied disappears as soon as the paint dries. It is also claimed that the odor referred to is a necessary accompaniment of the highest grade of insulating ingredients, and is, therefore, an indication of the quality of the product.

W. C. STERLING & SON, Monroe, Mich., report that they are getting out a large number of cedar poles in Northern Michigan, notwithstanding the extremely cold weather at the different cedar camps. Poles are being piled up along the Au Gres and Rifle River, and in the early spring these will be rolled onto the ice in the river to be carried down to the lake, where they are rafted to Monroe. The sleighing is so good in the forests that the pole yards on the railroad are becoming well stocked, and a large trade is looked for in the early spring. The market for telephone poles has been very good this winter. Since Sterling & Son made their consignment of poles to Buenos Ayres, South America, they have sent several car-loads to Texas.

THE ELSON & BREWSTER ENGINEERING COMPANY, 143 Liberty street, agents for the Belknap Motor Company, Portland, Me., reports business excellent, and that it has recently completed some very satisfactory contracts. This company superintended the entire electric and power plant in the building of Mrs. Frank Leslie, Bond street, also the entire power plant of the factory of Messrs. Sternau & Co., of Brooklyn, and recently installed the complete electric plant of one of the Hoboken ferry boats. Its moulding business is steadily increasing, the company having recently furnished the electrical mouldings required in wiring the American Express Building, 65 Broadway, the Fall River steamer Priscilla and the Brooklyn Bridge cars. An electric whistle was placed on the steamship City of New York by this company.

F. J. MURPHY & COMPANY, 1[illegible]6 Liberty street, New York, point with pride at the list of notable buildings equipped by them with switchboards, which includes almost every one of the modern structures that have in recent years added so much to the architectural glory of New York. Their work, however, has not been confined to one vicinity; in Philadelphia, for example, they equipped among others, the great Betz and Drexel buildings, and we note that the magnificent Ponce de Leon Hotel at St. Augustine, in Florida, was also benefitted from their services. One of the reasons for the success met with by this firm is their ability to design switchboards to suit the exact conditions of a given case, however restricted they may be in regard to location or however elaborate the surroundings. All of the mechanical work is designed and executed in accordance with the best electrical principles as regards insulation and safety, and, if desired, the finish is made to accord with the trim or decorations of the building or a special artistic form given.

Business Notices.

WOVEN WIRE BRUSHES.—The Belknap Motor Company, of Portland, Me., are the patentees and manufacturers of the best woven wire commutator brush on the market.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEBRUARY 12, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

11,471. FIRE ALARM APPARATUS; Samuel W. Ludlow, Madisonville, O. App. for re-issue filed Jan. 19, 1895. In a fire alarm, the combination of air or gas pipes, an alarm-actuating device operating by pressure connected to the pipe, and a thermostat for creating the pressure consisting of an expansible medium normally inactive till application of heat thereto and in communication with the pipe, and when expansion takes place adding its volume to the contents of the pipe to cause the pressure necessary to actuate the alarm.

533,861. ELECTRIC LOCOMOTIVE; Eben M. Boynton, West Newbury, Mass. App. filed April 9, 1894. In a single rail, supported railroad car the combination with the car body of a frame fastened to same near one end thereof having guide wheels engaging with an upper guide rail, a driving wheel having removable web plates fastened to hubs revolving loose on a shaft situated in the frame, armature and field magnet elements situated between the web plates and one element fastened to the wheel tire and the other element to the shaft and means for fastening the shaft to the motor frame or allowing it to rotate.

533,869. CONDUIT SYSTEM FOR ELECTRIC RAILWAYS; Fred. S. Davenport, Jerseyville, Ill. App. filed Oct. 26, 1894. The combination with a feed wire and traveling contact bar, an underground conduit having for one of its sides one of the track rails secured to the laterally projecting base of the opposite side, the top of the latter being surmounted by a removable cover adapted to shelter and protect the feed-wire and contact bar.

533,873. ALTERNATING CURRENT DYNAMO ELECTRIC MACHINE; Axel Elstrom, Lynn, Mass. App. filed July 26, 1894. In an alternating current dynamo electric machine and in combination coils carried upon a revolving armature, one terminal of such coils connected to collecting rings and the other terminal to a commutator, and a shunt between one of the terminals, the collecting ring and the commutator.

33,877. RAILWAY SIGNALING APPARATUS; Chas. L. Fielder, London, England. App. filed June 13, 1894. The combination of a link motion, a friction pulley attached thereto, a locking blade on which the pulley travels, a distance piece restraining the blade when actuated by the electric current through an armature lever and a fixed guide block directing the movement of the distance piece.

533,885. APPARATUS FOR WINDING ARMATURE COILS; Henry Geisenhönor Schenectady, N. Y. App. filed Aug. 22, 1894. In an apparatus for winding coils for dynamo electric armatures, a curved supporting body part, and parts reciprocating therein and engaging the sides and ends of the coil.

533,893. ELECTRICAL EXCHANGE SYSTEM; Geo. W. Hey and Arthur E. Parsons, Syracuse, N. Y. App. filed March 30, 1893. Metallic circuits having corresponding wires normally connected together and their opposite wires normally disconnected, and an automatic switching device operated by current pulsations passed over one of the wires of the circuits for connecting the opposite wires together.

533,905. DISTRIBUTION SYSTEM FOR ELECTRIC RAILWAYS; Walter H. Knight, Schenectady, N. Y. App. filed Nov. 30, 1894. In an electric railway, the combination of a trolley wire and section insulators dividing successive portions of the trolley wire into insulated sections, with circuit connections coupling such successive sections of the trolley wire respectively to the positive and negative branches of a three-wire distributing system.

533,910. TIP FOR ELECTRIC CONDUCTORS; Amandus Metzger, Schenectady, N. Y. App. filed Nov. 26, 1894. A conductor tip formed of a single piece of metal comprising a flat portion doubled upon itself, and a tube formed integrally with the flat portion for embracing the conductor end.

533,913. FUSE BLOCK AND SOCKET; Fred. W. Mount, St. John, Canada. App. filed July 16, 1894. A fuse block provided with a hollow metallic bushing having a screw threaded end, in combination with a socket screwed to the extended end, and insulated fusible conductors passing directly from the fuse block into the socket.

533,919. SYNCHRONIZER FOR CLOCKS; Henry S. Prentiss, Elizabeth, N. J. App. filed June 30, 1892. The combination of a master clock constructed to close the circuit at a predetermined period before the hour and to break it at the hour, and a secondary clock provided with a separable connection between two operative parts of the train, an electromagnet controlling the connection, a detent for arresting the movement of the train when in a predetermined position, and a circuit closer operated by the train and set to close the circuit through the electromagnet in advance of the closing of the circuit at the master clock, and to break it simultaneously with the closing of the circuit at the master clock.

533,920. SERIES PARALLEL CONTROLLER; Ed. D. Priest, Schenectady, N. Y. App. filed Nov. 24, 1894. In a series parallel controller for electric motors a switch adapted to connect the motors in various combinations, series, multiple series, or multiple, and a reciprocating resistance switch adapted to cut in resistance and open the circuit before each of such changes of combination.

533,926. ELECTRIC AUTOMATIC BLOCK SYSTEM SIGNAL; Jos. B. Stewart, Haverstraw, N. Y. App. filed March 8, 1894. In an electric automatic block signal system, the combination with the signal devices normally held to the danger position, of a normally open circuit comprising an electrically continuous rail, a series of electrically continuous rail sections, the sections being insulated from each other, a series of batteries having like poles connected to the electrically continuous rail and their other poles connected to one end of the sectional rail and a relay connected to the adjacent ends of two sectional rails.

533,930. ARMATURE WINDING; David P. Thomson, Schenectady, N. Y. App. filed Aug. 4, 1894. In a dynamo-electric machine, aramature coils and commutator segments, the segments cross-connected to the coils by leads of equal lengths.

533,931. DYNAMO ELECTRIC MACHINE; Elihu Thomson, Swampscott, Mass. App. filed Dec. 29, 1890. A method of regulating a dynamo for constant potential under increase of speed, consisting in increasing the speed of a separate generator more sensitive to speed changes, and using the increased current of such generator as a generated counter magnetizing force on the main.

533,932. CARBON FOR ARC LAMPS; Elihu Thomson, Swampscott, Mass. App. filed Nov. 26, 1894. A carbon for arc lamps, comprising an outer casing or shell of hard carbon and an inner core of softer material, the inner core being cut away from the tip of the electrode.

533,936. ELECTRIC BATTERY; Jas. M. Wells, Peoria, Ill. App. filed July 31, 1893. The combination of an inclosing case having its interior divided into two compartments, one of which is adapted to contain a suitable battery fluid by a partition of insulating material, a support pivotally connected to the shell, an induction coil arranged in one of the compartments of the shell and adapted to be connected with suitable electrodes, a metallic pin carried by the insulating partition and having one end in contact with the core of the induction coil and its other end projecting into the compartment containing the battery fluid, a positive battery element secured on the projecting end of such pin, a metallic plate secured to the insulating partition and electrically connected with the helix of the induction coil, and attached to the plate.

533,958. SEMAPHORE FOR RAILWAY SIGNALS; David H. Wilson, Chicago, Ill. App. filed April 28, 1894. The combination of an electromagnet, and armature for the same to which is attached a tube containing mercury and having the air exhausted therefrom, contacts sealed to the ends of the tube, a semaphore and connections between the semaphore and the armature, whereby the semaphore is vibrated while it is acting as a signal.

533,967. COMBINED TELEPHONIC AND TELEGRAPHIC SYSTEM; Chris. A. Shea, Boston, Mass. App. filed July 30, 1892. The combination with line wires of a metallic circuit, and independent telegraphic instruments for each line wire, of a telegraph or telephone converter, each terminal of which has a separate connection, outside of telephone coils, capable of transmitting electric impulses, with each line wire.

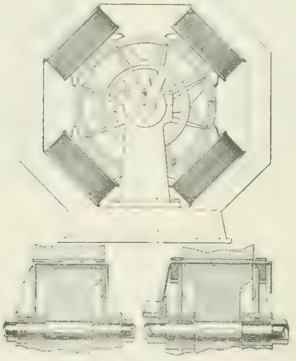
533,979. ELECTRICAL TIME ALARM; Walther Wilke, Wermelskirchen, Germany. App. filed Aug. 7., 1894. The combination of the arbor, hub mounted thereon, insulating packing on the conoidal end of the hub, the conoidal shell fitting on the packing, a hand carried by the shell, contacts arranged to be successively touched by an attachment of the hand as the latter is carried around by the arbor, and circuit wires making connection with the shell and the contacts.

534,021. ANGULAR PIPE SECTION; Fred. A. Swan, Boston, Mass. App. filed Aug. 8, 1894. This comprises two members at an angle to each other and an anti-friction device loosely mounted within the angular pipe section.

534,025. AUTOMATIC TELEGRAHING MACHINE. Chas. E Yetman, Oak Park. Ill. App. filed Dec. 2, 1893. The combination with the rotating driver and with the reciprocating shifter controlled by the character key of the circuit make and break ring interchangeably supported at its inner rim upon the driver and alternately at its outer rim on the shifter.

534,036. GALVANIC BATTERY; Warren P. Freeman, Brooklyn, N. Y. App. filed June 11, 1894. A box having imperforate walls and containing a number of cells, a flanged tray placed in or upon the top of the box, a cover applied to the top of the tray and forming with the tray a sealed chamber, electrode connections within the chamber, a pocket in the under side of the tray above each cell, a carbon connected at its upper end to the tray within each pocket, and a zinc electrode in each cell; the pockets being filled with a sealing compound around the upper ends of the carbons to prevent the upward escape of acid fumes.

534,038. DYNAMO ELECTRIC MACHINE; Rodolphus Fuller, Detroit, Mich. App. filed Oct. 20, 1894. The combination of an armature shaft, two commutators thereon on opposite ends, and double windings upon the armature comprising a number of separate turns of wire connected to the two commutators in alternate order



No. 534,079.—Dynamo Armature.

534,060. ELECTRIC CONTROLLER; Geo. F. Card, Covington, Ky. App. filed May 17, 1894. In an electric controller, a shaft; a non-conducting sleeve embracing the shaft; a series of cams mounted on the sleeve, a cut-out mechanism adapted to be actuated by the cams and means for rotating the shaft.

534,073. REGULATING DEVICE FOR CAR MOTORS OR OTHER ELECTRICAL APPARATUS; H. F. Parshall, Schenectady, N. Y. App. filed Dec. 11, 1891. The combination of the main shaft, switch apparatus moved thereby for controlling the motor, the second shaft parallel with the first and a reversing switch moved thereby, and an arm on the second shaft, which arm is locked or released by movement of the first mentioned switch.

534,079. ARMATURE FOR DYNAMO ELECTRIC MACHINE; H. F. Parshall, Schenectady, N. Y. App. filed Feb. 20, 1892. A stationary field magnet, a stationary armature core of iron but without magnetizing coils, and a rotating armature body consisting of an iron ring in the annular space between the field magnet poles and the stationary core, the ring being perforated, insulated conductors passing through the perforations and forming a drum winding for the armature. (See illustration.)

534,083. TELEPHONE METALLIC CIRCUIT; Chris. A. Shea, Boston, Mass. App. filed July 30, 1892. The combination of two main lines, a receiving instrument at each end included in both main lines, a transmitting instrument at each end connected with one only of the main lines, and, on the other a line, a balancing device at each end balancing the transmitting instrument at that end.

534,084. COMBINED TELEPHONE AND TELEGRAPH SYSTEM; Chris. A. Shea, Boston, Mass. App. filed July 3, 1892. The combination of a line wire, telegraph and telephone instruments connected therewith, a branch wire from the main line to the telephone core, and thence to earth, and an inductive resistance interposed to stop the passage along the branch wire of telephonic impulses between the telephone core and main line.

534,085. TELEPHONE METALLIC CIRCUIT; Chris. A. Shea, Boston, Mass. App. filed July 30, 1892. The combination of two live wires between two stations, each wire being provided with means for transmitting and receiving an electrical impulse therealong, the means including at each end a core and a coil of the wire around it, with a third wire between the stations wound round the cores in succession in the opposite direction to the live wire round the cores.

534,086. ELECTRIC ARC LAMP; Thomas Spencer, Philadelphia, Pa. App. filed June 6, 1894. An arc lamp provided with movable carbon holders for its electrodes, independent pairs of conducting guides for the respective carbon holders, regulating mechanism for causing the mutual approach of the electrodes when the lamp is burning, and a plurality of movable elastically supported roller contacts mounted upon arms of carbon holders and engaging the guides.

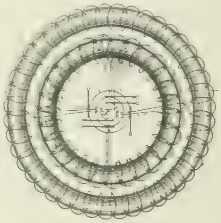
534,092. MEANS FOR MOUNTING DYNAMOS ON RAILWAY CARS; William Biddle, Brooklyn, N. Y. App. filed May 23, 1894. The combination with the car axle, of a sleeve permanently secured around the car axle and having a cylindrical portion forming a journal, a dynamo and dynamo frame having an oil box beneath the journal, a cap or box over the journal and screws for connecting the same to the dynamo frame, a dynamo bolted to the frame and gearing for connecting the axle and armature shaft of the dynamo.

534,151. ALTERNATING CURRENT MOTOR; Robert H. Hassler, Pittsburgh, Pa. App. filed Nov. 30, 1894. A method of starting alternating current induction motors which consists in subjecting the armature thereof to the combined inductive action of primary and secondary coils and decreasing the electromotive force in secondary coils as the speed of the movable member increases.

534,158. ALARM DEVICE FOR MILLS; Chas. L. Judge, Austin, Pa. App. filed Nov. 5, 1894. A pair of spaced upright contact posts included in a suitable alarm circuit, a pivotally supported oscillating lever carrying at one end a circuit closing bar working over the contact posts, a ball chute attached to the end of the lever opposite the circuit closing bar, a tube arranged under the lower end of the ball chute, and means for elevating weight balls from the tubes on to the high end of the ball chute to provide for overbalancing the end of the lever carrying the circuit closing bar.

534,206. FILAMENT FOR INCANDESCENT LAMPS; Thos. A. Edison, Menlo Park, N. J. App. filed Jan. 4, 1894. The process of making incandescent conductors for electric lamps, which consists in softening a horny animal substance in a suitable liquid, forming it into filaments and carbonizing same.

534,207. MANUFACTURE OF CARBON FILAMENTS; Thos. A. Edison, Menlo Park, N. J. App. filed Dec. 27, 1886. A group of covered receptacles or carbonizing boxes for incandescent lamp filaments, the several boxes being placed one above another and having covers on which are standards or projections which support the boxes above it.



No. 53,208.—Induction Converter.

534,208. INDUCTION CONVERTER; Thos. A. Edison, Llewellyn Park, N. J. App. filed May 21, 1888. In an induction converter, the combination of a stationary field coil and a stationary armature with two coils, the field coil and one armature coil being connected in multiple arc to a source of current by means of commutators, and the second armature coil being connected to the consumption circuit. (See illustration.)

534,209. INCANDESCENT ELECTRIC LAMP; Thos. A. Edison, Llewellyn Park, N. J. App. filed Sept. 17, 1890. In an incandescent electric lamp, the combination with the glass stem or wire support of leading in wires passing through the same and held therein by the fusing of the glass tube upon them, and each composed of an outer covering of readily fusible metal or alloy and an inner core or base of metal of comparatively high fusing point.

534,238. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS; Malone Wheless, Washington, D. C. App. filed Dec. 3, 1894. A track terminal holder comprising a socketed receptacle formed with a passage below the socket for the connecting wiring of the terminal in combination with a non-conducting block seated and held in the socket, a track terminal pin passing up through the block, and a contact cap seated on the block and detachably connected to and covering the upper end of the terminal pin.

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OUR CONVENTION REPORT.

For the convenience of those who may not care to read the papers and discussions in full or in lengthy abstract, and also to serve as an index to their general character, we print in our running report of the Cleveland Convention a concise outline of all the papers read and of the accompanying discussions. In other columns the more important papers and their discussions will be found printed at greater or less length for those who desire to follow the subject more closely, exception being made of the papers of Dr. Bell and Messrs. Houston and Kennelly, which, on account of their great length, are reserved for another issue. This plan was adopted, though involving a great amount of labor, because it was thought it would more nearly supply the needs of all classes of readers.

THE CLEVELAND CONVENTION.

The tenth year of the existence of the National Electric Light Association was fittingly marked by the success of its recent meeting in Cleveland, and the start on the second decade of its life is made with every prospect of a continuance of the prosperous career thus far enjoyed. The only suspicion of danger is that the growth of rival bodies in various parts of the country may detract from its national character. To counteract the tendency now noticeable in this direction, and which might lead, through untoward circumstances, to a curtailment of the dignity and usefulness of the National Association, a broad policy is necessary with respect to geographical distribution of meetings and solicitation of membership in order that a fuller representation of all sections of the country may result. The local associations modeled after the national body promise to become more numerous, as they undoubtedly serve a good end, but their existence does not necessarily menace the supremacy of the latter, whose scope, if maintained truly national, implies opportunities that will always give it the ascendency.

THE CONVENTION PAPERS.

While but one notable paper was read at the Washington meeting of the National Electric Light Association—that of Mr. C. F. Scott—the Cleveland Convention was favored with several dealing with subjects of pressing importance to the interests represented by its membership. Another feature of the more important papers is that they have brought forward topics of which the discussion is likely to be continued, much to the educational advantage of the electrical public. In this respect the paper of Dr. Bell easily takes the lead, not only from the newness of the subject itself, but particularly, as foreshadowed in the discussion of the paper, from its challenge of the usual definition of multiphased systems. Among other points that it will also probably bring forward, the discussion of which promises to be of professional value aside from their bearing on the interests concerned, are those relating to the comparative saving of copper and the efficiency of transformers with different alternating systems, as well as the subjects of inductive drop and balance, the practical elucidation of which will be particularly welcomed. The paper of Mr. L. B. Marks and the discussion which followed have definitely placed before practical men a number of important points relating to the economy of the arc light, exact knowledge of which had previously been more or less confined to a limited circle. With a possibility of a variation of 50 per cent. in the quantity of light from different carbons supplied with the same amount of energy, there is offered abundant room for improvement, though, it must be confessed, the problem is not a simple one for the average station man, on account of the difficulty of controlling the several factors entering and determining their most efficient value. In view of the discussion that has recently been taking place as to the enormous coal consumption of the average central station, largely or entirely due to varying load, the paper of Mr. N. W. Perry was particularly apropos. Although the lack of data from actual practical trial under the condition of the work to which their application was proposed may detract from the conclusions arrived at in regard to the absolute or relative economy of the systems of storage considered, yet a good service has been rendered by a discussion of the possibilities that may be contained in thermal storage. It is to be hoped that the illuminometer, described to the convention by Messrs. Houston and Kennelly, may in practice amply demonstrate its reliability and fitness for commercial work, for it would then offer a means of placing the measurement of light upon a rational basis—that of the illumination at the surface where light is required, rather than the intensity of the source.

COAL CONSUMPTION IN CENTRAL STATIONS.

The report of the Committee on Data of the National Electric Light Association, which we print elesewhere, while making a somewhat more favorable showing than that of last year, yet indicates an appalling lack of economy in the operation of central stations. While part of this is probably due to waste in the boiler room through the absence of skill in the firemen, yet much of it can doubtless be accounted for by the conditions of load and the type of machinery used. As an example, in a certain lighting station within 50 miles of New York, where thorough data are recorded, the consumption of coal was found to be 23.9 pounds per kilowatt-hour in the summer and 13 pounds in the winter. Referring to the article by Mr. E. A. Merrill in our last issue, we find from the curve corresponding to the engine used that these two quantities refer to load factors of 25 per cent. and 55 per cent. respectively—the curves accounting for all of the efficiency factors between the boiler and switchboard. The various curves in the article to which we refer will be found of interest to the engineer in many respects, and will be of particular benefit in assisting to select the size of unit and type of engine to install, either in a new station, or to increase the economy of an old station. The curves of the coal consumption per kilowatt-hour for various types of engines enable comparisons to be made as to whether the decreased consumption of more expensive machinery will compensate for the increase of investment, while the economy curves of various types of engines running at different loads serve to indicate the size of units to adopt. From the latter table we learn, for instance, that small units fall off very rapidly in efficiency with light loads, but that large engines of the more highly efficient types may be worked through a great range with little loss—a compound condensing engine represented, for instance, showing an increase of less than a half-pound of water per horse power hour between the limits of 750 and 2,200 horse power, and a 500 horse power engine of the same type but one pound between 200 and 500 horse power. Another notable point in regard to this efficient type is that the ratio of water consumption between the larger and smaller units is much smaller than with less efficient types. For instance, four units of 500 horse power each would, if worked near their rated capacity, show an economy corresponding to less than three pounds of water per horse power hour more than a large engine worked between 500 and 1,800 horse power. In this case, should the load vary from less than 500 horse power to the maximum, the smaller units direct connected would probably be most efficient through the reduction of losses beyond the engine.

THE EARLY DAYS OF ELECTRIC LIGHTING.

To those engaged in electrical pursuits, the developments of the present present so much interest and the promises held in the near future are so enticing that they are little inclined to take retrospective glances. As a consequence, the address of Mr. Chas. F. Brush, at the Cleveland Convention on the early days of electric lighting, was unusually appreciated, and though most of those in the audience had witnessed all of the developments referred to, yet we doubt if the minds of any were unaffected by the contrasts so vividly presented by the speaker. Less than two-score years have passed since the beginning of the period recalled, yet, in listening to the story of the first commercial arc machine and hearing tell of carbons costing $240 per thousand, the presence, in the speaker, of the inventor of the former and pioneer manufacturer of the latter, alone prevented the mind from involuntarily locating the events in a dim and distant past. The conceptions then held by the public of the nature of electricity, and concerning the operation of electrical machinery, as related in several amusing anecdotes, we fear, are yet largely prevalent. It is only a short time ago that a Jersey farmer expressed to the writer his wonder that the frail roof of an electric car did not give way under the strain of the trolley-pole pushing it along. As to the operation of dynamos, we have heard of a successful electrical engineer of to-day who confesses that when a foreman engaged, not so long ago, in installing mill plants he really believed that the brushes were the chief agent in producing electricity, which explanation was the one seriously given to inquisitive customers. In the matter of investments the public were probably even less gullible in those days than at present, for then the evidences of the wonders electricity could perform were less substantial. At the present time the schemes based upon the credulity of the public concerning electricity and upon their dense ignorance as to its real nature, are innumerable, and furnish a more profitable return to those engaged exploiting them than all but a few workers in the legitimate field can boast of. Within a few days we have been called upon by two persons, one of whom was about to invest a small fortune in an "invention" through which, by means of electricity, a hundred or more horse-power could be obtained from the expenditure of two or three horse-power in a steam engine or electric motor; the other inquired, on the part of a friend, about a dynamo in which the latter had invested $15,000 upon the representation that the power required to generate current for 100 lights was so small that the machine could be turned with a "force no greater than that of the little finger." We will add that, as is usual in such cases, the only result of the advice given was apparently to strengthen the faith of the inquirers, both of whom quoted the popular fiction as to what Lardner said about the impossibility of the Atlantic being crossed by a steamship, and the other stories not less widely believed in regard to the condemnation of the incandescent lamp by scientists, and the hawking of the telephone about the United States for several years by Bell, in a vain attempt to sell it for a few thousand dollars.

From Remote Asia.

A correspondent at Singapore, Straits Settlements, sends the following description of an electrical plant just installed in the tin mining section:

A 30-kw generator, driven by a 50-hp "Little Giant" (English make) turbine, furnishes current at 300 volts for a 2-kw and three 10-kw shunt motors located at different points in the mining district. The larger motors belt direct to 6-inch centrifugal pumps working on 20 to 30-feet lifts, and the small motor drives a blower for the smelting furnace.

Although of insignificant output judged from an American standpoint, this little plant is of peculiar interest in that it constitutes the introduction of applied electricity into the Malay States, and will doubtless be the opening wedge leading to the utilization of the magnificent water powers of that country.

Electrical Consonance.

BY CHAS. PROTEUS STEINMETZ.

Referring to the interesting article on this subject published by Prof. M. I. Pupin in your issue of Feb. 9, I may say a few words, not to add anything essentially new, but to explain the phenomena in a different way to those who have no time or inclination to study mathematical equations, no matter how simple.

Prof. Pupin investigated the condition under which primary current and E. M. F. in an alternating current transformer coincide in phase.

An alternating current transformer can in all its essential features be considered as a divided circuit, with the secondary current (reduced by the ratio of turns to the primary, in the one branch, and the exciting current (current at open secondary circuit) in the other branch. The latter current is a lagging current.

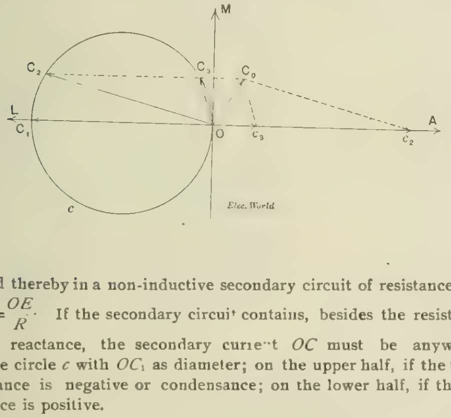
The secondary current is in phase with the E. M. F. in a non-inductive circuit, or circuit of zero reactance, that is, a circuit containing either no inductance and capacity, or in which the negative or capacity reactance is equal to the positive or inductive reactance.

The latter case is called complete resonance. In this case, resonance of the secondary circuit, the primary current, which consists of the secondary and the lagging exciting current, is not in phase but lags, and to bring it in phase the secondary current must be made to lead so much that the leading component of the secondary current equals and thereby neutralizes the lagging component of the exciting current. This condition has been called consonance by Prof. Pupin.

Obviously it requires a larger capacity in the secondary circuit to make the current leading than to bring it merely into harmony with the E. M. F.

The relative proportions are easily understood from the diagram.

Let, in Fig. L, OC_0 represent the exciting current leading the magnetism OM, due to the effect of hysteresis. The induced E M. F. OE is then 90 degrees behind OM, and the current produced thereby in a non-inductive secondary circuit of resistance R is $OC_1 = \frac{OE}{R}$. If the secondary circuit contains, besides the resistance R, a reactance, the secondary current OC must be anywhere on the circle c with OC_1 as diameter; on the upper half, if the total reactance is negative or condensance; on the lower half, if the reactance is positive.



The primary current is the one side of a parallelogram with OC_0 as diagonal and OC as other side. Thus it is in the direction OA, or in phase with the E. M. F., for the values of secondary current OC_2, OC_3, where C_2 C_3 C_0 is parallel to OA.

This diagram shows that two different values of secondary current OC exist, which bring the primary current to phase coincidence. One, OC_2 and the corresponding primary current Oc_2, very large, the other, OC_3 and the corresponding primary current Oc_3, small.

This diagram shows nicely the connection between this phenomenon and the phenomenon of resonance. Changing gradually to an ideal transformer of no self-induction and no exciting current by decreasing OC_0 indefinitely, we see OC_2 coincide with OC_1, electrical resonance, and OC_3 equal zero, open circuit. That is, the two values of consonance are: 1. The condition of secondary resonance combined with sufficient leading current to neutralize the lagging component of exciting current; 2. A capacity in the secondary circuit sufficient to cause a leading secondary current to flow, sufficient to compensate for the magnetizing current.

Both cases find their analogue in resonance as a special case, corresponding to $OC_0 = 0$, which gives two values also, the resonance proper, and the value of capacity reactance infinite, or open circuit, which makes the phase relation of current and E. M. F. indefinite.

Method for Obtaining Alternating Current Curves.

BY LOUIS DUNCAN.

In some cases a telephone method for obtaining the curves of alternating currents and electromotive forces is very convenient. The method ordinarily employed for obtaining current curves is to shunt from a non-inductive resistance in the circuit, and include in the shunt circuit a contact-making arrangement on the dynamo shaft, a telephone, and an electromotive force, due to a constant current. This constant current is adjusted until there is silence in the telephone. When this occurs, the fall of potential due to the alternating current is equal to the fall of potential due to the continuous current, and knowing the latter, we get the value of the alternating current at the instant the contact on the shaft is made. Electromotive forces may be obtained in the same way by balancing a continuous electromotive force against the instantaneous value of the alternating electromotive force when the contact on the shaft is made.

There are several difficulties in this arrangement. Any small thermal electromotive force at the contact makes it difficult to get even an approximate balance, while only one curve may be obtained from a single contact-making arrangement on the shaft. I have employed, with some success, a method in which some of these difficulties are eliminated. To a telephone diaphragm, made preferably of mica, I attach a small coil of fine wire. Beneath the diaphragm are two coils wound together, and so placed that the diaphragm coil is in a magnetic field due to currents flowing in them. Through the diaphragm coil I send instantaneous currents obtained from a contact-making-device on the shaft, there being a battery in circuit with the coil and the contact maker. Through one of the stationary coils I send a current proportional to the electromotive force to be measured, or a current obtained from a shunt on a non-inductive resistance in the dynamo circuit. The other coil has a continuous current flowing through it, which latter is measured. I now adjust the continuous current until the sound in the telephone is zero. If the coils are equal, this will mean that the continuous current is equal to the instantaneous value of the alternating current when the intermittent current is made. It will be seen that the method is independent of any small electromotive forces due to the contact, and any number of curves may be obtained from the same contact-making device.

This method is fairly sensitive, and gives good results. It has, however, the difficulty of all telephone methods, that unless the contact only lasts for an infinitely short time, there will always be a sound in the telephone. By making a sharp contact, and after some practice, the results are good.

Telephony in Great Britain.

(From Our Own Correspondent.)

For some years the growth of interurban telephony was the cause of considerable apprehension on the part of the telegraph officials of this country; and in May, 1892, they succeeded in inducing the Treasury to pay serious attention to the matter with the result that a minute was drawn up embodying what it was deemed should in future be the policy of the Government in connection with telephony.

To put it briefly, the trunk wires of the National Telephone Company were to be purchased, and that concern was to be confined rigidly to urban exchange work, and *per contra* the Government was to delegate—always with the sanction of the local authorities concerned—so much of its statutory privileges in connection with the running of wires as the Government mind deemed desirable in the interests, not of the National Telephone Company, but of national telephony.

In August, 1892, an Act of Parliament embodying this policy was passed. This policy was so suddenly sprung upon the country, and so rapidly rushed through Parliament, and there were so many peculiar circumstances connected with the matter, that in any other country than England I think there would have been allegations of corruption. Since then the Government has been engaged in embodying this policy in a legal agreement between itself and the National Telephone Company, and to-day, more than three and a half years since the passing of the Act of 1892, this agreement still remains unsigned. It is complete so far as the contracting parties are concerned, but Parliament and the municipalities are throwing all possible obstacles in the way of the signature of the agreement. Recently a deputation from the Municipal Corporations Association waited upon the Postmaster-General and displayed a strange lack of knowledge of the facts of the case. Later a deputation from the London County Council waited upon the Postmaster-General protesting against the agreement, and calmly suggested that the County Council itself should be granted a telephone license for London. The fact is, Government purchase is inevitable, and the present arrangement is only a half-way house on the way toward it. The Post-Office has a perfect right to grant compact licenses if it thinks fit, and no doubt the municipalities would be the only bodies whom it would be of any good to place in competition with the National Telephone Company. The assumption by the London County Council, however, of the duty of providing a city of some five million inhabitants with a cheap municipal telephone service is absolutely out of the question. The task would be too big, and the County Council has not the confidence of the telephoning public.

The Early History of Arc Lighting.*

BY CHAS. F. BRUSH.

A few days ago I was asked to make some remarks on this occasion concerning the early history of electric lighting, strictly from my own standpoint. Now, as most of you are aware, I retired from the electrical business several years ago in order to give my competitors a chance on the field. I therefore objected, as this ancient history is forgotten and buried, and pleaded that I could not spare time to take it up again and polish up the bones and arrange them in sequence and articulate them and make the whole thing presentable. I really cannot afford to let you go, however, now that you are here, and I will say a few words.

I will begin by calling your attention to the fact that dynamo-electric machines for electric plating antedated, by a considerable period, the use of such machines for lighting purposes. This is interesting from a historical standpoint, because when I invented the compound field winding for constant potential, now so generally used in lighting and power transmission, I applied it first to plating machines. That, I believe, is not generally known, and may therefore be interesting. Some of you will remember that all of the early Brush arc lighting machines were single-lighters. Two of these machines were exhibited in the summer of 1877 at the Franklin Institute in Philadephia. My friend at the left (Prof. Houston) will remember all about it. It was soon after that when we sold a single-lighting machine to Dr. Longworth, of Cincinnati. This was one of the very first, if not the first sale of a Brush arc lighting machine. It was late in 1877, or the very beginning of 1878; and the doctor paid for it—paid cash for it. I hear these things are done differently now. At any rate, I went down to Cincinnati to show the doctor how to run that machine, and one evening while I was there he exhibited the light from the balcony of the building on one of the principal streets in which he lived. It was a 4,000 candle light, and of course it attracted a large crowd of people, and every man in that crowd was ready and willing and anxious to tell his neighbors all about it. I mingled in the crowd for a time to hear the comments. I found one man who had collected quite an audience about him. Calling attention to the solenoid at the top of the lamp, he said, "That is the can that holds the oil;" and speaking of the side rod of the lamp, "That is the tube which conducts the oil from the can to the burner." He did not say anything about electricity at all—a little oversight that was not noticed by his hearers.

These early single-light machines were quickly followed by two and four-light machines; that is to say, machines adapted to furnish two or four separate, distinct currents, each adapted to run a single arc light. Several of these machines were sold during the season of 1878 for lighting stores and shops. Among others, Mr. Wanamaker, of Philadelphia, bought a number to light his store. One of the earliest of these four-light machines was exhibited at the works of the Union Steel Screw Company in this city to a number of invited guests. One gentleman on that occasion looked the whole apparatus over very carefully, perhaps a half hour, sized it up, and then, pointing to the line wire, he said to me, "How large is the hole in that wire that the electricity flows through?" Another gentleman, one connected with the screw company, observed in complete silence the machine running for perhaps five minutes. Then he fully digested the whole thing, and was ready to tell me all about it. He said, "The electricity in that thing is generated by that revolving business there, rubbing the air up against these iron blades (meaning the magnets), just as you get sparks when you rub a cat's back." I raised the objection that while that was a good theory, it did not fully meet the facts, but he would not hear anything from me. He said, "The whole thing is plain. If you should run that machine in a vacuum where there is no air, you could not get any electricity." His ignorance was so blissful that I thought it would be folly to enlighten him, and did not try to do it.

The year of which I am speaking—1878—was memorable in the history of electrical lighting. It was during that year that I had the great pleasure and good fortune to invent and develop and commercially introduce the modern series arc lamp with the shunt coil. It was this invention—I am sure you will all agree with me—which first made arc lighting from central stations commercially possible, and I think it may justly be considered as marking the birth of the electric lighting industry of the world to-day.

One of the first instances, I think quite the first instance, of the use of arc lighting for purely commercial purposes was in our little public square in this city. Twelve lights were carefully installed in the park on high ornamental poles. The lamps used were of the ordinary, so-called 2,000, candle power. In this connection, it will be remembered that a professor in New York once said he imagined the electrical companies arrived at the 2,000 candle power by measuring it north, south, east and west, giving 500 each way, and added them all together. That measurement was taken in the interest of the gas company, as I have learned. While we were installing this plant in the public square a great deal of interest was manifested in the installation by the public, and on the occasion of starting the lights our little park was packed from side to side, and it was evident that many of the people expected a blinding glare of light, as evidenced by the fact that many of them had provided themselves with colored spectacles or smoked glass. Of course, there was a general feeling of disappointment at first in this respect, although every one was ready to admit he could read with perfect ease in any part of the square. After a few weeks, when the novelty had worn off, and the people had got tired of staring at the arc, and had time to see how nicely the little park was lighted, the general verdict was that the electric lights in the park were a pretty good thing after all; and that is the general verdict everywhere.

Of course, we had lots of trouble in the early days with carbons. The history of the carbon business is peculiar. Our first carbons were crooked, of course, and were soft, and had high electrical resistance, and burnt out rapidly, and were very expensive. To decrease the electrical resistance and prolong the life of the carbons, we electro-plated them with copper, which is still done. This little scheme of covering the carbons with just enough and not too much copper was the only easy invention that it was my good fortune to make, and it paid fairly well, considering the effort involved, which was mighty small. It yielded, if I remember, something like $150,000 in cash royalties before the bottom fell out of the carbon business. They were sold at the rate of $240 a thousand. I say at the *rate* of $240 a thousand because nobody ever thought of ordering a thousand carbons at once. Fifty or a hundred was considered a fair order. As the business increased a little we were able to reduce the price of the carbons, and we did reduce it at one step to $150 a thousand. It was at a loss for a time, but then we held our own, and afterwards made a little money. We subsequently reduced them from $150 to $62.50, on the theory that cheaper carbons would stimulate the growth of the electrical light industry, and our theory was proven correct. Their use was stimulated, and the business increased enormously, so that while we lost money on the carbons for a good while, later we made a handsome profit at that price. Others seemed to grasp the situation about that time, and competition sprung up, and it knocked the profits of the carbon business all to pieces. I presume now you can get your carbons for next to nothing a thousand, with "a beautiful chromo in each box;" and I have no doubt if you insisted, you could get a nice gold frame for each of the chromos. This is a pointer for you.

As to electrical lighting at the present day, most of you know more about it than I do, for I have been accumulating rust for several years, and I will not attempt to tell you anything about it, but will simply thank you for your attention.

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* An address delivered before the Cleveland Electric Light Convention.

PROCEEDINGS OF THE NATIONAL ELECTRIC LIGHT CONVENTION

AT CLEVELAND, OHIO FEBRUARY 19-20-21-1895

THE great success of the Cleveland Convention of the National Electric Light Association fittingly marked the tenth anniversary of the founding of this flourishing body. The meeting was unusually well attended, and its proceedings were characterized by a dignified tone and earnest spirit very appropriate to the professional role of the Association and the vast commercial interests which it represents. The former reproach of perfunctory interest in the reading and discussion of papers no longer applies to the meetings of the National Electric Light Association, and it was remarked that the Cleveland Convention furnished quite a contrast in this respect to the recent annual meeting of another association.

The commercial exhibits were not so extensive as at some other meetings, but what was lacking in number was more than compensated for by the admirable working exhibit of the monocyclic system, which, as a beautiful example of the flexibility of alternating working and a practical illustration of the modern trend of electrical advancement, served a purpose beyond a merely commercial one and received a corresponding appreciation.

C. H. WILMERDING, President.

FREDERIC NICHOLLS, 1st Vice-President.

One of the notable features of the Convention was the presence of three of the great pioneers of electric lighting, Brush, Thomson and Houston, and the address of Mr. Brush formed the most interesting part of the proceedings, important and interesting as the latter were. His reminiscences of the early days of electric lighting and amusing anecdotes of the impressions which the mysterious agent then produced on the public brought to the minds of his hearers the newness of an art which, in view of its present stage of advancement, requires such an occasional reminder in order to keep the fact from escaping the memory altogether.

The social features of the convention added, as usual, much to the enjoyment of the occasion, and the visitors had every evidence that the high reputation enjoyed by Cleveland for warm hospitality has not been unworthily bestowed. None were more hearty in approval of the selection of Cleveland for the meeting place of the Association than the ladies among the visitors, who were given every opportunity to appreciate its enviable fame among American cities for the beauty of its streets and residences as well as for the social qualities and artistic culture of its residents.

TUESDAY FIRST DAY FEBRUARY 19 1895

The Convention was called to order in Army and Navy Hall at 11 a. m., by President Francisco, who then introduced Mayor Blee.

The Mayor of the Forest City, in an appreciative speech, said he hardly thought it necessary to offer the delegates the freedom of the city, as he had from observation found that they had already taken it. He would, nevertheless, inform them that the city was theirs, and should his electrical friends, Messrs. Brush, Wason and others, into whose hospitable care he consigned their confreres, fail in the duties thus delegated to them, he would try his hand at it himself. The Mayor then introduced "the next Governor of Ohio, and an eloquent after-breakfast speaker—Mr. James M. Hoyt."

Mr. Hoyt informed his audience that the Mayor was right in saying he was an after-breakfast speaker, as he never remembered making a speech before breakfast in his life. He understood the Convention was a little slow in gathering, and ascribed it to the reason that, there being some doubt as to whether or not electricity was a fluid, many had probably been delayed in the barroom of the Hollenden experimenting in regard to that point. He regretted that the Convention was not held during a more pleasant month, but added that all would try to make up for the chill in the air by the warmth of welcome and hospitality extended. As to the appropriateness of the Association meeting being held in Cleveland, he said that while "Franklin in Philadelphia first harnessed the lightning, and Morse of New York made a winged messenger of it; while Bell of Washington endowed it with the power of speech so clear and penetrating that not distance, but only the telephone girl, could render it inaudible, and Edison of Menlo Park made a mock echo of it, it was Brush of Cleveland who made illumination of it, the beams of which, while I talk, are penetrating into the remotest corners of the earth, piercing the fog of

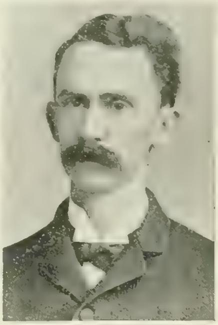
E. F. PECK, 2nd Vice-President.

London, shining on the boulevards of Paris and Vienna, glistening on the icy surface of the Neva, and rending apart the mantle of darkness and throwing a kindly light over the horrors of the battlefields of distant Asia." The witty and eloquent remarks of Mr. Hoyt were received with much applause.

The president next introduced Mr. Charles F. Brush, who delivered an exceedingly interesting address, reprinted in full elsewhere, replete with amusing anecdotes relating to the first days of electric lighting, and which was frequently interrupted by the applause and laughter of the audience.

Mr. Francisco then delivered his presidential address, in which he referred to the eminent appropriateness of the tenth annual convention of the Association being held at the home of one of the pioneers of electrical industries—Mr. Brush. He called attention to the gigantic strides made in electrical progress during the past decade, in which the 100 central stations at the beginning of that period have grown to 25,000, representing assets of $300,000,000, to which should be added 7,500 isolated plants valued at $200,000,000 more. Ten years ago, he said, the total number of arc lamps could be counted in a moment's time, while now more than 500,000 are in use. He described the first central station built in 1882, and referred to the fact that then voltmeters and ammeters were not in use, lamps being regulated by their appearance, and in case of trouble the station was shut down and all hands turned out to hunt and repair damages. As a contrast, to-day there are single stations furnishing 150,000 lamps and the interruption of light for a moment is regarded as the result of gross incompetency. In 1884 the first experimental street railway started in Cleveland, using but one car; to-day there are 1,000 railways in operation, with 10,000 miles of track and assets amounting to $600,000,000.

W. R. Gardener.


J. J. Burleigh.

Mr. Francisco then dwelt upon the immense possibilities in the future of electricity, and briefly treated what he called the "recent craze for municipal ownership," which movement, he stated, ought to receive the most careful consideration by this convention. In conclusion he called attention to the excellent condition of the Association in regard to membership and finances and paid a fitting tribute to the labors of Secretary Porter. His remarks were closed with a reference to the high character of the papers to be read.

The convention was then declared open for regular routine work, but adjourned on motion to allow the members to meet Mr. Charles F. Brush and Professor Elihu Thomson, who became the subjects of an impromptu ovation.

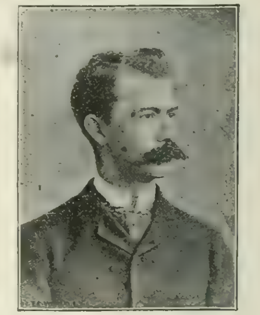
AFTERNOON SESSION.

The meeting was called to order at 2:30 and Mr. Nelson W. Perry proceeded to read his paper on "The Storage of Energy Essential to the Economy of Working in Central Stations." Mr. Perry estimated the cost of producing a unit of electrical energy with present methods, and with this as a basis then made comparisons with different systems of storage. His conclusions were that the storage battery system would entail no saving except in special cases or as an auxiliary; that of three thermal storage systems described, there would be the following savings: With coal at $1.75 per ton, a saving of 6 cents, $20.20 and $23.36 respectively, per annual horse power for steam storage, feed storage, and feed and steam storage combined, on the basis of a load factor of 25 per cent., an annual horse power hour under present methods being assumed to cost $117.78; with coal at $3.50 per ton those figures become $13.63, $30.82, $37.05 and $148.40, respectively.

A lively discussion followed, which was participated in by Prof. W. M. Stine and Messrs. Herbert Lloyd, John Seely, J. I. Ayer, Peter Wright, Fred Nichols and C. L. Edgar. Prof. Stine, in commenting upon the paper, suggested that many of the failures with storage batteries were due to the lack of knowledge on the part of the inventors and manufacturers, and called attention to the many points which enter into the manufacture and care of storage batteries. Mr. Herbert Lloyd severely criticised many of the figures given by Mr. Perry, claiming that as far as they related to the use of storage batteries they were extravagantly high. By substituting what were claimed to be true commercial costs, Mr. Lloyd arrived at the result that instead of electrical storage costing more than present methods, it really cost much less, and was even cheaper than any of the thermal systems described, assuming Mr. Perry's figures in these cases as correct. For instance, the amended figures showed a saving per annual horse-power of $39.50 with coal at $1.75 and $48.29 with coal at $3.50. Mr. Peter Wright referred to his experience with the Germantown, Pa., auxiliary storage battery plant, which he stated gave good satisfaction and entailed an annual saving of $1,871.70. Mr. Edgar, of the Boston Edison Illuminating Company, stated that at present his company is operating one of the largest storage battery plants in the world and saving 10 per cent. of its coal bill, and the total investment, with half battery and half steam power, is only 75 per cent. of what it would be with steam alone. The battery is guaranteed for ten years and maintained in order by the makers for six per cent. per annum of the cost of the cells. In reply to criticisms made, Mr. Perry maintained the substantial correctness of his figures, and stated that the case mentioned by Mr. Edgar was not one of complete storage and therefore did not affect the conclusions of the paper. The paper and discussion are printed in fuller abstract elsewhere.

At the conclusion of the discussion of Mr. Perry's paper Prof. Houston read a paper by himself and Mr. A. E. Kennelly on "A New Method of Measuring Illumination," which will be printed in full in another issue. The authors lay stress upon the fact that the degree of actual illumination produced by a source of light, and not its photometric intensity, is what is desired to be known in a given case. Owing to complexity of calculations and their lack of weight in dispute, a method of measuring illumination is much needed, and an apparatus for this purpose devised by the authors is then described. The total length of the instrument is 6½ inches, its breadth is 1½ inches, its height 2¼ inches and its weight 10 ounces, and it can therefore be readily carried in the pocket. Its principle depends upon the fact that the illumination received upon the printed page of a book or newspaper must have a definite value in order to render the printed characters legible, and that the intensity of the illumination so required will, for a normal eye, depend upon the size and character of the print. In carrying this out a small printed tablet is placed in a darkened box and exposed to illumination from a translucent plate of porcelain or opal glass which receives, directly on its surface, the illumination whose intensity is to be measured; the area of the translucent plate is then varied by a sliding shutter until the amount of light received by the test characters just permits of their legibility, and from a scale in connection with the shutter indicator the luminous intensity of the source is read. The authors also explained the proposed international unit of illumination—the lux or approximately the illumination produced by

Chas. A. Wason.


E. A. Armstrong.

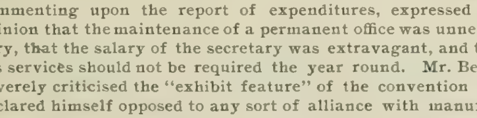
a British candle at a distance of a metre—and strongly advised its adoption by the Association.

In the discussion which followed part was taken by Mr. Caryl D. Haskins, Prof. Elihu Thomson and Mr. J. I. Ayer. Mr. Haskins suggested that the translucent screen might not have the same permeability for rays of light of different color and that the human eye appreciates one more than the other in different individuals. Prof. Thomson referred to the time element of the eye responding to changes in light, which would enter in taking observations with the instrument described, and which is different in different individuals. Another physiological element which enters is that after the printed characters become known they will be easier read. Other objections are that all eyes do not have the same aperture for light, that the iris does not respond equally in different people, and that color blindness may vitiate the results. In conclusion Prof. Thomson said that if after testing these and other points the error does not exceed 10 per cent., as claimed, the instrument will be unqualifiedly indorsed.

Mr. J. I. Ayer related the experience of a committee which investigated the point brought forward by Prof. Thomson in regard to the influence of familiarity with letters in testing for eyesight; it was found that this influence was great, but in the instance referred to, was neutralized by substituting slips containing lines of Volapuk, practically impossible to memorize.

Mr. Kennelly, in reply, said that the question as to the relative sifting power of the translucent screen did not apply if the instrument was calibrated by light of the same character as measured, and otherwise the discrepancy was too small to be noticed. In regard to familiarity with the test characters, the observer will simply endeavor to bring them down until he cannot read them. As to the imperfection of human eyes, it is not possible to get an instrument based upon the agency of the eye that will be absolutely correct; on the other hand, our eyes have some definite value, and just in so far as they are perfect or normal, just in so far can the measurements relied upon be conducted. Prof. Houston said that the objections raised by Prof. Thomson must necessarily apply to any instrument of physical research. After all, the instrument proposed only requires for its use that a person be able to do what his training has taught him to do, since he first opened his eyes in this world—to be able to see an object with fair distinctness.

A vote of thanks was tendered to Messrs. Houston and Kennelly for their paper, and a number of communications to the convention were then read, including an offer to the delegates by the Cleveland electric railway and telephone companies of the free use of their facilities while in attendance on the convention. A number of letters and telegrams regretting inability to be present were received from a number of gentlemen, including Nikola Tesla, S. P. Thompson, Hon. William McKinley, George Westinghouse, Jr., and C. A. Coffin.



President Francisco called the meeting to order at 10.15 a. m. The Committee on Finance, Mr. J. A. Seeley, chairman, made its report, which showed the Association to be in a highly satisfactory condition, there being no liabilities outstanding and quite a comfortable cash balance in hand. Mr. John I. Beggs, commenting upon the report of expenditures, expressed the opinion that the maintenance of a permanent office was unnecessary, that the salary of the secretary was extravagant, and that his services should not be required the year round. Mr. Beggs severely criticised the "exhibit feature" of the convention and declared himself opposed to any sort of alliance with manufacturers, whom he denounced generally as inimical to central stations. Mr. W. R. Gardener and Mr. Seely replied to Mr. Beggs' criticisms, and the sense of a large majority of the members present seemed to be strongly in favor of maintaining permanent headquarters, and that the secretary's expense account is by no means in proportion to the value of his services.

Mr. W. E. Harrington then read a paper on "The Correct Method of Protecting Electric Circuits," in which he gave the result of some experiments made in order to determine the rate of increase of current upon suddenly closing a generator circuit. It was found that quite an appreciable time was required to bring the current up to its normal value. Mr. Harrington considered that this demonstrated the superiority of magnetic circuit breakers for the reason that they would act in case of great increase of current due to short current or overload, before the current could reach a strength that would injure the armature. Fuses, on the contrary, not acting so promptly, would enable the current to obtain a normal value.

Mr. C. N. Black next read a paper on "Large Arc Dynamos," which is abstracted at length in another column. Mr. Black advocated the superiority of the open-coil type arc dynamo, and gave a number of reasons to sustain his position. Among these were the greater self-induction of the coils and less number of commutator segments, thus preventing sparking around the commutator. Also, that this great armature self-inductor tended in case of the circuit being opened to reduce the rise in the E. M. F. In addition, a further advantage in this respect consists in the fact that when the rise of voltage exceeds a certain point, which is below that of danger to insulation, the commutator will flash and short circuit the armature, thus reducing the voltage to zero. Two large Brush machines of the latest type were described and characteristic curves shown which indicated that beyond the bend of the curve the machines gave an almost constant current. The electrical efficiency of these machines was stated to be 94 per cent. and the commercial efficiency 90 per cent., while magnetic reluctance is very much less than in older types and the density at which the armature iron is worked is less than 12.4 kilogausses.

CHAS. F. BRUSH.

ELIHU THOMSON.

Part was taken in the discussion by Messrs. S. M. Hamill, C. Townley, T. C. Smith, Prof. Elihu Thomson and others. Mr. Hamill said that during the past year the Brush Company has built large arc dynamos amounting in all to from 8,000 and 10,000 lights capacity. Prof. Thomson referred to the early history of arc lighting and said that the development of the arc dynamo had been somewhat backward. He recollected that machines were built in the early days capable of giving a curve similar to that referred to above. He considered that a closed coil dynamo is a better electrical structure than the open coil, but when it comes to the conditions of practice this conclusion may be modified. In the early history of arc lighting the open coil dynamo was particularly valuable from the fact that it could be run without much liability to damage by inexperienced men. He confirmed Mr. Black's opinion in regard to the action of flashing in preventing a high rise of E. M. F. upon breaking circuit.

Mr. Townley confirmed the statement of Mr. Hamill that the pressure is very strong for large units for arc lighting, and said that if the conditions were not so severe with regard to insulation it would be advisable to use machines of capacities even as large as 1,000, 2,000 and 3,000 legats. He considered that the development in the future will be along the lines of larger units. Mr. Prentiss said that the question of line insulation with large units seems to be one of care more than anything else, and that the only difficulty he had experienced was at the point of connection between lamps and the line, which was principally due to moisture getting into the cut-out boxes. Mr. T. C. Smith referred to the practice of coupling machines together in case of emergency, which, he said, had been done for years without any difficulty being encountered. He cited one case where fifteen 18-ampere 10-lighters were worked in series. Mr. Prentiss added that in New York City at one time 240 lights were run on a single underground circuit.

Upon the conclusion of the discussion of Mr. Black's paper, an invitation was read from the ladies of Cleveland, to the delegates and their wives or other members of their families, to attend an exhibition of paintings in the Garfield Building.

Resolutions were on motion adopted cordially endorsing the Cotton States' International Exposition to be held in Atlanta, Ga., from Sept. 18 to Dec. 31 of this year, and urged members to attend and also avail themselves of the opportunity to make electrical exhibits.

AFTERNOON SESSION.

Upon opening the session the topic "How to Light Large Cities," was taken up. Mr. Wilmerding criticised the figure given by City Electrician Barrett, of Chicago, as the cost of arc lighting in that city—$96.25 per lamp per annum—saying that it did not include interest, depreciation, insurance, taxes, etc., but simply labor and material. As the plant cost per lamp installed was $500, if 6 per cent. for interest and depreciation, respectively, were added, the true service cost would be $156 per lamp, while the speaker's company was furnishing lamps to the city at $137.50. Mr. Wilmerding thought that there is no question but that in every municipal organization in this country the cost of carrying on what may be considered a commercial or private business is much greater than where it is carried on by a private corporation, where all expenses are carefully considered.

Dr. Louis Bell then read his paper on the "Monocyclic System," which will be printed in full in another issue. The monocyclic dynamo differs from an ordinary alternator merely in having a supplementary winding connected to the middle point of the main winding, and so placed with relation to the latter to have its E. M. F. displaced 90 degrees in phase from the main E. M. F.—the supplementary winding having a less number of turns than the main winding. The length of the supplementary coil is such as to produce an E. M. F. of a value that, when compounded with the main E. M. F. a difference of phase of 60 degrees will be produced between the supplementary line wire and the two main line wires. If, then, one of these E. M. Fs. is reversed, either in transformers or anywhere in the translating devices, the result will be three E. M. Fs. 120 degrees apart, one of them having been turned through an angle of 180 degrees. Consequently lights on the line can be run from the two main wires exactly as with the simple alternating system, and, in addition, three-phased motors through the aid of the supplementary or power wire, similarly, two-phased motors, by means of suitable transformers, may be thus used. The monocyclic motor is a reversed monocyclic generator, and has the property of starting with load and requiring no current from the power wire when running at synchronous speed, at which point it works precisely as a simple induction motor. This is accomplished through the supplementary coil of the motor at synchronous speed being designed to have a counter E. M. F. equal to that of the line; if the speed lowers, current is taken by the supplementary coil, and if it increases beyond synchronism, current is generated by it. It was stated that the power wire would never need to have a cross section greater than one-fourth the joint cross section of the two main wires, and generally a smaller wire will suffice. The subsidiary E. M. F. may be generated anywhere along the line, and the power wire led from that point, the machines in the central station in this case being merely simple alternators.

An interesting discussion followed, in which Messrs. Jno. F. Kelly, C. P. Steinmetz, C. F. Scott, Prof. E. Thomson and Dr. Bell participated. Mr. Kelly thought that the monocyclic system was a step backward, and should have come before the multiphased system. He considered that there were no practical difficulties in balancing the two-phased system, which required less wire than the monocyclic system; multiphased generators also have a greater output than would monocyclic generators, and the system described would require more wire than the simple alternating one and have a greater drop. Mr. Kelly said that there was no difficulty in making multiphased motors to operate with high efficiency and torque at 16,000 alternations per minute.

Mr. Steinmetz said that though the multiphased system had been before the public for ten years, it is just beginning to be used in special work, and really only possesses a limited application. He said that the monocyclic system is entirely single phased, the total flow of energy issuing from the generator passing through zero and fluctuating, while the flow of energy in multiphased systems is more or less constant. As to the output of multiphased generators being greater than simple alternators, that is a common mistake, as the amount of wire on an armature is fixed, not by the space at command, but by the armature reaction; as a very great armature reaction can be taken care of by compounding in the case of simple alternators, their output is greater or at least equal to that of multiphased generators. Mr. Scott considered that the monocyclic system showed the great flexibility of the multiphased system, to which it belonged. He said that while two-phased circuits may be unbalanced in some cases, this would be seldom encountered in practice. Transformers of one-sixth greater capacity would be required for monocyclic motors than for other multiphased motors. Mr. Scott considered that the monocyclic system operating with three-phased motors has really the elements of a three-phased system distorted somewhat by changing the E. M. F. on the middle or teaser wire, reversing the secondary of one of the transformers and leaving out the third transformer. The monocyclic motor he considers to be "rather a decrepit two-phased motor." Mr. Scott differs with Mr. Steinmetz as to the definition of a multiphased system, which he defines as a system in which the operation of apparatus is due to difference of phase. He says that in the monocyclic system the power wire merely contributes to bring the motor up to speed and then lies idle, while it would continue to deliver power, thus utilizing the copper, if the motor were a symmetrical multiphased motor instead of one possibly made defective to meet the requirements of the system discussed.

A. E. Kennelly.

E. J. Houston.

Dr. Bell, in reply, insisted that the monocyclic was not a multiphased system, though its operation may suggest that system. He denied that the motor on the monocyclic system was in any sense a two-phased motor, and stated that its winding in every respect was similar to that of a three-phased motor, and only fit to operate on three-phased or monocyclic circuits. The currents flowing through it are in phase, and therefore not three-phased currents, though the E. M. Fs. differ 120 degrees in phase. The monocyclic system is to be regarded, not as a modified single phase, nor as a decrepit multiphase system, but rather as a class by itself.

At the conclusion of the discussion on Dr. Bell's paper, an invitation was announced from the reception committee of ladies resident in the city of Cleveland tendering a banquet to the visiting ladies at the Stillman Hotel, and a large basket of roses sent with the invitation was greeted with much applause. On motion of Mr. Seely a hearty vote of thanks was tendered in recognition of the invitation and gift.

EVENING SESSION.

The topic of "Practical Demonstration of Protecting Lines from Lightning" was discussed by Mr. A. J. Wurtz, who illustrated his remarks by means of a series of interesting experiments. He pointed out the fact, not generally known outside of scientific circles, that lightning discharges do not always take the nearest path to earth, and defined the discharges as being entirely selective within the limit of 9-16 inch, passing a ¼ inch gap quite as frequently as one of 1-32 inch, the two gaps being connected in multiple. In the course of his experiments Mr. Wurtz very conclusively demonstrated the great efficiency and durability of his two forms of non-arcing arresters.

President Francisco called the meeting to order at 10 o'clock, and Mr. W. R. Gardener continued the discussion of Dr. Bell's paper. He said that he had been operating in the station at Pittsfield a two-phase machine for over a year and a half with perfect satisfaction, and to-day power, incandescent and arc lights are all furnished from the same circuit. The two-phased system is about to be adopted exclusively in his station, and would displace five simple alternators of from 750 to 1,500 lights capacity each, although they are in as good condition to-day as when bought; one two-phase machine will be substituted for these five, which will greatly simplify station attendance and reduce the repair bill. It was found that repairs on simple alternators were very expensive, while not one cent had thus far been expended on the two-phased machine. In reply to a question from Mr. Jennings, Mr. Gardener said he has experienced practically no interference with lights due to the operation of motors on the same circuit.

The Committee on Data, Mr. H. M. Swetland, chairman, then made its report, which we print elsewhere, and in the discussion which followed Messrs. W. R. Gardener, E. L. Powers, E. A. Armstrong, H. M. Swetland, J. J. Jennings, J. C. Hadley, J. J. Burleigh, F. E. Barker and J. I. Ayer took part. Mr. Gardener related his method of making a test of the Pittsfield station, which covered a period of 24 hours of time, readings being taken at intervals of from 10 to 30 minutes. His object was to find the ratio of the different items entering into the cost of developing energy, the items being as follows: 1st. Steam cost, including coal and water only. 2d. Cost of engine, including wages of fireman, boiler repairs, interest on boiler room investment, fire and boiler insurance and depreciation of boilers, which is estimated at 5 per cent. 3d. Cost at the switchboard, including wages of engineers, dynamo tenders, mechanic, and wiper; repairs to electric plant, interest on steam electric plant and real estate, insurance on entire building and contents, oil and waste. 4th. Cost at lamp or motor, without depreciation, including the above, and general salaries, office expenses, cost of carbons, interest, incidental expenses, incandescent lamps, law expenses, oil and waste, steam and electric repairs, line repairs, taxes, wages, wiring and wiring supplies. 5th. Cost at the lamp or motor, including depreciation on total investment, which is placed at 5 per cent., but including drop in lines from station to lamp or motor. Taking the fifth item as the total cost, Mr. Gardener found the steam cost to be 33.8 per cent. of the whole; the cost at engine 6.8 per cent. more, or 40.6 per cent. of the whole; the cost at switchboard 26.4 per cent. more, or 67 per cent. of the whole; the cost at lamp or motor without depreciation 15.7 per cent. more, or 82.7 per cent. of the whole; cost at the lamp or motor, including depreciation on investment, 17.3 more, or 100 per cent. of the total. He called attention to the great importance of the first factor and advised the greatest care in the selection of coal and its economical use. Mr. Armstrong recommended that each member of the committee should engage to personally get reports from a certain number of stations in his territory. Mr. Jennings said that the report of the committee is of the utmost importance, and that for his part he had made an effort to move up from near the bottom of the line, where he was last year, and this year thinks he is getting up toward the middle. Mr. Barker referred to the general neglect of electric companies in keeping a record of essential data, and from his own experience he thought that the report of the committee was, under the circumstances, very complete. Mr. J. I. Ayer suggested that the committee be requested and authorized to formulate a set of blanks upon which the record of the desired information could be kept, these blanks to be furnished to central stations; a resolution was presented to that effect, and carried. The meeting then adjourned to executive session, at which the following special committee was appointed on "The Relation between Manufacturing and Central Station Companies": Messrs. A. J. DeCamp, John I. Beggs, E. A. Armstrong, T. C. Smith and F. Gilbert. A committee on resolutions and another to nominate officers were appointed, and the constitution amended to provide for the holding of one meeting each year in the months of May or June. A motion was passed recommending that the next meeting be held in New York.

LOUIS BELL.

A. J. WURTZ.

Mr. L. B. Marks then read his paper on "Arc Carbons and the Rating of Arc Lamps," printed with accompanying table elsewhere, which gave the result of experiments with many different carbons to determine the range of voltage between the flaming and hissing points. It was found that this range varied widely with different carbons, and that the flashing point with some grades is below the voltage of maximum efficiency. Attention was called to the fact that absolute purity in a carbon did not necessarily imply high voltage, and that the quality of light has an important bearing upon the actual luminous efficiency of an arc. Mr. Marks approved of the rating of arcs by watts instead of by nominal candle power, even though the quantity of light varies notably with different carbons supplied with the same amount of energy. Station managers are advised to test carbons for the range of voltage between which they will burn and also for the voltage of maximum efficiency. The continuous current was stated to be more efficient in producing the arc light than alternating currents, and much more care is required in selecting carbons for use with the latter.

Prof. B. F. Thomas and Messrs. E. F. Peck, J. I. Ayer and E. A. Armstrong took part in the discussion which followed. Mr. Peck said that the rating of arc lights according to the watts used really means nothing, as it had been discovered by experiment that the quantity of light varies widely with the size and quality of carbon used. Mr. Marks considered that it would be well to remember that a gain in light efficiency with a given grade of carbon was invariably accompanied by a loss of longevity. He referred to the influence of the diameter of carbons upon the candle power to the variations that crept in during the process of manufacture, and to the selection of carbons best adapted for the light required for the special purpose in view, stress being laid upon the latter point.

Prof. Thomas related the result of some work recently done at the Ohio State University in connection with the proposed watt rating of arc lamps. Measurements were made on ten or more pairs of carbons from lots that were in regular use in street lighting service. The current was maintained steadily at ten amperes, and it was found that sometimes 51 or 52 volts were required to maintain the arc in normal condition. The basis of comparison was on the candle power of a 45 degree ray, and it was found that with a watt variation amounting to but two to three per cent. there was a variation of candle power in the strength of this ray of from 20 to over 50 per cent. Prof. Thomas was of the opinion that the proposed rating of arc lamps was not a rational one, and agreed with Messrs. Houston and Kennelly in advocating that contracts specify the degree of illumination required. Mr. Marks said that while it is only too true that the candle power with the same watts may differ from 50 to 100 per cent. with different carbons, yet he did not see that the Association at this time could be benefited by adopting a standard of candle power. He referred, with respect to the quality of light, to the tests of two carbons, which for a mean hemispherical candle power of 456 and 486, respectively, gave an efficiency of 11.71 and 10.01 respectively, the efficiency being the ratio of luminosity to total radiation. It seems quite probable that the difference in the quality of light explains the discrepancy.

Prof. Thomas criticised the principle of the proposed illuminometer, which, he said, was discarded several hundred years ago; he stated that there were too many serious differences in the eyes of the same individual at different times to enable the proposed photometer to give accurate results.

Mr. Ayer did not agree with Prof. Thomas that in rating arc lamps by watts no progress had been made, but that all would welcome a method to determine the amount of illumination at different distances from a light.

Mr. W. J. Hammer submitted the report of the Committee on Standard Rules for Safe Wiring, which stated it was probable that in the near future joint meetings will be held with committees of the underwriters, street railway, telephone and other interests, which will enable a very satisfactory report to be made at the next meeting. Mr. C. H. J. Woodbury spoke in favorable terms of the character of the rules adopted at the Washington convention.

AFTERNOON SESSION.

President Francisco called the meeting to order in executive session at 2.30 p. m., and the topic of the Welsbach burner was taken up and discussed by Messrs. Gardener, Edgar, Carnes, Burleigh, Seely, Peck, Armstrong, Stetson, Corriveau and Francisco.

Mr. Gardener referred to a case in which a Welsbach burner exploded and embedded a piece of glass in the cranium of a dentist working underneath. He also cited a case where the vibration in a shop caused the mantle to be gradually shaken to pieces. Mr. Edgar said that in Boston the burner is gradually disappearing. He had one in his own house which at first saved considerable gas and gave a beautiful light; the first mantle lasted two years, but since then they have gone to pieces very fast and the gas bills are larger than they ever were with the old burner. He mentioned the effect of drafts of cold air in destroying the mantles. Mr. Carnes related that a year ago in Memphis the Welsbach burner displaced 1,500 to 2,000 incandescent lights in a month or two; at present 50 to 60 per cent. of the patrons lost have returned, and he expects to get back as many as 25 or 30 per cent. more within the next two months. He said that the reason the Welsbach light had lost favor is because the longer it is used the more objectionable its light becomes, and the greater is the amount of gas used. Mr. Seely considered that one of the reasons which encouraged the Welsbach burner was the poor service rendered by many of the electric light companies. Mr. Peck said that he noticed some four months ago about 25 large stores in Brooklyn using the Welsbach burner, and a few weeks ago discovered that they had gone back to simple gas or to the incandescent light. Mr. Armstrong reported that during the last quarter his company had lost 75 customers through the Welsbach light, and that it expected to lose more. Mr. Corriveau said that in Montreal users of the Welsbach burner are rapidly going back to the electric light on account of their experience with breakages of mantles and the bad color of the light. Mr. Francisco referred to the case of a customer who used about 200 of these burners and then returned to electric lights.

On motion of Mr. J. I. Ayer, seconded by Mr. Frederick Nichols, the thanks of the Association were tendered to Mrs. Sidney Short and the ladies of the local committee, to Mr. Wason and the gentlemen of the reception committee, and to various others for the many courtesies extended to the visiting members during the convention, which, as a consequence, will be remembered as one of the most pleasant, from a social point, in the history of the Association, as well as one of the most interesting and instructive otherwise.

L. B. Marks.

John A. Seely.

The Committee on Nominations then presented the result of its deliberations, after which the following gentlemen were elected as officers of the Association: President, C. H. Wilmerding, Chicago, Ill.; first vice-president, Frederic Nichols, Toronto, Ont.; second vice-president, E. F. Peck, Brooklyn, N. Y.; members of the Executive Committee, E. H. Davis, Williamsport, Pa.; W. R. Gardener, Pittsfield, Mass.; Geo. A. Redman, Rochester, N. Y., and J. J. Burleigh, Camden, N. J. After a graceful address by President Francisco, thanking the members for the sincere and generous support he had received during his incumbency of the presidency, the meeting adjourned sine die.

THE NEW PRESIDENT.

Mr. C. H. Wilmerding was born in the City of New York, Aug. 19, 1858. He was educated in the universities of Harvard and Princeton, as well as abroad, graduating on his return to America in 1879 from the Sheffield Scientific School as an engineer. His first actual work was done on the City Water Works of Troy, New York, where he was chief engineer. Being in close proximity to the Polytechnic Institute at that city he was attracted to it, and took a special course in mining and metallurgy. Shortly after this he went to Leadville, Col., and for a time was busily engaged in mining and assaying work. Depression in mining made Mr. Wilmerding turn his attention to railway engineering, in which work he was very successful. He built a large part of a section of the present Denver & Rio Grande Railway in Utah.

Mr. Wilmerding's first electrical experience was in 1886, when he allied himself with the Westinghouse interest. In the spring of 1888 he went to Chicago, representing the Accumulator Company, and has remained West ever since. In November of the same year he accepted the position of superintendent of the Chicago Arc Light and Power Company. From this position he was gradually advanced until he became general manager, and finally president. When the consolidation was effected in 1893 between that firm and the Chicago Edison Company, Mr. Wilmerding became general superintendent of the company, which position he still holds. Mr. Wilmerding married a Miss Fay, sister of C. N. Fay, for a long time general manager of the Chicago Telephone Company, and also president of the Chicago Arc Light and Power Company. Mr. Wilmerding is one of the best of fellows, and the chances are he will endeavor to add some Western enterprise to the association.

The hospitality extended by Cleveland to the stranger within her gates was of so hearty a character that in future other cities may well tremble at the mere thought of competing with her when their opportunity comes to entertain the National Electric Light Association. From the first moment of arrival, with its waiting row of carriages to welcome the begrimed and weary travelers, until the hour of departure, nothing apparently was left undone.

The Cleveland hostesses spared neither time nor pains but sacrificed their own home comforts and social pleasures for the sake of the guests, and the wives and daughters of the convention were seldom alone. The Ladies' Local Committee made frequent calls upon them and arranged many delightful drives about the city. A special car was placed at their disposal on the afternoon of Tuesday, Feb. 19, by means of which was made a very thorough tour of the city. The same evening the ladies gave a theatre party at the Lyceum, where the guests enjoyed the presentation of the drama "Friends."

On Wednesday a charming luncheon was given at the Stillman, and each lady bore away as a souvenir of the occasion a dainty water-color sketch, although such a gift was not necessary to insure pleasant memories of the bright faces, merry talk and sweet music of that delightful feast.

Mrs. S. H. Short welcomed the guests in a few happily chosen words, and Mrs. M. J. Francisco voiced the feelings of all in a "Short" address, full of thanks to the charming members of the reception committee. The enthusiastic waving of roses and lilies testified to the sincere appreciation of this toast without wine. Some of the ladies present said they had not been entertained so royally since the annual meeting of the American Institute of Electrical Engineers at Philadelphia last May. This may be more readily understood when it is remembered that the social features on that occasion were in charge of Mr. C. A. Bragg, the Quaker City representative of the Westinghouse interests.

After the luncheon at the Stillman the General Electric tendered a very pretty compliment to the ladies in a Flower Show held at the headquarters of the company in the banquet hall of the Hollenden. So generous were the gentlemen of the General Electric that a very fine microscope would have been required to find any flowers after the ladies had departed.

The genial hosts had also prepared a delicious claret cup, which raised them still higher in the opinion of their guests. The cooling draught was drunk, the flowers have faded, but the General Electric has made an impression upon the ladies of the National Electric Light Association that will long be remembered.

On Wednesday night the members of the Association were given a reception at the Art Exhibition, where they enjoyed meeting again their untiring hosts and hostesses as well as seeing a remarkably fine collection of paintings. During the evening the Misses Hart rendered some delightful music on violin and piano.

On Thursday morning a visit was paid to the Cleveland Illuminating Company's Canal Street station, where genial Prof. Elihu Thomson and the representatives of the General Electric Company explained to the ladies more than their minds could grasp of monocyclic machines, three-phase motors and a style of switch the women do not use.

In the afternoon a special car whisked the ladies to Professor Olney's private art gallery, where the gallant man of science and his courteous wife received the visitors and gave them a charming experience. More attractive than all the beautiful works of Corot, Bouguereau and others that lined the walls was the picture of the white-haired old gentlemen so interestingly explaining his art treasures, and now and then slipping to the piano to regale the ladies with music, while Mrs. Olney dispensed cooling refreshment. The ivory carvings, bronzes, porcelains and jewels were greatly enhanced in value by their owner's apt and entertaining descriptions, and a general sigh was heard when the hour for leaving this fairy-land of arts arrived.

So with every evidence of the culture and refinement with which Cleveland is filled, from its long avenues of magnificent residences, its beautiful art collections, the trees and parks with which it is adorned, its many churches, its shops of choice wares, its industries, its theatres, what is left to be mentioned? Only the charming spirit of kindly courtesy which animates its dwellers and enables the stranger to see and enjoy its beauties.

CONVENTION NOTES.

Page belting was on dress parade in parlor 101.

Grimshaw Wire had a great trio in Messrs. Wulff, Whitney and Kelly.

The John A. Roebling's Sons Co. was represented by the ever popular H. L. Shippey.

The interests of Aylesworth & Jackson, of Newark, were looked after by partner Jackson.

The Vulcan Blow Torch was shown in full blast by agent H. A. Smith, and seemed to be very well liked.

Cook Boilers, the product of McNeil & Co., Akron, O., described in a graphic black and white card.

The Akron Insulator & Marble Company made a fine display of their specialties, under Agent Daniels.

The Falls Rivet & Machine Company sent the Babcocks, *pere* and *fils*. There was no missing them.

The Whitmore-Dean Electromagnetic Feed Water Heater, represented by literature and Mr. Jas. A. Hersey.

Albert Hoppin kept a sharp lookout for engine orders. The Allis Engine Company could have no better man.

Weston instruments were remarkably well exhibited in parlor 134, and were looked after by Messrs. Heinrich and Shain.

The Schieren Belting cards were industriously displayed by Western Agent M. A. Sullivan, and made a good impression.

Globe Carbons had the veteran convention worker, Mr. Charles L. Rodman, to look after their interests, and he did it well.

Manhatton Arc Lamps showed up to splendid advantage. They are manufactured by the Manhattan Construction Company.

There were many regrets expressed that the Columbia lamp was not represented; but Mr. Rhotehamel is still on the sick list.

"A Few of Its Strong Points" was the title of a leaflet describing Hazleton boilers. This was one of the things that was carried away.

Patrick & Carter, the well-known pioneer electrical supply house, had Partner E. Ward Wilkins on hand to greet the delegates.

The Nashold Cleat was strikingly exhibited by the inventor, Mr. E. Nashold, both in parlor 113 and in the basement, and made a big hit.

The Harrison Telephone was talked about because of the great number of exchanges recently installed in Ohio and adjoining States.

Post-Glover Electric Company of Cincinnati had Mr. S. W. Glover as their standard bearer, and he made an exceptionally good one.

Washington Carbons, while having no exhibit, had an eloquent and able representative in the person of Secretary J. S. Crider of Pittsburgh.

Mr. A. P. Seymour was the delegate from Syracuse, which everybody knows is the home of Pass & Seymour, manufacturers of porcelain specialties.

Abendroth and Root boilers received a new impetus at the hands of Agent P. L. McLaren, who seemed to be on the best of terms with the whole world.

The King Bridge Company, of Cleveland, had invitations out to visit their extensive works in Cleveland, and many took advantage of the offer.

The Western Electric Company, of Chicago, could have had no better delegate than pusher C. D. Wilkinson, who kept an eagle eye out for supply orders.

Mr. J. C. Hobart, mogul of the Triumph Electric Company, of Cincinnati, was one of the new men at the Convention. He was unusually well received.

Thomas J. Creaghead, president of the Creaghead Engineering Company of Cincinnati, was in attendance, and reported business as unusually good.

Paragon paint was neatly displayed in parlor 101, while Messrs. Frank Abbot and E. B. Merriam were among the most zealous representatives at the show.

Jenney motors and "Jennyraters" were looked after by no less a person than Mr. Charles D. Jenney himself. Every one knows Jenney. He was warmly received.

The Packard Electric Company exhibited in a highly interesting manner one of their transformers running with the case immersed in water as an excellent test.

The Butler Manufacturing Company of Chicago circulated neat little pamphlets descriptive of its electrical specialties. As every one secured a copy description is unnecessary.

Micanite smiled through a maze of exhibits from one of the basement pillars. The local agents for this were the Cuyahoga Supply Company, of 10 South Water street, Cleveland.

The American Engine Company pleased its many friends by announcing in a neat circular that it was now ready to supply generators and motors of an improved design.

In Room 306 a great lay-out of Phœnix Glass was found by the visitors in search of good things. It was in charge of Mr. E. H. Fox, the typical Chicago hustler of the company.

One of the most notable absentees was Mr. J. C. Boss, of the Hornberger Electric Company, makers of the Elkhart transformer. Too much work at home was the cause.

The Bryant Exhibit of switches was one of the most complete. Tommy Grier's book of stories was much sought after, and he and Mr. Bryant were two of the notable characters present.

The Peru Electric Manufacturing Company had an excellent line of its porcelain specialties, batteries, etc. J. H. McGill, though suffering from an injured eye, did good work for this firm.

Okonite made parlor 108 its headquarters, but Captain Candee and Mr. George T. Manson made the entire hotel their camp for the distribution of points concerning this famous wire.

Solar Arc Lamps enjoyed the advantage of being shown in operation, and made a big impression. Mr. Joseph Sachs had them in charge, and made certain that everyone saw them.

The Alternating Fan Motor display made by the Holtzer-Cabot Electric Company of Boston was much admired on account of the improved and highly attractive appearance of the fans.

"Save" was the sound advice given by the Jewell Belting Company in their pamphlet describing Jewell Pulley Covering. People should write for this if they by an accident missed it.

Brooklyn was well represented by the Brooklyn Electric Manufacturing Company, which made a neat display of its switches, switchboards, etc. Mr. St. Louis Winter was in constant attendance.

Mr. William C. Pullman, of Chicago, was one of the new men at this Convention. He represented F. A. Lester, selling agent of the Bushnell Mfg. Company, and several other well-known manufacturers.

J. E. Way had a peculiar way of his own in impressing upon the delegates and others the name of R. Thomas & Son, the famous porcelain manufacturers of East Liverpool, Ohio. No one missed him.

The carbon man from Dayton was Mr. Edmund Dickey, representing the American Carbon Company. Mr. Dickey was assisted by Agent H. H. Walter and Mr. G. A. Gessner, and together they made a great team.

The Akron Insulator & Marble Company had displayed a fine line of its standard tubing, insulators, circuit breakers, etc., in charge of Mr. A. L. Daniels, who is well known to the electrical fraternity in the west.

The Electrical Engineering & Supply Company, of Syracuse, was another of the firms which made a telling exhibit. Mr. J. D. McIntyre looked after this company's interests, with the assistance of Messrs. J. L. Hinds and H. C. Hodgkins.

The American Circular Loom Company had parlor 103, and made a particularly striking display of its conduit. Messrs. J. S. Wilson and H. H. Brooks were in constant attendance, and did much work to advance the interests of this house.

The Carpenter enamel rheostats were represented by inventor C. C. Carpenter, who had his display in the centre aisle of the basement, where he was kept busy answering questions and filling orders for his popular rheostat.

Charles E. Gregory, of Chicago, who always has something of a novel character connected with his unique personality at conventions, pleased every one by distributing his pamphlet, "Our Installations to Date." If you miss this, send for it.

The Reliance Gauge Company made a fine display of its safety water columns in parlor 101. Messrs. Higgins and Wright pointed out to everybody the good points of this device, and they found that people were willing to be told all about it.

The Michigan Electric Company showed a real live motor, the product of the Detroit Electrical Works, of which they are general selling agents. Mr. Joe Lockwood was one of the most popular fellows at the hotel, and made many friends for his company.

People were on the lookout for the managers of the Commercial Electric Company, of Indianapolis, but they did not succeed in getting to Cleveland. Their firm was not overlooked, however.

The Chloride Accumulator Company of Philadelphia was represented by Mr. Herbert A. Lloyd, of Philadelphia, and Mr. William M. Potter of Chicago. But this battery scarcely needs a representative at conventions, because it is so well known.

The National Conduit Company, while they may have rested on the advanced fame of their conduit, sent a splendid staff in the persons of Messrs. J. P. McQuaide, H. F. Tait and C. Gallagher, each and all of whom worked hard for the company.

The Crane Company of Chicago, one of the best-known manufacturing companies in the world, sent specimens of their steam-fittings in charge of Mr. G. A. Hurd. He made a neat display and proved himself a popular fellow with the crowd.

Messrs. Herlitz and Smith, American agents for the Errisson Telephone, of Sweden, exhibited their instrument, and won a stream of compliments therefor. The Chicago Cross Arm Company arranged for the western agency while at the meeting.

The Nutting arc lamp, known to fame as the "Wax Wheel Lamp," was in charge of Mr. Carl McFadden, who now has the management of this lamp's destiny. Mac had two of his lamps on display and distributed some of his very attractive literature.

The Cummings and Engleman Conduit Exhibit.—Mr. James J. Cummings, inventor of the conduit, had in charge the interests of this remarkably popular system, and made many friends for it. He distributed one of the handsomest bits of literature seen at the convention.

Hill Clutches, than which there is no better known or better liked on the market, had room 114, where good things in the way of "Smiles with us," new stories and literature descriptive of the clutch were distributed liberally by Messrs. Hill, Leonard and McCarthy.

Hart and Hegeman switches were handsomely displayed in the basement. Mr. Gerald W. Hart represented the home office and Mr. George S. Searing, of Chicago, represented the great West. Between them there were few who did not learn all about this firm's switches.

H. Ward Leonard pleased everyone by exhibiting his new electric soldering iron. Mr. Leonard has designed this for use on any ordinary 110-volt circuit, it taking practically the same current as an incandescent lamp. This will insure for it a wide application.

P & B maintained their position as the two leading letters of the electrical alphabet. Mr. Frank De Ronde, accompanied by his charming wife, was enterprising as ever, and was ably seconded by Mr. J. C. Shainwald, who came from Chicago for the purpose.

The Wallace Electric Company of Chicago was unusually well represented by Mr. W. S. Hine and Mr. J. B. Wallace. Both of these gentlemen are built of the proper stuff to make a success of the electrical business, and they seem to have their share of it up to the present time.

"Gates of Chicago" was at the Convention, though but for a short time. There were many looking for "Gatsee" but he was too busy to stay more than a day. Mr. Gates is one of the busiest men in harness nowadays, and no one is more deserving of success than he.

The famous Worthington Pumps were represented by Mr. L. R. Alberger, who distributed some very neat literature descriptive of their electric pump for house, tank and similar service. In addition to this he had on display models of this pump that won many new friends.

From Dayton came Mr. A. A. Thresher, representing the Shawhan-Thresher Electric Company, which now manufactures a superior line of dynamos and motors. Although one of the younger men in the business, Mr. Thresher thoroughly understands his work, and is destined for a bright career.

Nothing better could be devised in the way of an attractive exhibit than that made by the Belknap Motor company. The ingenious arrangement of the kaleidoscope brought out the name of this company together with that of its "woven wire brush" in such a way that no one could miss it.

The Stirling Boiler, than which there is none better known to the electrical business, had Messrs. H. S. Peel, E. J. Weahely, F. E. Bruce, and the king of hustlers, Stettinius, in constant attendance, and their united efforts kept the name of their boiler in its usual position.

E. B. Kittle was an able and eloquent exponent of the claims of the Pettingell-Andrews Company, of Boston, well known to central station and street railway men throughout the country. Mr. Kittle was busy at all times in the interest of his house and made many new friends for it.

"Start Right" is the advice which the Cutler-Hammer Manufacturing Company is now giving the users of electric motors. This pithy remark was seen in large letters above their handsome display of rheostats, in charge of Mr. H. H. Cutler, who was one of the hardest workers of the convention.

"Push it Along" is what the agents of the Phœnix Insulating Paint advised every one. The presumption is that it is "a good thing." Mr. E. P. Morris, the always popular partner of Morris & MacCurdy, of Indianapolis, had the exhibit in charge. As usual, Morris made a great convention hustler.

"Fixtures and Supplies" were two words graphically illustrated by the handsome display board of the Chicago General Fixture Company. This company has recently taken up electrical supplies with much earnestness. Mr. Overbaugh reports that they are meeting with unusual success.

The Electric Selector and Signal Company had a graphic exhibit in the basement, in charge of the always popular P. H. Alexander, whom everybody was glad to see again. He had much to say in favor of the system he was championing, and what he did say was well received. General Manager C. P. Mackie was also present.

Louis Nahm, of the American Electric Mfg. Company, of St. Louis, manufacturers of the well-known American incandescent lamp, arrived early. What he had to say about incandescent lamps was impressive and timely, and he made many new friends. He was assisted by Messrs. W. J. MacConnell, J. F. Gerleman and P. C. Ackerman.

Telephone enterprises were much talked of, in which connection the new Strowger Automatic Switch received unusual attention. It is proposed by the company handling this to install it free of charge, charging a small rental. This will insure an immediate introduction for the device in scores of places.

Kerite wire had no less a representative than S. F. B. Morse, its enterprising Chicago agent. The Kerite men have always been popular at conventions, and everybody regretted the absence of Messrs. Brixey and Ham, who found it impossible to attend. Brother Morse, however, was active enough for six.

The Anchor Electric Company, of Boston, was fortunate in securing a very desirable location near the entrance to the basement. At his little stand Mr. N. Marshall kept distributing his literature and telling everybody all about the Anchor Electric. He may rest assured that its name is now well anchored in the electrical conscience.

M. Benedix, in his charming manner, told everybody about the famous Boudreaux dynamo brush, which he displayed with the confidence that is born of knowledge. This new brush is meeting with great success wherever it has been introduced, and is worthy of a trial by everybody who looks for something better than present practice.

The Colvin Telephone was fortunate in having its inventor, Mr. Frank R. Colvin, to look after its interest. Mr. Colvin, as every one knows, has been for many years a regular convention attendant in the capacity of newspaper man, and his numerous friends are now glad to push him along with his new Colvin telephone.

E. A. Waymire, of the Dayton Fan & Motor Company, was busy at all times telling people the good points of his celebrated fan. Specimens of these were on exhibition in the office of the W. D. Graves Electric Mfg. Company, Cleveland. Mr. Waymire should attend all future conventions, as there were many kind things said of him.

President Reid Carpenter, of the Card Electric Company, ran up from Mansfield to be ready for anything that came his way, and judging by the expression of his countenance, it is easy to understand that his trip was a complete success. He reports that they are away behind on orders for his motor, which is certain to create a big impression in the next year.

The switch display of the Perkins Electric Switch Manufacturing Company kept everybody talking. A physical illustration of the now popular phrase "push it along" was given by the wheelbarrow outfit designed by Mr. J. J. Gates, of this company. He was assisted by Chicago Agent Geo. Conover. The exhibit was very interesting and attracted a great deal of attention.

As a display, the exhibit of the Buckeye lamp will go down into history unrivalled. In one of the parlors on the second floor, as everybody will remember, were two pyramids of lamps, one of which contained nearly six thousand "Buckeyes," while in another corner was the other, with nearly two thousand of various colors. The effect was one of remarkable beauty.

The Union Brass Manufacturing Company, of Chicago, sent its Mr. W. S. Bartholomew from Chicago to supplement the work of its very effective little pamphlet describing arc lamps. Mr. Bartholomew found that his firm was no stranger to the central station men gathered there, and reported that he had secured a number of large orders. His alternating lamp is meeting with unusual success.

Paranite wire, which has lately jumped into the greatest popularity, had a specially good representative in Mr. C. J. Butler of the home office. The electric appliance men, Messrs. Low and Wells, very naturally had much to say in favor of this wire, they being the principal selling agents, but Mr. Butler also did very effective work and must have heard many compliments.

Sunbeam lamps, once more in the ranks of the living, were represented by no less a personage than Mr. F. S. Terry. Now that the patent litigation is practically at an end, Sunbeam lamps will again assume their old-time popularity, with every assurance of a world-wide application, for the reason that Mr. Terry insists that only a high-grade lamp can win an ultimate success.

The Electric Appliance Company, of Chicago, more notable at this convention than any previous one, had two good men in "Billy" Low of the home office and Agent Charles J. Wells. The Appliance Company's exhibit was embraced in that of the Warren Electric Company and the New York & Ohio Company. Mr. Low heard many things of a complimentary character for his enterprising house.

The Fort Wayne Electric Corporation was one of the great leaders. Its name was on every tongue, while its representatives were among the most notable in the gathering. The list included Vice-President C. S. Knight, and agents S. A. Douglass, New York; G. A. Wilber, Philadelphia; T. J. Ryan, Cincinnati; Tom Cooper, Columbus, and E. E. Wilson, of Chicago, making a great sextette.

The Chicago Cross Arm Company was very ably represented by President H. M. Angle and Vice-President C. S. Marshall. Its test card was one of the cleverest bits of literature for which the convention was responsible. This firm is in the market for two or three leading specialties, which it will handle in connection with its present work, and can be corresponded with at its office, Monadnock Block, Chicago.

The Interior Conduit & Insulation Company had one of the best displays seen in the basement. Their iron-armored interior conduit was much admired because of its allowing the use of two wires in one tube. Several slow-speed multipolars of the Lundell type were also exhibited and carefully examined. Mr. E. W. Little and Mr. R. Mace looked after the interests of the firm with the zeal for which both are noted.

M. M. Wood, whose specialties are known wherever electricity has been introduced, and who is now handling these popular devices himself, with headquarters at Monadnock Block, Chicago, found that he had more friends than he could look after at the convention. Wood is one of the most popular fellows, and this may account for the popularity of his devices, though it has been truthfully said that nothing could be better.

The Cotton States International Exposition had a splendid propaganda in one of the parlors. A great line of literature, together with graphic illustrations, told the story of what promises to be one of the greatest exposition successes of history, while Messrs. J. H. Allen and H. T. Edgar lost no opportunity to present its claims. This exposition, it will be remembered, will be held in Atlanta, Ga., this year, and will no doubt interest all enterprising manufacturers.

The Multifuse Switch, designed to insure continuous service on a circuit in case of a fuse giving out, was one of the novelties on exhibition. As the name implies, several fuses are arranged so that in case one should burn out, by turning the switch a point another fuse will be thrown, in order that the damaged one can be repaired at leisure. This is manufactured by the Multifuse Switch Company, 1031 Society for Savings Building, Cleveland.

In the lobby of Army and Navy Hall was displayed to good advantage an exhibit of the Tucker Electrical Construction Company, which embraced five exchange and two house station equipments of the Auto-Telephone system, that has already been described in these columns. Mr. Thomas McCoubray, a pioneer convention figure, and at one time secretary of the National Electric Light Association, had the display in charge.

The Sweet Limit Switch, about which every one has been reading for the last few months, was seen for the first time at any convention. Electrician Barnes had the display in charge and told everybody all about it. This switch, Mr. Barnes reports, is being widely introduced among electric stations to protect their apparatus from overloads, short circuits, etc. Nearly 5,000 have been manufactured since June, and the factory is away behind on its orders at the present time.

The Central Electric Company, of Chicago, always found to be the first to adopt new ideas in advertising, rather outdid all the other exhibitors in having a stereopticon at work in the basement. Helios Arc Lamps, of which the Central Company are Western agents, were used for the purpose, and Mr. C. G. Burton had it in charge, backed up by Messrs. Frank S. Marr and Thos. Spencer, from the home office. Mr. George A. McKinlock, with that confident smile that tells of the triumph he has achieved with his company, created a host of friends.

The Diamond Electric Company, of Peoria, Ill., displayed their Schaffer wattmeter to excellent advantage, and Chicago Agent A. M. Searles did much to extend the fame of this device. Curiously enough, there was a delegate to the convention from Paris, who was anxious to see this same meter, and not having an opportunity to visit Peoria while in this country, the convention display afforded him the opportunity he needed, and will no doubt result to the great good of the Diamond Company.

The lamp exhibit of the New York & Ohio Company embraced samples of lamps from one candle power to five hundred, the one candle power lamp being connected in circuit, and interested everybody by its contrast with the great mogul lamp made by this company. Mr. W. D. Packard looked after the display, and was materially helped by Messrs. Low & Wells, of the Electric Appliance Company of Chicago, who are general

Western agents of both the New York & Ohio Company and the Packard Electric Company.

The National Carbon Company's new factory at Cleveland is a most forcible illustration of the growth and importance of electrical industries. A party of delegates was very courteously shown over the works by Messrs. Lawrence, Miles and Hayes, and the display of facilities was amazing. The manufacture of carbons has been reduced by the National Company to a series of almost entirely automatic operations, so that a comparatively small amount of manual labor is required for the production of an enormous quantity of goods. To those who had the good fortune to inspect the works it seemed that the equipment shown were surely adequate to take care of the entire consumption of the United States without inconvenience.

The Walker Manufacturing Company's headquarters were also in room 101, where photographs of some of their notable apparatus were to be seen at all times. The company were thoughtful in supplying carriages for the conveyance of those who had an interest in their shops to visit them. Many took advantage of the opportunity and made a careful inspection of what has been declared to be the finest machine shop in America. The Walker Company have recently placed on the market a full line of lighting generators in addition to their street railway apparatus, that has already obtained wonderful popularity. Prof. Short and Prof W. H. Bone are worthy of special mention for their efforts in keeping the name of their firm before every one.

The Westinghouse Company's exhibit, near the main entrance, while not making any claim in the direction of pretentious or voluminous display, possessed one feature alone which was of vital importance to central station men, namely, non-arcing lightning arresters. Two of these were shown, one adapted for alternating and the other for direct currents. Several thousand disruptive discharges had already been passed through each of these arresters prior to the date of exhibition, and a continuous stream of discharges was kept going through them during the convention. The arrester for alternating currents consists of seven little posts or cylinders of non-arcing metal arranged parallel with each other, about $\frac{1}{64}$ inch apart, on a marble base. The line taps are connected with the outside cylinders and the central one is grounded. Repeated tests with this form of arrester have demonstrated the utter impossibility of maintaining an alternating current arc across from terminal to ground or between terminals.

The Wagner Electric Manufacturing Company, of St. Louis, presented several striking novelties, one of which was a knife-blade switch with carbon-breaking contacts. The carbon break is obtained by mounting just back of each contact jaw, and in electrical connection therewith, a metallic socket containing a carbon pencil normally pushed out by a spring until its end projects beyond the highest edge of the contact jaw. When the switch is closed the blades press the carbon pencils down in their sockets, and upon opening the switch the carbon pencils follow the blades until after the latter have broken connection with the contact jaws, so that the final breaks are between the knife blades and their respective carbon pencils. The device is very efficacious and the attendant advantages are obvious. Another ingenious specialty was the Wagner fuse arrangement for transformers, which is a combination fuse box and line-wire support. Then there was an ornamental economy coil for use with alternating current arc lamps, which is designed to be fastened upon the ceiling directly over the lamp, which is suspended from a hook on the under side of the coil case. This disposition reduces to a minimum the amount of ceiling space taken up by each lamp, and renders exceedingly convenient any adjustments that may be desirable. There were numerous other attractive devices shown, and taken altogether the Wagner Company's display embodied a larger percentage of novelty and ingenuity than almost any other.

The General Electric Company's exhibit was one of the most complete and comprehensive made at the convention. It occupied the entire second floor of the station of the Cleveland Illuminating Company, located in the handsome new building on Canal street, and besides a display of supplies was principally devoted to a working exemplification of the operation of the monocyclic system. Arranged in a line down the centre of the room was a complete monocyclic plant, consisting of a 60-kw 60-cycle monocyclic generator running at 900 revolutions and furnishing current to induction motors, incandescent lamps and arc lamps. The generator was driven by belt from a 50-kw 230-volt four-pole slow speed, direct current motor of the type which the General Electric Company has recently developed, and in which it has embodied many important improvements. This motor was driven by direct current taken from the circuits of the Cleveland Illuminating Company. Current for the monocyclic generator at 1,040 volts was taken through two 7,500 watt transformers to a 15-kw induction motor, also running at 900 revolutions, and this in turn was belted to an Edison bipolar 12-kw generator supplying direct current to a number of incandescent and arc lamps, the latter of the already well-known Thomson '93 type. The current from the monocyclic generator was led through a 1,000-watt and a 15,000-watt transformer to a number of incandescent lamps and Thomson '93 alternating arc lamps, and these burned brightly and without flicker. In addition a 5-hp induction motor was also driven by current from the monocyclic generator—the current in each case being measured by Thomson recording wattmeter. The system was thus shown to the delegates in detail and proved to their satisfaction the claims made for it that it solved the problem of operating lights and motors of a perfect type from a single alternating generator. A small 2-hp direct current motor of a new and peculiarly compact design was also shown in operation, and its small size and efficiency attracted considerable attention. Two handsome alternating focussing arc lamps and two direct currents focussing arc lamps were also to be seen lending their light to increase the brilliancy of the surroundings of the exhibit. The alternating current used was taken from the primaries of the Cleveland Illuminating Company. The exhibit of light-

Exhibit of the Monocyclic System.

Exhibit of the Monocyclic System.

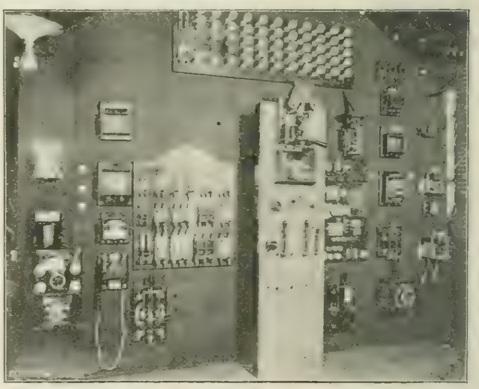


Exhibit of the Monocyclic System.

ing supplies occupied the end of the room back of the plant. It comprised a fine display of the porcelain specialties—switches, cut-outs, etc.—manufactured by the General Electric Company at its own works; a complete line of punched clip station switches, primary, alternating, railway, power, and direct current, two-wire and three-wire recording wattmeters, several of which were in operation, an arc wattmeter and a Thomson portable ammeter. In addition a supply of the new, General Electric key sockets with porcelain bases was shown, and one was bestowed as a souvenir on each of the visiting delegates. The exhibit was rounded off by a handsome specimen of railway switchboard work, the controlling instruments being mounted on a fine panel of Tennessee marble, and by a 12-inch search light projector. Visitors were taken to the exhibit in conveyances furnished by the company, and had an opportunity of inspecting at the same time one of the latest direct connected central stations—that just erected by the Cleveland Illuminating Company. At the headquarters in the banquet room of the Hollenden the company had a complete supply of the catalogues and pamphlets, for the visiting members to take home with them and study at their leisure, and an elaborate display of decorative miniature and candelabra lamps. On the second day of the session an informal reception was held in the banquet room, and was, for the time being, the centre of attraction, from which the ladies departed loaded with flowers and the gentlemen with good cigars and other things. On Thursday morning the ladies availed themselves of the company's invitation to visit the station of the Cleveland Illuminating Company and view the exhibit. Altogether, by the united efforts of the Cleveland Illuminating Company and the General Electric Company, the visitors were provided with an especially instructive exhibit such as has never before been made at any previous meeting of the National Electric Light Association by any manufacturing company. The representatives of the General Electric Company were Prof. Elihu Thomson and Messrs. S. D. Greene, E. W. Rice, Jr., Charles P. Steinmetz, Dr. Louis Bell, J. R. Lovejoy, B. E. Sunny, W. L. R. Emmet, A. D. Page, Wilson S. Howell, C. D. Haskins, H. C. Wirt, under whose special care the exhibit was installed; W. F. Hays, T. Beran, F. M. Kimball, C. E. Harthan, C. F. Rosenthal, L. D. Tandy, Edgar Mix, and others.

THE NOTABLES.

Geo. Cutter, the Chicago man.

Thomas J. Brady, of Brady Mast Arms fame.

G. J. Bernard, struggling with a celebrated name.

The Goodrich man from Akron, Mr. Chas. B. Raymond.

J. H. Parker, who told all about C. S. Knowles, of Boston.

C. J. Butler, the well-known Paranite man, from Marion, Ind.

Lieut. E. J. Spencer, Western representative for Safety cables.

Capt. W. L. Candee and Geo. T. Manson, the great Okonite team.

J. H. McGhie kept things boiling for the General Electric Company.

Fostoria Carbons were sung about by the Messrs. Crouse and Tremaine.

Columbia Lamps were thoughtfully looked after by New York Agent C. I. Hills.

James J. Godfrey, now working for Habirshaw wire with his usual push and zeal.

J. E. Way, of R. Thomas & Son, East Liverpool, O., one of the busiest men in town.

L. Stieringer, the famous old stager, and still one of the most active fellows in New York.

J. Holt Gates, known to fame as "Gates of Chicago," was one of the prominent figures.

The Imperial Arc Lamp was one of the debutantes of the meeting, and was well liked.

R. J. Randolph, Western manager for the Excelsior Electric Company and a great worker.

E. H. Heinrichs, the Westinghouse press agent, and one of the best story tellers in the world.

James I. Ayer, otherwise and popularly known as "Jim," working hard for the Marks-Ayer Co.

Parkin & Bosworth handled well the interests of the great Shultz Belting Company, of St. Louis.

Henry Hine, responsible for the success of the Stanley Electric Company, of Pittsfield, Mass.

S. A. Douglass, one of the best convention workers in the business, and a prince of good fellows.

T. C. Harnish, wanting every one to understand that Siemens-Halske apparatus was strictly in the push.

M. E Baird, the Eddy man, who smiles on every one and never lets the blues have anything to do with him.

H. T. Paiste, of Paiste switch fame, who carried his exhibit in his pocket, and whom every one seemed to like.

F. E. Donohue, from Chicago, and doing much for the American Electric Works, of which he is Western agent.

W. H. McKinlock, of the Metropolitan Electric Company, Chicago, one of the notable figures in Western business circles.

New switches from the shop of the W. S. Hill Electric Company were displayed and talked about by Mr. Charles H. Herrick.

McIntire Joints were handled by Mr. C. H. McIntire, one of the wise men of the times who take their good wives along to see the fun.

A. A. Thresher, of the Shawhan-Thresher Electric Company, Dayton, one of the new men whose name is going up the scale very rapidly.

Conduits of a new and improved type were handled by the Eppinger & Russell Company, of New York. Mr. Geo. Valentine did the honors.

C. H. Wilmerding, the newly-elected president, jumped into immediate popularity. His presidency promises to be pleasant and beneficial for every one.

"Roll Drop" were two words that attracted every eye to the display of the Forest City Electric Works, where fine samples of their commutators were displayed.

R. B. Corey, popular as ever, came late, but found that he was not in any sense forgotten. He can count perhaps more friends than any other one man in the business.

Morris, Tasker & Company, sent Mr. S. Bowman Wheeler, full of brotherly love for every one, but especially for those in need of electric light and street railway poles.

They were both there, Belden & Seely. If there was any construction work in sight before the New York delegation arrived, or throughout the meeting, this firm took it in.

H. B. Cram came from Boston to tell us about the Bernstein Company. This wasn't exactly necessary, as every one knows of it; but it was a pleasure to have Mr. C. in the crowd.

Standard Underground Cables, always found in the front rank at conventions, had no less than four of their best men—Messrs. J. W. Marsh, G. L. Wiley, J. R. Wiley and H. W. Fisher.

The Climax Boiler made by the Clonbrock Steam Boiler Works could have had no better exhibit than their plant in the station of the Cleveland Illuminating Company. Inventor T. F. Morrin had also a good deal to say on the subject of boilers.

F. S. Terry, known to every one in the industry, was busy greeting old friends. Mr. Terry is now arranging to handle a few specialties as selling agent. This will afford manufacturers an exceptional opportunity. His address is 100 Washington street, Chicago.

Col. W. S. Rogers, one of the finest fellows in the business, who distinguished himself by his clever handling of the Brush interests. The Colonel recently closed a $140,000 order in an Eastern city for Sperry apparatus, and is looked upon as one of the cleverest men in the field.

The following is a list of the representatives of central stations whose names were registered with Secretary Porter:

E. A. Armstrong, Atlantic Electric Light & Power Co , Atlantic City, N. J.
Wm. H. Atkins, Edison Elec. Ill. Co., Boston, Mass.
W. J. Barns, West Side R. R. Co., Pittsburg, Pa.
John I. Beggs, The Cincinnati Edison Elec. Co., Cincinnati, O,
W. Worth Bean, St. Jos. & Benton Harbor El. Ry. & Lt Co., St. Joseph, Mich.
J. J. Burleigh, Camden Ltg. & Htg. Co., Camden, N. J.
F. E. Bearn, Barberton Elec. Co., Barberton, O.
G. H. Blaxter, Allegheny County Lt. Co., Pittsburgh, Pa.
G. H. Blaxter, Brush Elec. Co. of Baltimore, Baltimore, Md.
M. A. Beal, Forest City Elec. Lt. & P. Co, Rockford, Ill.
Jas. L. Belote, Elec. Co. of Virginia, Norfolk, Va.

H. L. Brintnall, The Swift Elect. Lt. Co., Saginaw, Mich.
Wm. M. Broeck, Edison Elec. Ill. Co., Paterson, N. J.
H. B. Brooks, Piqua Elec. Co., Piqua, O.
Jas. B. [illegible], Muncie Ill., Lt. & P. Co., Muncie, Ind.
W. L. Candee, Suburban Elec. Co., Elizabeth, N. J.
S. T. Carnes, Memphis Lt. & P. Co., Memphis, Tenn.
W. H. Coughlin, Worcester Elec. Lt. Co., Worcester, Mass.
J. A. Colby, Des Moines Edison Lt. Co., Des Moines, Ia.
J. T. Cowling, Powelton Elec. Co., Philadelphia, Pa.
S. G. Coleman, Badger Elec. Ill. Co., Milwaukee, Wis.
J. Caven, Indianapolis Lt. & P. Co., Indianapolis, Ind.
A. J. Corriveau, Montreal Park & Island Ry. Co., Montreal, Can.
D. L. Davis, Salem Elec. Lt. & P. Co., Salem, O.
E. H. Davis, Lycoming Elec. Co., Williamsport, Pa.
James R. Dee, The Peninsula Elec. Lt. Co., Houghton, Mich.
H. T. Edgar, Georgia Elec. Lt. Co., Atlanta, Ga.
C. L. Edgar, Edison Elec. Ill. Co., Boston, Mass.
A. W. Field, Columbus Edison Lt. & P. Co., Columbus, O.
H. H. Fairbanks, Worcester Elec. Lt. Co., Worcester, Mass.
T. F. Flanagan, Portsmouth Gas & Lt. Co., Portsmouth, N. H.
M. J. Francisco, Rutland Elec. Lt. Co., Rutland, Vt.
I. H. Francisco, Rutland Elec. Lt. Co., Rutland, Vt.
Samuel A. Freshney, Muskegon Elec. Lt. & P. Co., Muskegon, Mich.
J. B. Foote, Battle Creek Elec. Lt. & P. Co., Battle Creek, Mich.
W. A. Foote, Jackson Elec. Lt. Co., Jackson, Mich.
D. T. Flick, New Castle Elec. Co., New Castle, Pa.
Wm. H. Fitzgerald, Detroit Elec. Lt. & P. Co., Detroit, Mich.
J. Gwynn, Steubenville Gas & Elec. Co., Steubenville, O.
W. R. Gardener, Pittsfield Elec. Co., Pittsfield, Mass.
C. C. Gartland, Buffalo General Elec. Co., Buffalo, N. Y.
F. F. Gardner, Newark Elec. Lt. & P. Co., Newark, N. Y.
W. J. Greene, Cedar Rapids Elec. Lt. & P. Co., Cedar Rapids, Ia.
J. L. Gans, Connellsville, N. Haven & Leisenring St. Ry., Connellsville, Pa.
L. W. Greene, Brooklyn Elec. Lt. Co., Brooklyn, Mich.
B. P. Holmes, Youngstown Elec. Lt. Co., Youngstown, O.
J. C. Hadley, Pana El. Lt., P. & St. Ry. Co., Pana, Ill.
Welles E. Holmes, Newton & Watertown Gas Lt. Co., Boston, Mass.
C. R. Huntley, Buffalo General Elec. Co., Buffalo, N. Y.
W. C. Hedges, Mansfield Elec. Lt. & P. Co., Mansfield, O.
P. A. Hinds, Peninsula Elec. Lt. Co., Detroit, Mich.
J. L. Hinds, Syracuse Elec. Lt. & P. Co., Syracuse, N. Y.
John J. Jennings, Wilkinsburg Elec. Co., Wilkinsburg, Pa.
A. H. Jones, Suburban Elec. Co., Philadelphia, Pa.
A. J. Jones, Edison Elec. Ill. Co., New Brunswick, N. J.
S. C. D. Johns, Cleveland Elec. Ill. Co., Cleveland, O.
J. H. Kammerer, The Royal Elec. Co., Montreal, Canada.
Jos. E. Lockwood, Michigan Elec. Co., Detroit, Mich.
Chas. A. Learned, Hudson County Elec. Co., Jersey City, N. J.
Robert Lindsay, Cleveland Elec. Ill. Co., Cleveland, O.
Stuart Lindsley, Essex County Elec. Co., Orange, N. J.
Homer Laughlin, Wellsville Elec. Lt. Co., Wellsville, O.
H. M. Lyman, Canton Elec. Lt. & P. Co., Canton, O.
W. M. Lynch, Canton Elec. Lt. & P. Co., Canton, O.
C. A. Latham, Loraine Co. Lt. & P. Co., Elyria, O.
A. H. Manwaring, Brush Elec. Lt. Co., Philadelphia, Pa.
E. H. McKnight, Elec. Lt. Co., Middletown, O.
George M. Myers, Southwestern Elec. Lt. & Water Power Co., Joplin, Mo.
M. Murphy, Second Avenue Ry. Co., Pittsburgh, Pa.
W. B. McDonald, Calumet Gas Co., Chicago, Ill.
J. H. Miller, Springfield Elec. Lt. & P. Co., Springfield, O.
Frederic Nicholls, Toronto Incandescent Lt. Co., Toronto, Canada.
E. N. Nunn, San Miguel Constr. & Gold Mining Co., Telluride, Col.
J. F. Outwater, Edison Elec. Illg. Co., Brooklyn, N. Y.
Thomas O'Dea, Edison Elec. Lt. & P. Co., Erie, Pa.
Jerome Penn, Washington Gas & Elec. Co., Washington, O.
A. Pabst, Mahoning Elec. Lt. Co., Youngstown, O.
A. J. Purinton, Stamford Gas & Elec. Co., Stamford, Conn.
E. P. Peck, Citizens' Elec. Ill. Co., Brooklyn, N. Y.
James A. Pentz, United States Elec. Ltg. Co., Philadelphia, Pa.
Charles R. Price, New Bedford Gas & Edison Lt. Co.
J. E. Pyle, Edison Elec. Ill. Co., Westchester, Pa.
J. C. Perry, Indianapolis Lt. & P. Co., Indianapolis, Ind.
James G. Rossman, Georgia Elec. Lt. Co., Atlanta, Ga.
J. E. Rhetts, Salem Elec. Lt. & Artificial Ice Co., Salem, Ind.
J. Ritchie, Manufacturers' Elec. Co., Philadelphia, Pa.
George A. Redman, Brush Electric Lt. Co., Rochester, N. Y.
F. R. Swaney, Ceramic City Lt. Co., East Liverpool, O.
J. Brodie Smith, Manchester Elec. Lt. Co., Manchester, N. H.
George R. Stetson, New Bedford Gas & Edison Lt. Co.
John A. Seely, Rockaway Elec. Lt. Co., Rockaway, N. Y.
T. Carpenter Smith, Keystone Lt. & P. Co., Philadelphia, Pa.
H. J. Smith, Edison Elec. Ill. Co., New York, N. Y.
Emil G. Schmidt, Sandusky Elec. Lt. Co., Sandusky, O.
J. C. Thullen, Leetonia Elec. Lt. & P. Co., Leetonia, O.
L. H. Thullen, Leetonia Elec. Lt. & P. Co., Leetonia, O.
J. M. Uptegraff, Sewickley Elec. Co., Sewickley, Pa.
C. R. Van Trump, Wilmington City Elec. Co., Wilmington, Del.
E. E. Wade, El Paso Elec. Co., Colorado Springs, Col.
C. H. Wilmerding, Chicago Edison Co., Chicago, Ill.
F. H. Welscher, Citizens' Elec. Co., Battle Creek, Mich.
C. P. White, Evansville Gas & Elec. Co., Evansville, Ind.
E. L. Wilkinson, The Kensington Elec. Co., Philadelphia, Pa.
H. A. Wagner, Edison Elec. Ill. Co., St. Louis, Mo.
E. P. Young, Sewickley Elec. Co., Sewickley, Pa.
Richard Young, Faraday Ht., Lt. & P. Co., Morton, Pa.
Harry P. Young, Faraday Ht., Lt. & P. Co., Morton, Pa.

Fuel Consumption in Central Stations.

The Committee on Data of the National Electric Light Association submitted at the Cleveland Convention a tabulated report of the data relating to fuel consumption, which we print below. While the recorded data is from fewer stations than in other

No. of Report	EQUIPMENT.							PRODUCTION.													FUEL.		
	Engines.		Boilers.		Dynamos		Arc Circuit.				Incandescent.				Power.								
	Class.	W't'r Consump-tion per H. P.	Class.	Evaporation Per Pound of Combustible.		Efficiency.	Average Amperes	Average Voltage.	Hours Run.	Total Watts.	Average Amperes.	Average Voltage.	Hours Run.	Total Watts.	Average Amperes.	Average Voltage	Hours Run.	Total Watts.	Readings Every Min.	Total Watts From All Circuits.	Whole Amount of Coal Used in One Day.	Watts Produced per Lb. of Coal	Kind and Grade of Fuel.
22	A	17	A	9 37	Multipolar.	85	....	.	...	....	7670	124 9	24	22,967,952	....	....	....	....	30	22,967,952	87 358	262	⅓ Soft Coal, ½ Hard Screenings.
1	B & F	.	C & D	....	Con. & Bipol	..	10	8145	24	1,954,800	224	1140	24	6,128,640	50	500	13	325,000	60	8,408,440	46,700	180	Hocking Screenings.
9	B	..	C	....	Multi. Alt., &c.	.	10	2387	13	5,896,081	....	....	24	2 434,560	....	500	....	2,322,750	..	10 653 331	59,884	177	Run of Mines, Alabama.
15	F		C	....	Arc Alt.	..	6 8	47	4	1,278	66.4	1010	15	67,064	....	....		....	..	997,238	5,460	182	George's Creek, Cumberland.
8	E	27¼	C	.	Alt. & Con.	..	10	1000	12	120,000	37	1100	13	529,100	...	....	..	.. ..	15	649,100	3,700	175	Cumberland.
18	B X F X	32 7	C	11.3	Alt. & Con.	..	6.7	7000	8	355,144	7.05	1172	24	1,983 024	42 4 80.3 65 2	1142 325 548.2	23¼ 10 16½	1,125 765 260 170 589 743	15	4,313,846	24,750	174	Pennsylvania Soft Coal.
12	B	..	B	8 4	Arc	..	9.5	48	14	10,552 752	....	....	..	......	....	....	...	....	..	10,552,752	62,000	170	Soft Coal.
2	B E Z	15 5	A	....	Various.	..	9¼	4800	12	6,600,000	150	2200	24	7,920,000	....	250 525	24 18	908,200 400,000	10	15,878,250	50 tons	158	Slack and Nut.
16	E	.	C	.	Arc Alt.	..	by	Meter	..	246,000	....	....	..	580,000	....	....	...	948,000	..	1,774 000	....	150	Pocahontas. Soft.
13	C X	24	C	10 5	Various.	..	6 8	2275	14	7,042 426	....	....		....	....	....	....	....	..	7,042,426	50,238	140	Babylon Pea
10	B F	23 6	B	11 34	Alt. Bipolar.	..	9 8	50	12	1,817 256	137	1130	24	3,715,200	36	535	24	465,000	30	5,997,456	45 000	133	Illinois Washed Pea.
21	C X		A C	....	Alt., Bipolar.	.	6 8	....	..	1,779,051	37	....	16½	837,930	....	....	10½	190,000	30	2,806 981	21 203	132	George's Creek, Cumberland.
17	B E	..	C	...	Alt., Bipolar	.	6.8	....	7	357,000	40	1200	14	672,000	....	....	...	....	60	1,029,000	8,000	128.6	Coaldale. Bituminous.
19	F	..	C	...	Alt.	..	6.8	1100	5¾	43 010	27	1100	7½	Meter 224,400	...	...	..	....	60	267,410	2,200	121	Pocahontas, Cumberland.
3	A Y	18	C	8 8	Alt., Bipolar.	..	10	Meter	24	1 990,000	....	Meter	24	90 900	....	....	24	950 000	..	3,849 000	35,322	108	Michigan Run of Mines, Poor.
20	F	..	C	9 02	Various	..	6 8	6500	8½	367,333	100	240	16	384,000	...	....	....	....	..	845 333	8,131	104	Cumberland and Hard Screenings.
14	A	.		...	Various.	..		....		......	6000	116	24	......		....	....	....	15	16,704 000	164,000	100	Buckwheat, No. 1 and 2.
4	....	..	A	.	Various.	..	10	3472	24	833,250	339	117.5	24	3,823,600	23	1060	24	584,640	15	5,241,500	60,283	86	Illinois Lump and Nut.
7	F	.	C	7 68	Alt.	.	6.8	1150	7¼	56,840	24	1040	7¼	105 560	....	....	....	....	30	162,400	1,963	83	Second Youg'y. Nut.
6	F		C	....	Alt	..	6.8	656½	8	35,700	16 75	2000	8	268,000	5	3916	6 5	127,269	30	530,996	6 583	80	Indiana Slack.
5	G X	.	A	....	Con. & Mult.	..		....	..	....	180	116.6	24	2,016,000	....	....	....	....	..	2,016,000	25,600	78	Illinois Nut.
11	....	..		....	....	..	10	50	..	1,500,000	104 140	120 1100	24 24	3,700,000 299 000	32	550	14	509,850	..	6,008,850	86,750	69	Soft Slack.
23	B E X	.	A	....	....		..	....	..	....	160	1000	16	1,640,000	....	....	....	....	30	1,640,000	42,000	44	Indiana Block.
24	F	.	C	6 3	Various.	..	10	50 ea.	12	1,104,250	112	1120	12	1,505,280	45	223 5	18	181 035	30	2,790,565	79,800 11,900	.. 30	Bituminous Pea. Bituminous Slack.

EQUIPMENT.

Class A. Boiler room: Horizontal water-tube boilers; feed through heaters by steam or power pump; hand firing. Engine room: Triple expansion condensing engines. Dynamo on engine shaft.

Class B. Boilers vertical water-tube; economizers, feed as A. Hand firing. Engines, Corliss compound condensing, belted to jack shaft.

Class C. Boilers, horizontal tubular feed as A. Engines, simple Corliss or slow speed, condensing, belted to jack.

Class D. Boilers, upright tubular; feed as A; engines, simple Corliss, non-condensing.

Class E. Engine, high speed compound condensing, belted direct.

Class F. Engines high speed simple non-condensing, belted direct.

Class G. Engines. High speed Compound non-condensing.

Ref. X. Any of the above non-condensing.

Ref. Y. Belted to dyanmo.

Ref Z. Dynamo on the engine shaft.

reports, the committee states that the present is believed to contain more correct information and in greater detail. An instance was pointed out in the report where 262 watts are generated from one pound of coal, the plant furnishing 23,000,000 watts during twenty hours; the equipment in this station consisting of triple expansion engines with direct-connected dynamos and horizontal water tube boilers with heaters, but without economizers; the firing being done by hand. This result is secured with one-half soft coal and one-half hard screenings. This is a high average for even twenty-four hours, as an evaporation of 9.27 pounds of water per pound of combustible and a water consumption of 17 pounds per horse power hour, allowing 10 per cent. non-combustible in coal and taking the stated efficiency of the generators, 85 per cent., gives a result of 314 watts from one pound of coal under these conditions. The electrical efficiency, taking an average of the ten reports from stations running over five million watts in twenty-four hours, is 147.5 watts per pound of coal, or one electrical horse power hour for four pounds of coal. The committee complains of the difficulty it has experienced in obtaining the data and endorses the suggestion of Mr. H. T. Edgar, of the Georgia Electric Light Company, that those supplying data should permit their names to be used in order that they may be communicated with for further information by managers of stations desiring to improve the operation of their plants.

Large Arc Dynamos.

In a paper with the above title read at the Cleveland Electric Light Convention, Mr. C. N. Black spoke of the significant fact that while arc lighting was among the first practical applications of electricity, it has been the most backward branch as regards improvements in its generating machinery. This cannot be ascribed to the fact that there was nothing left to be desired in the efficiency of the arc dynamo, since it has always been notoriously weak in this respect and has by no means kept pace with the incandescent dynamo. Within the past 18 months, however, there has been an awakening to this fact, and the general tendency now seems to be to large units and lower speeds, but while the increase of size has increased the efficiency to some extent, yet we still see massive field magnets, having an enormous amount of copper, and small armatures, both of which militate against high efficiency. Another noteworthy fact is that with the one exception all new machines thus far described are of what is known as the closed coil type, which is the more remarkable when it is considered that fully 75 per cent. of the arc lights of this country are at present run from open coil dynamos.

In accounting for the reasons for the preference heretofore given to the open coil type, Mr. Black states it is a principle that the large amount of self-induction in each bobbin of these machines is an advantage, being in fact, almost essential in order to obtain the best results. On the other hand, the less self-induction in each bobbin of the closed coil type the better the action of the commutator, which is true of all closed coil machines whether for arc or incandescent lighting. Referring to the spark at the commutator on open coil machines, wonder is often expressed that this spark does not cut the segments; as a matter of fact, it does so to a certain extent, but the current is so small, and the accompanying heat is radiated so rapidly that the ill effects in practice are almost inappreciable. It is in connection with this that the self-induction of the bobbin plays an important part. Were it not for this the current in the bobbin, which is being cut out, would be reversed before the segment had reached a sufficient distance from the brush to prevent the current jumping across the heated arc, and thus causing the machine to flash.

The design and proportioning of the field magnets are the same in the closed and open coil machines, and it is in the commutator and commutation, therefore, that the most marked differences are found between the two types, and Mr. Black considers that in this lies the great superiority of the open coil machines. For example, in a new open coil 125-light machine there are only 24 segments in the commutator, while in one of the latest closed coil 100-light machines there are 160 segments; to go into details as to which is the easiest to insulate and keep in repair is hardly necessary. Referring to the disadvantages urged against the open coil machines, owing to the small amount of segments causing a discontinuity in the current, and consequently a greater strain upon the insulation of the line, Mr. Black considers that this claim has no weight. He referred to some experiments by Mordey, showing that by passing the current from a Brush machine through the secondary coil of a transformer no difference of potential was produced at the terminals of the primary. Mr. Black also described an experiment made by himself in which the currents from a closed coil dynamo having 78 bars in its commutator, giving, therefore, practically a steady current, was passed through the field coils of a 125 arc light machine and the fall of potential measured with a Weston voltmeter; the machine was then run self-exciting, and the drop through the field again taken. The currents in both cases gave identically the same readings on the voltmeter, so that if there is a discontinuity in the case of the latter machine, it is so slight that no instrument less sensitive than the telephone will show it, and consequently it is difficult to understand how the insulation of a conductor could be more strained by an open than a closed coil machine.

A vital question in connection with large units delivering current to the lines at an E. M. F. of 6,000 volts or more is in regard to the value which the E. M. F. will attain in case the current is suddenly broken. In this respect it was claimed that the open coil machine has largely the advantage. It was explained that opening the circuit is the same, in one sense, as the sudden throwing of a large resistance into the line, and when this is done the point of commutation is shifted back under the brush owing to the reaction of the armature current being reduced. Consequently, the bobbin which should not go out until the segment has passed from under the brush, short circuits the one in parallel with it and as a result the segment connected with this bobbin carries the arc around opposite the brush, thereby causing the machine to flash; this short circuits the armature and the E. M. F. drops to zero. The machine is not injured in any way by this, the flash not being due to the insulation breaking down but simply to the drawing out of the arc of the short circuited bobbin part way around the commutator, and it is ready to again supply current to the line when the break in the circuit is repaired.

Some experiments are described made with a view of learning accurately the value the E. M. F. would attain when the circuit of an open coil machine is suddenly broken, and it was found that the sparking lengths obtained agreed very well with the results of De La Rue and others from their experiments on sparking distances. The rise in voltage was only from 1,500 to 2,000 volts upon breaking the circuit, the small increase being accounted for by the fact that it takes an appreciable amount of time for the arc on the commutator to be carried from one brush to the other. Owing to each segment extending about 60 degrees around the commutator, the time required to short circuit is just one-third what it would be with a closed coil machine, and consequently Mr. Black considers it a conservative statement to say the voltage would rise in the latter to fully double its normal value under the same conditions, which would necessarily injure the machine. An experiment was described where a Brush open coil 125-light machine was connected to 12 miles of underground circuit supplying current to 125 arc lamps the voltmeter registering 6,850 at the machine terminals; these experiments showed that the capacity of the underground circuit more than counterbalanced any rise in voltage due to the machine and line, the voltage at breaking being less than normal. Mr. Black states that the above considerations led the Brush company to adhere to the open coil type in designing their large units.

Two Brush machines of 100 and 125 lights respectively were described, and it was stated that the electrical energy consumed in operating the regulator is less than one-tenth of 1 per cent. of the output of the dynamo, while the machine is absolutely automatic from one lamp to the full capacity, and the whole load may be thrown on or off with impunity. The characteristic curve of these machines was stated to be remarkable from the fact that after passing the bend the curve is almost perpendicular and probably the nearest approach to a constant current curve ever attained in practice. By winding more wire on the armature of the machine from which the curve was taken a constant current of 9.6 amperes could be obtained at all loads without shunting any current from the field;

but this would increase the internal resistance and also make the machine much less efficient at light loads.

It was pointed out in connection with the efficiency of the machine that the C^2R losses at one-quarter load had been reduced from 4,018 to 3,367 watts, or, in other words, an electrical horse power gained.

At full load the electrical efficiency reaches 94 per cent., which is accounted for by the liberal use of iron in the armature reducing its reluctance and by the large size of wire on both field and armature. A curve of commercial efficiency showed this to be at full load over 90 per cent., thus approaching very closely the efficiency of incandescent dynamos of equal capacity. The high efficiency at quarter load was alluded to, and also the new departure in arc dynamo design in working the magnetic circuit at a much less point of saturation than in the old types.

DISCUSSION.

Mr. Hamill said that during the past year the Brush Company has built large arc dynamos of from eight to ten thousand lights capacity, and that the inquiries concerning them do not come in from the new installations, but almost entirely from older stations. This he considers natural, for the reason that nearly all large electric light stations are quite centrally located in the large cities of the country, where real estate is expensive, where the business is growing, and where it is a question either of going away further from the centre of the cities, or purchasing additional real estate at great expense in order to increase the capacity, or exchange small dynamos for larger ones. The business in these large units at present, he said, is almost entirely along the line of exchanges from the small to the large units, and there is therefore very little profit in it for the manufacturer.

Prof. Elihu Thomson considered the paper of Mr. Black a very true exposition of some points connected with the operation and design of arc dynamos. The development of the arc dynamo, he believed, has been somewhat backward, but he recollected that machines were built far back in the early days, which were capable of giving a characteristic curve similar to that which has been shown, but they were disadvantageous from the very large armature reaction, the size of the armature, the amount of wire, and the dead resistance of the wire used in the construction.

As to whether open coil dynamos or closed coil dynamos are the best for arc lighting, considered purely from an electrical standpoint without reference to the practical uses, he thought there was no question but that the closed circuit dynamo is the better electrical structure, but when it comes to using that dynamo in the conditions of practice, there may be considerations which will modify this conclusion. When he first entered the business, the speaker said, his object was to get that kind of a machine which, put into the hands of men of no experience with machines of the kind, could be run successfully and keep the lights going, and therefore the object was then to reduce to the utmost simplicity those parts which were subject to wear and which could be injured by bad handling. Consequently the commutator was reduced to very few parts, and it was constructed so that if anything happened to it, it was a simple thing to take off the segments and put on others. With a commutator containing from one to two hundred segments, on the other hand, it would have meant taking off the whole commutator, and making all the connections with a new one before the machine could be started. In the early history of electric lighting, the machines were in charge of an engineer, who might know how to run his engine, but knew nothing about the dynamo, and who had a superstitious idea that it was a thing which he must not touch.

The fact that an arc dynamo, when it has its circuit interrupted, will not give the rise of voltage which the continuous dynamo gives, Prof. Thomson said, has been known for a long time. The moment the circuit of a machine begins to be opened it is the same thing as overloading, that is, putting in a high resistance, or so many additional arcs. The potential, on account of the self-induction of the wire coils, at once begins to rise with the attempt to hold a diminished current. If at that moment the commutator, owing to its arrangement and construction, flashes over—arcs across from one side to another—the E. M. F. of the armature is removed, and if the machine, as is often the case, has a copper band on the field cores, then there is an inductive circuit parallel with the field winding which takes out the inductive E. M. F. from the field coils, and it is not surprising that there should not be a great rise in a case of this kind. Long ago it was known that when the circuit of the open coil machine was ruptured the flashing did not extend any great distance, but it was also a well-known fact if in a close coil dynamo the circuit of flash is much longer. Mr. Townley confirmed the statement of Mr. Hamill as to the strong demand for large arc units, and said that in the future the development would be along the line of larger units, and would become a very prominent factor in electric lighting interest.

Mr. Prentiss considered that the question of line insulation with the use of larger units seems to be one of care more than anything else. Several instances had been brought to his notice where large machines were put on ordinary circuits, in which very little trouble was experienced, and the same was true of underground work. The only trouble which will be practically met would be in the connecting appliances from the point of the line into the place where the light would be used. The trouble principally arises from the moisture getting down onto the cut-out box, and very few cut-out boxes will stand the ordinary high potential of 3,000 volts, when there is a spell of wet weather for three or four days. When that point is taken care of there will be very little trouble. Existing lines installed for two or three thousand volts can be made to run at a high potential, as has been demonstrated in practice in several instances.

Mr. T. C. Smith, in referring to the question of the use of large units on the old lines, said that he thought some of the older members probably remember when in times of trouble they did not hesitate to put two 50-light machines together on a single circuit. The most extreme case he knew of was fifteen 10-lighters in series for an 18-ampere current, which was as much of a strain as would be experienced with any of the large machines being advocated, and an extreme case was probably reached in New York City a few years ago, during the time the wires were being put underground, when in one station two 60-light and one 30-light machines were run in a series. Mr. Prentiss cited an instance in New York City where once 240 lights were run on a single underground circuit.

The Storage of Energy Essential to the Economy of Working Stations.

In a paper with the above title read before the Cleveland National Electric Light Convention, Mr. Nelson W. Perry compares the cost of generating electrical power under present methods and by systems of storage that have been proposed with a view to reducing cost.

The total annual cost under a very regular load of an electrical horse power hour is given at $48.60 on the assumption that the power is generated for 7,884 hours annually, and that for each effective horse power machinery of 1.4 horse power is installed. A consumption of 14 pounds of water per indicated horse power hour is assumed, with an addition of 7½ per cent. for leakage, working auxiliary engines, etc., thus making the total consumption 18 pounds per effective horse power hour, which at the rate of nine pounds of steam per pound of coal, and allowing 5 per cent. for lighting and banking fires, amounts to a coal consumption of 2.1 pounds per effective horse power hour.

In the table below are given the items which make up the total annual cost of an effective horse power hour from engines working under variable load and under conditions similar to those existing in electric light stations. Here for one effective horse power of average load throughout the year, 5.87 indicated horse power hours are assumed to be necessary; a consumption of 3.8 pounds of coal per effective horse power hour and a dynamo efficiency of 95 per cent. are further assumed, which, finally, correspond to a coal allowance of four pounds per electrical horse power per hour:

COST OF INSTALLATION PER ELECTRICAL HORSE POWER.

Cost of engines, 6.17 × $44.50	$274.56	
Cost of boilers, 6.17 × $24	148.08	
Cost of buildings, 6.17 × $30	185.10	
Cost of dynamos, 4, at $30	120.00	
Total		$727.74
Interest on $727.74 at 4 per cent	$29.11	
Maintenance and depreciation of machinery, $542.64, at 7½ per cent.	40.70	
Buildings, $185.10, at 2 per cent	3.70	
Total fixed annual cost		$73.51
Cost of coal, 4 pounds for 8,760 hours, at $1.75 per ton	$30.63	
Cost of petty stores	1.64	
Cost of driving, stoking and cleaning	12.00	
		44.27
Total annual cost electric horse power		$117.78

It is pointed out that in comparison with the cost in steady working—$48.68—there is a margin of $69.10 for possible saving, and the paper then proceeds to show how much, if any, of this may be saved by different systems of storage.

An estimate is given showing that if some means could be devised by which the same amount of energy could be supplied by continuous operation of the boiler plant working at its most economical rate, the total annual cost per electrical horse power would then be $87.09, which would leave $30.69 as the limiting expense of the installation of the storage system necessary between the boiler and engine. If the storage is moved forward one step and introduced between the engine and the dynamo, it is calculated that the additional saving of $23 50 per electrical horse power would be made, and that by moving it forward still another step—between the dynamo and distribution—another gain of $14.85 would be made, no storage plant charge being deducted, however, from any of these amounts.

The different methods of storage that have been proposed are then taken up, beginning with battery storage. The following table is given to show the total annual cost to produce an electrical horse power, using an electrical storage battery, whose cost is assumed at $420.

The total fixed investment therefore becomes.	$726 80	
Interest on $726 80 at 4 per cent	29 07	
Maintenance and depreciation.		
Buildings $125 at 2 per cent	2 50	
Machinery, $181.80 at 7½ per cent	13 64	
Storage battery, 420 at 10 per cent	42 00	
Total fixed annual cost		$87 21
Coal, 2 95 pounds for 8,760 hours, at $1 75 per ton	$22.61	
Petty stores, attendance, etc	13 31	35.92
Total annual cost per electrical horse power		$123 13

The conclusion drawn from these results is that an annual horse power hour under this system, on account of the great cost of the storage battery and its maintenance, would be $5.35 more than without the use of a battery. With coal at $3.50 per ton the cost per electrical horse power would become as follows:

Steady load without storage battery	$52 31
Variable load without storage battery	148 40
Variable load with storage battery	145.74

The author states that while this estimate shows the use of the storage battery to be entirely out of the question as an economical device for complete storage, it does not condemn its use in central stations in other ways, as where the day load is exceedingly light, or for changing of the load curve from an irregular one, due to the natural load, to one made up of a series of rectangles having in the aggregate about the same area as that of the curve. In the latter case the storage battery is thrown in to take successively increases or decrements of load until such time as the successive increases or decrements become of sufficient amount to be taken care of by an extra generating unit, the battery and generating units thus supplementing each other with the variations of load. The author states that in this case the storage battery will prove economical with some load curves but not with others. There are also other considerations than economy that might render the use of the storage battery convenient, as a regulator of potential, for example, or in distribution from sub-stations, while, on the other hand, its use is limited entirely to the storage of energy when generated in the form of electricity and also to the employment of direct currents.

Gas engines are next taken up, and many data of economy trials are given showing a horse power generated on from .87 to 1.25 pounds of coal per brake horse power hour. The following estimate is given of the cost of a gas engine plant, which shows a saving over present methods of $29.50 per annual electrical horse power with coal at $1.75 per ton, and a saving of $44.79 with coal at $3.50 per ton.

Cost of engines, 6 17 at $50	$308 50	
Cost of gas plant, 1.547 at $20	30.94	
Cost of buildings	120.00	
Cost of dynamos	120.00	
Total fixed investment		$579.44
Interest on $579.44 at 4 per cent	$23.18	
Maintenance and depreciation of machinery, $459 44 at 7½ per cent.	34 06	
Buildings, $120 at 2 per cent	2.40	
Total fixed annual cost		$59.64
Cost of coal, 2 pounds, 8.760 hours, at $1.75	$15.33	
Cost of petty stores	1 64	
Cost of driving, stoking and cleaning	11.67	
		28 64
Total annual cost per electric horse power		$88.28
With coal at $3.50 the total cost		103.61

Thermal storage is then treated and three systems are described. In the steam storage system of Mr. Halpin only sufficient boilers to supply the mean demand are employed, in connection with storage tanks to supply the maximum demand. The boilers work continuously at their most economical rate and have their excess of energy during light load taken up in the water of the tank, from which it is drawn at will during heavy load. It has been proposed that in this system the boilers and tanks work under the pressure of 265 pounds per square inch and the engines under a pressure of 130 pounds, thus giving a total of available heat storage corresponding to a range of temperature of [illegible] degrees. In this system the boiler is completely filled with water and the storage tank nearly so; the two are in free communication by means of pipes and a constant circulation of water is maintained between them, but the steam for the engine is taken only from the top of the storage tank through a reducing valve.

In the feed storage system, the excess of energy during light load is stored in the tanks as before, but the boilers are not completely filled. In this system the steam is taken exclusively from the boilers, the superheated water of the storage tanks being used during heavy load as feed water to the boilers.

The third method, which is a combination of the two former; the pressure in the boiler and storage tank is equalized by connecting the steam spaces of each by a pipe, and the steam from the engines is, therefore, taken from both.

The following estimate is given of the cost of the three systems, the basis being the same as employed in the other comparisons:

WITH FEED STORAGE.

Engines	$274 56	
Boilers	113 47	
Buildings	120 00	
Dynamos	120 00	
Tanks	29 32	
	$657 35	
Allowing 10 per cent. for interest, depreciation and maintenance on the investment, exclusive of tanks, which is the same as before, and only 5 per cent on the tanks, we have $628 01 at 10 per cent	$62 80	
29.32 at 5 per cent.	1 47	
Total fixed annual cost		$64.27
Coal	$20 00	
Other expenses as before	13.31	33.31
Total annual cost per electrical horse power		$97.58

WITH STEAM STORAGE.

Engines	$274 56	
Boilers	37.13	
Tanks	236.70	
Buildings	120.00	
Dynamos	120 00	
	$788 39	
$757 69 at 10 per cent	$75 77	
$236 70 at 5 per cent.	11 83	
Total fixed annual cost		$87 60
Coal, 2.21 pounds at $1.75	$16 93	
Other expenses	13 31	30 24
Total annual cost per electrical horse power		$117.84

COMBINED FEED AND STEAM STORAGE.

Engines	$274.56	
Boilers	37.13	
Tanks	180.37	
Buildings	120.00	
Dynamos	120.00	
	$732.06	
$551 63 at 10 per cent	$55.16	
$180 37 at 5 per cent	9.02	
Total fixed annual cost		$64 18
Coal, 2.21 pounds at $1.75	$16.93	
Other expenses	13.31	30 24
Total annual cost per electrical horse power		$94 42

The conclusions of the author are that the above calculations show, with the assumed load line and coal at $1.75 per ton, an annual saving with the feed water storage of $20 20 per horse power annually; with steam storage a loss of six cents, and with combined feed and steam storage an economy of $23.36. With coal at $3.50 per ton there would be a saving of $30.82, $13.63 and $37.05 respectively.

The final conclusions of the author are that, of all the methods of storage available, the storage battery would, on theoretical grounds, be the best because of its forming the last link in the chain, thereby giving the economies of continuous working to all that precede. Unfortunately, it involves such large losses in itself as to nearly if not quite nullify the advantages it would otherwise present. And again, its extreme cost above all other methods renders it unavailable in any complete storage project.

This necessitates going back of the engine for equalization schemes and bearing the losses due to variable load upon all that follows. Fortunately, the losses that can be overcome at this early stage are quite considerable, and there are a number of methods at hand. Of these the gas engine—involving a gas storage—seems to give the best results. Very closely following this comes Halpin's combined feed and steam storage, followed by feed storage and steam storage. Below is given, in tabular form, the cost to produce for one year one electrical horse power, with coal at $1.75 per ton and at $3.50 per ton; also, the saving effected by the various methods over present methods in a station having a mean load 25 per cent. of its maximum.

	Recapitulation.		Saving Effected.	
	Coal, $1.75 per ton.	Coal, $3.50	Coal, $1.75	Coal, $3.50
Present method, steady load......	$48.68	$65.62	......	......
gas engine	88.28	103.61	$29.50	$44 79
Combined feed and steam storage	94.42	111.35	23.36	37.05
Feed storage	97.58	117.58	20.20	30.82
Without storage, load factor 25 per cent.	117.78	148.40	......	......
Steam storage.......	117 84	134.77	—00.06	+13.63
Complete battery storage	123.13	145.74	—5.35	+2.66

DISCUSSION.

Prof. Stine referred to the positive prejudice manifested in this country toward the storage battery, which he considered to be due to the hit-or-miss manner in which they have in the past been constructed and exploited, and the lack of proper knowledge in their operation, and a number of considerations were presented with reference to the latter point. Stress was laid upon the fact that an accumulator plant must be intelligently and judiciously cared for, as it requires constant inspection, testing and supervision when in action. Many points to be observed in the operation of a storage battery were detailed. Prof. Stine stated that while European experience has shown that it is possible to reach a watt efficiency of from 75 to 80 per cent., which, while good, would yet seem capable of improvement, he was of the opinion that the most we can expect from invention is to make the product more uniform and reliable, as the least variation in the quality of the materials employed often leads to disastrous failure. He referred to the practice of central station managers of requiring a life guarantee, which seems to be unfair unless the management also guarantees the competency and extent of attention to be given the plant. As militating against high efficiency, Prof. Stine mentions the nature of the complex chemical reactions in the cell, which absorb energy and cannot well be reduced in amount. There also occurs during every charge and discharge a certain amount of chemical action which cannot be reversed,resulting in the eventual consumption of the plates, whose material, accumulated at the bottom of the cell, tends to produce short circuits. The considerations which should be observed in selecting a battery for a central station or power are enumerated as follows: Plenty of lead in the elements, one maker placing this at two amperes capacity per pound; ample storage capacity for the work to be exacted, which should preferably be over-estimated. The plates should be well installed and easy of access for cleaning and have a mechanical strength to stand charging strains. They should be free from soldered joints, and from all points that may be specially weakened by local action, and the metal should be homogeneous. The active material should be so disposed as to have freest access to the acid and to be so thoroughly attached to the plates that it will not readily fall off in use. The separate plates of the elements should be so attached to the connecting bars that they may be readily removed for inspection or repairs. Good sulphuric acid should be used, free from metallic impurities, such as iron or arsenic, and, particularly, lead sulphate. If commercial acid is used it should be purified by sulphuretted hydrogen or other means, it being well to bear in mind that excellent plates may be ruined by an impure electrolyte. No reasonable expense should be spared in the installation of a storage battery plant, and if well supplied with measuring instruments and auxiliary devices, a pure electrolyte and good plates, and given intelligent care, such a plant is undoubtedly a paying investment and a source of marked economy in operating a central station.

Mr. Herbert Lloyd considered that the figures of Mr. Perry relating to electric storage batteries were entirely too high, about 50 per cent. having been added to the real cost. A battery plant, he said, can be installed to-day for $24 per horse power. Ten per cent. for maintenance on the total investment of the whole battery plant he declared to be unheard of; ten per cent. on the price of the lead plates is the highest maintenance of which he had heard, which would correspond to about six per cent. on the first cost of the installation. The following table was then given as one indicating the true cost of installation on the basis which Mr. Lloyd considered to be that which can be attained in practice.

Fixed investment, cost of batteries..................................	$288.00	
Fixed investment, cost of remainder of plant..........	223.72	
Total..	$511.72	
Interest at 4 per cent	$20.47	
Maintenance and depreciation of machinery, $155.42 at 7½ per cent.	11.66	
Maintenance and depreciation of battery, $288 at 6 per cent........	17.28	
Maintenance and depreciation of buildings, $68.30 at 2 per cent....	1.37	
Total fixed annual cost		$50.78
Cost of coal, 2.21 lbs. for 8,760 hours, at $1.75 per ton.....	$16.93	
Additional coal for loss in battery, 12½ per cent....................	2.11	
Cost of petty stores and attendance..................................	13.37	32.41
Total annual cost per electrical horse-power....................		$83.19

Mr. Lloyd gave the table below to compare the results of the various other systems with the storage battery system, the above corrections being included:

	Recapitulation.		Saving Effected.	
	Coal, $1.75 per ton.	Coal, $3.50 per ton.	Coal, $1.75 per ton.	Coal, $3.50 per ton.
Present method, steady load.. ...	$48.68	$65.62	......	......
Gas engine......................	88.28	103.61	$29.50	$44 79
Combined feed and steam storage	94.42	111.35	23.36	37.05
Feed storage....	97.58	117.58	20.20	30.82
Without storage, load factor 25%..	117.78	148.40	......	......
Steam storage.....................	117.84	134.77	00.06	13.63
Complete battery storage.........	83.19	100.11	34.59	48.29

Mr. Lloyd thought that the figures given for gas engines were far too favorable for central station work, judging from results obtained in this country. These units are necessarily small, and the speed comparatively high, making the cost of labor, maintenance and depreciation much higher than is the case with large steam plants. He considered that Mr. Perry touched very lightly on the great utility of a storage battery discharging in from one to three hours to take care of the peak at maximum load, and that he has been informed by many large station managers that a battery to give one and one-half to two hours' service, is what they most need, which would cost to install only about $50 per hp. A complete steam plant, including boilers, engines and dynamos of the most durable and improved types, will cost certainly from $60 to $75 per hp, and Mr. Lloyd consequently thinks that as it is possible to install a storage battery to discharge at a one-and-a-half to two-hour rate for about $50 per hp, electric storage is well to the front. He also stated that Mr. Perry is mistaken when he says that at a rapid discharge the battery has less than 75 per cent. efficiency, as better results are being obtained every day.

Mr. Peter Wright gave some data in regard to the operation of the storage battery plant in connection with the Germantown electric light station. It supplies current to a 220-volt three-wire system for incandescent lights and stationary motors, and has been in operation from dawn until dusk, with the exception of one day, since Feb. 4, 1894. The battery is put into charge during the evening after the load has dropped somewhat and when fully charged, which is done in from five to seven hours, is allowed to stand until the engine is stopped in the morning. The battery is then put into circuit and feeds the line until dusk when the engine is started again. The day current which the battery supplies is small, not averaging over fifty amperes or the equivalent of one hundred 16-cp incandescent lamps. Data relating to the daily performance of the battery are carefully taken and close account kept of all expenditures, from which it has been found that the net saving from the use of the battery is $1,871 a year, or a reduction of about fifty per cent. over the former cost of running the day circuit direct.

Mr. C. L. Edgar, of the Boston Illuminating Company, said that his company had been operating for the past year one of the largest storage battery plants in the world. This battery, which was procured in Germany, is guaranteed for ten years and maintained in condition by the makers at six per cent. on the cost of the cells, which is about four per cent. on the cost of the installation. The company is saving 10 per cent. on its coal bill through the employment of the storage battery, which cost about $50 per hp to install, or only one-half as much per hp as the present steam plant. The battery is only in service during one and a half hours at each discharge, taking care of the maximum load. The total investment in the station, with half batteries and half steam, is only three-fourths of what it would be with all steam.

Mr. Perry in reply stated that he thought he was safe in assuming $35 per hp hour as the cost of the battery and 10 per cent. for depreciation. Unwin puts the cost at $40 and Prof. Forbes at about the same figure. In regard to the plant described by Mr. Edgar he expressly states in his paper that his conclusions do not apply to this auxiliary use of the storage battery.

Arc Carbons and the Rating of Arc Lamps[1].

BY L. B. MARKS.

The report made at the last convention of the National Electric Light Association by a special committee, recommending that what is ordinarily known as a 2,000 candle power arc lamp shall be considered as one requiring on the average 450 watts for its maintenance, naturally suggests the inquiry as to how far the candle power produced depends upon the watts consumed, and in the present paper attention will be confined to the part played by the arc carbon in this important relation.

It is, of course, well known that the so-called 2,000 candle power arc really gives a mean candle power of only 300 to 600, the candle power at the angle of maximum illumination seldom being greater than 1,200, and often as low as 700. In an elaborate series of comparative tests made by the writer[2] several years ago there was found to be a variation of over 80 per cent. in the candle power of commercial arc light carbons consuming the same energy. Quite recently, Prof. W. M. Stine[3] has reported on a number of tests, the results of which show a variation of about 30 per cent.

The difference in the quality of arc carbons was well brought out in a table of some ests made by the author, in which values were determined for the hissing point and the flaming point of various American and foreign products.

Number.	Structure.	Diameter (inches).	Basic Material.	Process of Manufacture.	Hissing Point (Volts).	Flaming Point (Volts).	Range (Volts).
1	Solid	½	Petroleum Coke	Molded	43.6	71 3	27.7
2	Solid	½	Petroleum Coke	Molded	48.2	79.0	30.8
3	Solid	7/16	Petroleum Coke	Molded	45.7	79.7	34.0
4	Solid	15/32	Petroleum Coke	Squirted	51.3	62.7	11.4
5	Solid	½	Petroleum Coke	Squirted	47.3	75.0	27.7
6	Solid	½	Lamp Black	Squirted	47.2	70.8	23.6
7	Solid	7/16	Lamp Black	Molded	43 0	67.3	24.3
8	Solid	7/16	Lamp Black	Squirted	43.7	76.8	33.1
9	Solid	7/16	Gas Black	Squirted	46.	70 7	24.7
10	Solid	7/16	Gas Black	Molded	41.3	74.3	33.0
11	Solid	7/16	Not Ascertained	Squirted	41.7	75.3	33.6
12	Solid	7/16	Pure Coke	Molded	53.7	73.7	20.0
13	Solid	7/16	Pure Coke	Molded	52 0	71.5	19.5
14	(+), 1/16 hole (—), solid	½	Petroleum Coke	Squirted	42.8	60.7	17.9
15	(+), cored (—), solid	(+), 9/16 (—), ½	Petroleum Coke	Squirted	35 0	61 7	26.7
16	(+), cored (—), solid	½	Petroleum Coke	Squirted	31.3	58.7	27.4
17	(+), cored (—), solid	(+), ½ (—), 7/16	Not Ascertained	Squirted	31.3	70.7	39 4
18	(+), cored (—), solid	7/16	Not Ascertained	Squirted	32.3	66.3	34.0
19	(+), cored (—), solid	(+), ½ (—), 7/16	Not Ascertained	Squirted	31.7	71.3	39.6

In order to determine these values a pair of carbons was placed in a lamp, and burned for 20 to 30 minutes. After the point had been well formed, the carbons were gently brought together until the arc hissed. A voltmeter connected to the terminals gave the potential difference. The lamp was then adjusted for a silent arc and the mechanism so arranged that the rod was held rigidly. The carbons were then allowed to burn away until they flamed, the voltmeter being carefully watched meanwhile. Before the flaming point was reached, the instrument would invariably fluctuate, due to "jumping" of the arc. At the flaming point, there was a marked drop in the potential, as indicated by a voltmeter. Great care was taken to secure perfect alignment of the upper and lower carbons.

An average of three different tests was made of each pair of carbons. The carbons were all intended for a current of from eight to ten amperes, nine and one-half amperes being used in the tests. The total length of a pair of carbons was ten inches in each case.

It was found that the *range*, that is, the difference in volts between the hissing point and the flaming point, varied greatly with different carbons; thus, while one carbon had a range of only 11.4 volts, with another it attained 34 volts. Both of these carbons are sold by representative American manufacturers, the former being a squirted petroleum coke carbon, and the latter a moulded coke carbon. The hissing point of the cored carbon averages over ten volts lower than the solid. The hissing point of American cored carbons does not vary much from that of foreign, but the range of the latter is fully ten volts greater than that of the former, and exceeds that of any of the American products tested, cored or solid. In the case of some makes of cored carbons tested it was impossible to measure the hissing point with any degree of accuracy because of the deposition on the negative of small portions of the core thrown out by the positive at low potential differences. The amount and nature of foreign matter in a carbon have much to do with the commercial efficiency of the latter, and determine to a large extent the range of the carbon.

It has been the desire of central station men to obtain, and the aim of the manufacturer to produce, an absolutely pure petroleum coke carbon, thinking that this would, in a large measure, solve the candle power question so far as uniformity is concerned. The writer is of the opinon, however, that an absolutely pure coke carbon, if such could be commercially manufactured for arc lamps, would not meet the requirements of central station practice to-day. Two carbons tested were taken from two batches made with special reference to purity, and it was found that one of them hissed at 53.7 volts, and the other at 52.

To be operated at maximum efficiency, these carbons would require more than 55 volts at normal current and under no conditions in practice would they give satisfactory service at less than 55 volts average—fully five volts higher than that of good commercial carbons. In connection with the potential difference required for maximum candle power in a given case, it is interesting to refer to a test reported by Prof. H. S. Carhart, in which a pair of commercial carbons designed for use on full arc circuits showed a maximum efficiency at about 55 volts. These carbons at 10 amperes and 45 volts gave 450 candle power.

Thus, it is of the utmost importance to the carbon manufacturer to test not only the range of his carbons, but also the voltage at which they give maximum efficiency. The importance of steadiness in arc lamps has been very well shown by the introduction of cored carbons. Here, again, we are confronted with the question of candle power in relation to the consumption of energy. If we assume that a 450 watt arc gives nominally 500 candle power with efficient solid carbon sticks, we must make an allowance of at least from 15 to 20 per cent. for reduction in candle power for the same energy substituting an efficient cored carbon stick. Yet, for indoor illumination the consumer is better satisfied with the cored carbon than with the solid.

Reference has already been made to current density. It would be entirely out of the question to designate a given current density for commercial light carbons, yet, in attempting to formulate a relation between candle power and energy expended in the lamp, the question of current density must necessarily be considered.

Schreihage deduced the law that for homogeneous carbons of the same make the candle power varies inversely as the diameter. He states that this relation, as is to be expected, is not completely satisfied in the case of the mean horizontal candle power, especially when the carbons are very small or very large.

When we consider that as a means for securing long life, flat carbons and "twin" carbons have been more or less used, we are reminded that in connection with the available candle power per watt expended in the arc lamp, the shape of the carbon must be given due consideration.

A consideration of alternating current arcs opens up another field in the discussion of candle power, wherein the carbon point plays an important part. In the commercial operation of alternating current arcs, cored carbons are almost exclusively used. The constituency of the core has much to do with the efficiency of this type.

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[1] A paper read at the Cleveland Electrical Light Convention, slightly condensed.

[2] "Life and Efficiency of Arc Light Carbons."—Trans. Am. Elec. Engs., Vol. VII., Nos. 6 and 7, 1890.

[3] W. M. Stine—"Influence of Arc Light Carbons on the Candle Power."—N. Y. Elec. Eng., Oct. 3, 1894; see also ELECTRICAL WORLD, Feb. 23, 1895.

The comparison of the candle power of a commercial alternating current arc with that of a direct current arc consuming the same energy, as measured at the carbon points, shows that the former gives less illumination than the latter. So important is the relation of the carbon point to efficiency of the alternating current arc that the substitution of a solid carbon for a cored carbon in this form may reduce the candle power and decrease the efficiency to such an extent as to make the lamp unmarketable.

Thus far we have discussed arcs which burn with free access of oxygen. In the case of inclosed arcs, or those which are operated in small bulbs, to which the air has very limited access, the conditions that govern the relation of watts to candle power for the open air arc are more or less modified. With inclosed arcs purity of the carbon is very important, and in some applications of these arcs the objections which stand in the way of commercial utilization of pure carbon electrodes in open air arcs, do not apply.

The importance of details in the manufacture of carbons cannot be overestimated in the consideration of this subject. With the carbon maker rests the task of supplying a uniform and efficient product; but even with the best carbon product it would seem advisable to discard the term "2,000 candle power" or "1,200 candle power" as applied to arc lamps.

Measurement of the wattage, provided for in the resolution of the Committee on the Rating of Arc Lamps, appears to be the true solution of the problem. The central station manager will undoubtedly find it to his interest to furnish good carbons, and if he demands them, the carbon manufacturer will supply them. To quote Capt. William Brophy, "The sooner you sell your light as power, the sooner this trouble will end, and I advise every man in the future to sell his lamp at 450 watts, or whatever is necessary, and bury out of sight the term '2,000 candle power.' "

DISCUSSION.

Prof. Marks, in reply to a question as to the influence of the diameter of carbons, said that the reference in the paper to current density partly answers the inquiry. It was stated there that within certain limits the candle power varies inversely as the diameter of the carbon; that is, in the assumption, of course, that the current be constant and the carbons be of the same batch and homogeneous. The limitations of life of the carbon cuts a very important figure with the central station man. It is well to remember that invariably a gain in light efficiency for a given grade of carbon is accompanied by a loss of longevity of the carbon points. A soft carbon will give a better light than a hard one of the same diameter, and if a hard carbon of small diameter is used the same efficiency may be obtained as with a soft carbon of larger diameter. Again, though carbons of a certain diameter may be suitable for one purpose of illumination, change in the character of distribution of light desired may prove them to be less suitable for another. Even if the same current be used and the same watts expended in the lamp, it would be impossible to designate a particular size of carbon to meet all cases of distribution. The candle power is influenced by variations in the character and size of grain of the pulverized crude material; in the nature of the binders, in the constituency of the mix, in the pressure in molding or squirting, as the case may be; in the duration and temperature of carbonization, etc. A carbon arc that may be well adapted to bringing out the colors of natural objects, may fall somewhat short if the power of its illumination as applied to black and white be considered. For one purpose a carbon of particular structure, operated at a high voltage, may give the best results, while for another a different structure and low voltage may be required. The quality of the light as distinguished from its candle power must be carefully considered in the selection of a carbon and in the proper operation of a lamp intended for a particular kind of illumination. All are doubtless familiar with the preponderance of the longer wave lengths, or those at the yellow end of the spectrum, in arcs operated on direct incandescent circuits. Contrasting these arcs with the constant current series arcs, the latter show a decided richness in the shorter wave lengths, or those at the violet end of the spectrum. In the former case cored carbons are used; in the latter solid. The analysis of the core tells the story.

Prof. B. F. Thomas gave the results of some work recently done at the State University, at Columbus, Ohio, which was undertaken with particular reference to the bearing of facts upon the proposed watt rating of arc lamps. The measurements consisted in the determination of the amount of light given by carbons, mounted in rigid holders, the length of the arc being adjusted to a definite amount by means of the image of the arc formed by a lens upon a screen. The strength of the current passed through the carbons was ten amperes, and the candle power was measured by means of the Weber portable photometer. The carbons upon which measurements were made consisted of ten or more pairs of carbons obtained by students of the university from their homes, or by their friends at home, from lots of carbons that were in regular use in street lighting service. The point of the investigation was to determine how much variation there is in the candle power afforded by arcs which are maintained at an expenditure of constant watts—500 in this case. The machinery was adjusted so as to work steadiest at ten amperes, and with the arc length commonly maintained in lamps in Columbus, it was found that sometimes 51 or 52 volts were required to maintain the arc in that condition.

The results refer to an angle of 45 degrees, which was found to be about the angle at which the light is produced.

It was found in the case of one carbon that at 45 degrees the candle power measured ranges between 1,855 and 1,422, and the variation in the candle power of this make showed 23.3, with a variation of 3 per cent. in watts. The candle power relation is widely different from the relation of watts. Second make, similar data, candle power 886 to 1429; variation in candle power 38 per cent., 2 per cent. in watts. The next make, 55.6 candle power, 7 per cent. variation of watts; candle power 977 to 2,200. Here is a reading of 2,200. The next make of carbons gives a variation of 39.8; 2.2 watt variation. Next candle power, 2,048 to 1,370; 33 per cent. variation in candle power, for 2.3 variation in watts. Next, 40.3 in candle power, one-half of 1 per cent. in watts. Next, 45 candle power, with 3.3 in watts. Next, 26 variation in candle power, with 2.8 variation in watts. Next, 44.7 variation in candle power, 3 in watts. The foregoing will answer in part the question which was partly answered by Mr. Marks as to the influence of size, etc., whether the carbons are coated or uncoated. The difference between them is on a basis 45 degrees. The average candle power of all makes with uncoated carbons, 1,677; half coated carbons, 1,474, half-inch size; $\frac{7}{16}$ uncoated, candle power 1,611; coated, 1,459. In both these cases the smaller carbon has the smaller candle power. Of course, this is not to be taken as conclusive, because the point of investigation was not to determine the influence of size, and, from a scientific point of view, there are many points left out of this investigation.

Prof. Marks called attention to a test in which two carbons, tested for mean hemispherical candle power, showed 456 and 486 candle power respectively. On being tested for efficiency they showed 11.71 per cent. and 10.01 per cent. respectively. The efficiency referred to here is the radiant efficiency or ratio of luminosity to total radiation. The current in each test was nine amperes and the P. D. 45 volts. One of the carbons was a squirted coke carbon, the other a molded. It will be noted that the carbon showing the higher candle power had lesser efficiency. It seems quite probable that in this case the difference in the quality of light explains the discrepancy.

Correct Methods of Protecting Electric Circuits.

In a paper with the above title read before the Cleveland Electric Light Convention, Mr. W. E. Harrington describes a method of measuring the rate of rise of current in a dynamo circuit when the circuit is suddenly closed. By means of a contact on a weight falling from different heights a dynamo circuit is closed momentarily

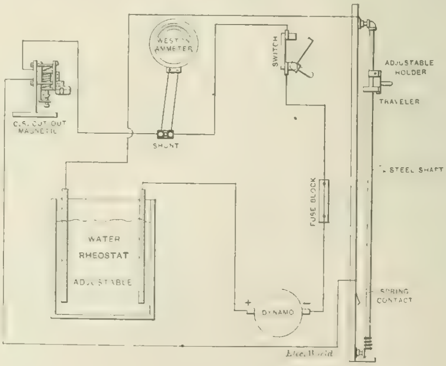


DIAGRAM OF CIRCUITS.

by contact during the fall of the weight with a spring, the interval of time during which the contact lasts being calculated from the velocity of the weight and length of spring in contact. A magnetic circuit breaker carefully set to open when a certain current passes through it is in the circuit, as shown in the cut, and the weight is dropped from different heights until a current flows which will just open the circuit breaker. The water resistance shown in the circuit is adjusted for different normal currents—that is, for the steady current which would flow in the dynamo circuit with the switch shown closed.

Curves plotted with data thus obtained were given for several different normal currents. With a street railway generator in circuit and a resistance interposed to fix the normal current at 40 amperes, the current in .004 second was 20 amperes and had risen to only 32 amperes at the end of .020 second. With a normal current of 70 amperes, the current was 18 amperes .004 second after making circuit and 35 amperes at the end of .020 second.

Mr. Harrington considers these experiments clearly establish the superiority of magnetic circuit breakers over fuses, as they insure the circuit being opened on a short circuit or overload before the current can reach its normal strength, while the time element will not allow a fuse to act in a time so short.

On Potential II.

BY WILBUR M. STINE.

The transition to a similar explanation of chemical potential at once follows. In chemical compounds we meet with a condition of attraction, which, so far as the mutual action of their components is concerned, closely resembles the actions which large masses exert upon each other. When a chemical compound is disturbed this change represents a readjustment of its constituent atoms. We then pass from the consideration of large masses to the ultimate particles of matter, the atoms. When work is done in producing molecular change there again exists its equivalent in potential energy. A mass of CO_2 may be regarded as in the condition of a body resting on the surface of the earth—it has given out all its available energy under this condition. If the molecules absorb energy and separate into constituent carbon and oxygen, they possess a potential energy equal to that expended in causing the change. This is expressed by saying if they recombine they will produce so much heat, the equivalent of gramme-centimetres of work, or ergs. The potential of free carbon to free oxygen is evaluated in terms of the number of ergs of work one gramme of carbon can do in combining again with oxygen to form CO_2.

This is numerically expressed by saying that one gramme of carbon burned to CO_2 evolves 8.080 heat units, the heat unit being 41,600,000 ergs. The potential energy then of a certain mass of carbon may be found by multiplying its total mass in grammes by the unit condition of potential stress, 8.080 heat units. In a similar manner the potential of hydrogen toward oxygen is 34.462 heat-units, a stress more than four times that existing between carbon and oxygen. These relations are general, and apply whenever two or more substances enter into a chemical reaction, for "Every chemical reaction is a compound of two parts; a transformation of matter, and a transformation of energy." (Elements of Thermal Chemistry, Muir, p. 12.)

Viewed in comparison with the action of the earth on a body, the identity of the potential energy and the similarity of the potential stress of one body on another becomes clearly apparent. When free carbon and oxygen are brought within the sphere of mutual action under conditions favoring their combination there exists a condition of stress between them whose total amount represents the potential energy involved, and the unit stress condition—the potential of the one chemical element on the other. Gravity and chemical potential relations are then differentiated from each other only as regards their sphere of action; in the one case it is universal attraction or action through all distances, and in the other the action is specific and occurs only over atomic ranges.

Gravitation or the attraction which bodies exert upon each other in consequence of their masses is perfectly general and is exercised, so far as we know, wherever matter exists throughout the universe. Chemical attraction is, however, selective and restricted. Though these two forms of attraction seem to have much in common, they are in no sense identical. But it has already been shown that, as means for the transformation of energy they are measured in terms of the same unit, the erg, and give rise to the same conditions of potential and potential energy. In a certain restricted sense, these two classes of attraction foreshadow electric and magnetic actions, the former being a condition into which bodies in general may be brought, irrespective of the particular matter of which they are composed, while the latter is again selective and apparently exists only under restricted conditions.

It is the intention to show that these different manifestations are all conditions of stress, and without pointing out the particular manner in which the stress is supposed to affect the intervening ether, to reduce them all to the same fundamental ideas and units of measurement. Let us suppose that two parallel flat plates are thoroughly insulated from each other and all surrounding bodies, and each charged with a certain quantity of static electricity by having been connected to the conductors of a Holtz machine. They attract each other, and if free to move, come together. The force of attraction between them is found to be expressed by the product of the action of the two quantities of electricity divided by the square of the distance separating them. This, it will be noticed, is similar to the case of the stone and the attracting earth. Here again the total stress represents potential energy in ergs of work done by the Holtz machine in bringing them to their condition of electrification, and the unit stress existing is called the electrical potential of the one plate on the other. We are again obliged to consider a system of units applicable to the measurement of such phenomena.

The unit quantity of electrification is that amount which will, through a distance of one centimetre, attract or repel a like quantity with the force of one dyne.

If a unit charge is moved through one centimetre against an average force of attraction or repulsion of one dyne, a unit of work, or an erg, has been expended in doing this. The potential or unit stress existing on the one plate is determined in the following manner: Suppose this plate, which we may call A, be stationary, the potential then of each unit quantity on the other, or B, represents the ergs of work necessary to remove this unit charge to an infinite distance; and in general, electrical potential always represents some definite number of ergs of work. The total stress then existing between the plates A and B is the product of the units of electricity on B and the potential.

It may be here pointed out that electrical potential always implies at least two charges in action; a completely isolated electrical charge can no more possess potential than an isolated mass in space can have potential due to gravitation.

Electrical potential as here defined is not the popular sense in which the term is employed. As ordinarily used it has reference to electromotive force or *potential difference.* Electrical potential, as just defined, is a mathematical conception to which a numerical value may be assigned, and is rarely measured or estimated. The plate B at a distance of one centimetre from A has an absolute potential value. If B now be removed to a distance of five centimetres from A it is in a position whose absolute potential is less in an algebraic sense; but since energy has been expended in removing the plate, this energy, divided by the units of charge moved, represents the *difference* of potential in ergs between the two positions of the plate.

There exist in electrical nomenclature two systems of units, known as the practical, and the absolute, or C. G. S. (centimetre, gramme, second). The practical unit of electrical potential, or as it is sometimes called, electrical pressure, is the volt, and the value of the volt representing ergs of work is 100,000,000 absolute units of potential. As the absolute unit is so small the volt is usually employed as the scientific unit.

Electricity is a word in frequent ordinary and scientific use, but there is perhaps no other term which more completely defies definition. It is safe to state that scientists know practically nothing about the nature of what is ordinarily termed electricity. For the sake of dealing with the phenomena to which it gives rise, scientists have regarded it as a kind of fluid, since its actions follow many of the laws governing hydraulics and hydrostatics.

This mental conception has been too freely accepted at large, and the imagined materiality of electricity come to be regarded as an established fact. Many scientific writers, too, have fallen into this error and speak of the transfer of electricity and the difference of potential as the force causing the movement. Others more accurately regard primarily the conditions of stress in the ether, this stress giving rise to potential difference. The attraction or repulsion between stationary electrified bodies or electrostatic charges implies only the existence of a stress or potential energy.

When this stress is in process of equalization the potential energy becomes kinetic, producing by its disturbance of the ether through which it acts those effects ascribed to an electrical current. A cell of battery in no sense generates an electrical current. The chemical reaction which takes place between the liquid electrolyte and the active plate simply establishes a condition of stress whose amount is expressed in volts. If this stress be equalized the phenomena of the so-called current results. The progressive chemical action of a cell in operation, on the contrary, does not maintain the current, but simply the condition of stress.

So long as the voltage of the acting cell remains constant we know that the stress in volts is being maintained at the same rate that it is being equalized throughout the conducting circuit. The case is not a mere question of phraseology, but clearly depicts the real conditions of these phenomena. A cell of battery is often compared in its action to a pump, and here again another fallacy must be pointed out. Contrary to the usual view, no pump ever pumped water. A pump is simply a machine for disturbing the equilibrium of forces under which the water is at rest in the cistern. By its action it creates a stress of unbalanced pressure with reference to the pressure of the atmosphere under its piston and on the surface of the water. As a result the water is forced up into the pump by the excess of pressure of the air on the water in the cistern over that in the pump.

Let us consider the action of a dynamo generating 110 volts as an analogous case. If the dynamo be running on open circuit it at first generates a difference of potential at its terminals of the value of 110 volts. The work that the steam engine has performed in doing this is the electrostatic value of 110 volts in ergs. As soon as this difference of electrical potential has been established no further work is done by the engine in running the dynamo except overcoming its mechanical friction.

If the circuit is completed through a number of lamps equalization of potential results, and the engine is called upon to do work to the extent of maintaining the potential as rapidly as equalization occurs. The number of lamps turned on determines the extent to which this equalization takes place, or as ordinarily put, the amount of current flowing. The rate at which the dynamo and engine are doing work is expressed by the product of the amount of the equalization of the stress and the difference of potential through which it takes place, or as usually stated, the product of the difference of potential, or electromotive force and the current.

The numerical value of this product is expressed in terms of a unit called the watt, which, in absolute measure, is equal to 10,000,000 ergs. The usual rating of mechanical work is in terms of the horse-power, which itself is equal to about 746 watts. The electrical work, then, which any dynamo is performing, expressed in horse-power, is found by dividing the product of its electromotive force, or E. M. F., and current by the number 746. It is thus seen that a dynamo does not generate a current of electricity, but may be regarded as an electrical pump for setting up and maintaining a definite difference of stress or potential. The maximum rate at which the equalization may occur with a steady maintenance of potential difference depends upon the size or output of the dynamo; just as the output of a cell of battery depends upon the size of the active plate and the amount of the electrolyte or available chemical action.

The discussion of electrostatic potential applies similarly to that of magnetic potential, and it were scarcely necessary to elaborate this phase of the subject were there not so many popular errors and misapprehensions connected with the energy relations of permanent magnets. To many magnetism is not only an obscure force, but one invested with something of the power of Aladdin's lamp. The fact that a piece of magnetized steel is seemingly able to magnetize an indefinite number of other pieces of steel, and, moreover, possesses the power to both attract and lift considerable masses of iron or steel has led to the fancy that a magnet, somehow, is a storehouse of energy without limit. Many attempts have been made to construct perpetual motion devices whose energy would be indefinitely supplied by permanent magnets, but it is almost needless to say that like all other dreams of this nature, they have inevitably failed.

The amount of either attraction or repulsion existing between two given magnets is expressed in dynes, as in all the other cases considered. The amount of magnetism on the ends of a magnet is measured in terms of a unit magnetic strength of pole, as an electrical charge is estimated in terms of a unit charge.

Similarly unit magnetic strength is that amount of magnetism which will repel or attract, as the case may be, a similar amount located at a distance of one centimetre from it, with a force of one dyne. If a magnet is moved against the attraction or repulsion of another magnet through a certain distance ergs of work are expended whose number is expressed by the average resisting force in dynes multiplied into the number of centimetres through which the movement has taken place. The relation of potential energy and potential or unit condition of stress are thus seen to be the same as in the other phases which we have considered. In the case of the dynamo and battery the difference of potential existing between the extremes of the circuit was called electromotive force or volts, and since a magnet represents an analogous closed circuit of lines of stress, we may speak of the difference of magnetic potential or magnetomotive force which exists between the extremities of these lines. The unit of magnetomotive force is now called the gilbert.

If a piece of iron is brought near the poles of a horseshoe magnet it is strongly attracted, and if not too heavy, lifted bodily to the magnet. Should the piece of iron be of sufficient size the magnet will have no further effect on iron bodies brought near it, but together with the attracted iron forms a closed system in a condition of equilibrium. If the iron armature is now removed energy is expended to the exact amount of work done by the magnet in attracting the iron. The magnet in this case has the power to do a certain number of ergs of work, which, when spent in attracting the iron, is done forever, unless the power be restored by forcibly removing the iron, when the cycle of transformations may again be repeated. A magnet is thus a conservative storehouse of limited energy, just as the earth is with reference to bodies which it attracts. The failure to realize that the amount of energy required to remove a piece of attracted iron from a magnet is the exact equivalent of the work done by the attraction is what has led many would-be inventors to attempt to construct perpetual motion magnetic devices. All attempts to utilize the attraction of the earth for this purpose have failed because of the losses due to mechanical friction, and the conditions governing magnetic devices being the same, it can safely be said the permanent magnets will never be able to furnish the energy for perpetual motion.

The Brush Company at the Convention.

The Brush Electric Company occupied parlor 137 in the Hollenden, where it had one of the most interesting exhibits at the convention. A notable feature of the exhibit was the first arc-light dynamo built by Mr. Brush. This is a one-light machine, and was built in 1876 at Mr. Brush's residence and hauled, in the rear of his buggy, to the works of the Telegraph Supply Company in Champlain street, where it was set up and run. Later on it was sold to the Viaduct Manufacturing Company, at Baltimore, who operated it regularly for twelve years. During the World's Fair year the dynamo was purchased by the Brush Company and exhibited as a historical relic in Electricity building, where it was shown in actual operation. The exhibit also included four Brush-Adams arc lamps of the latest designs, one of these being of the type to be furnished in filling an order for 1,500 lamps, recently booked from Detroit.

The parlor display was not made particularly extensive, the company's factory being located right in the city within easy access, so that the delegates could readily inspect completed electrical apparatus of the latest types as well as view the process of construction in all its details. The Brush Company kept two special private cars running regularly between the hotel and the works for the benefit of those who desired to visit the factory, no charge being made for the ride. At the works one of the leading attractions was a new 125-light arc dynamo running 135 lights. This machine was put under very severe tests by Prof. Elihu Thomson, Mr. C. P. Steinmetz and other prominent electricians who visited the works. The load of 135 lights was repeatedly thrown off and on without any injury whatever to the machine, the regulator taking entire care of the load. The same was done with a 100-light machine, the maximum load in this case being 120 lights. A majority of the central station men who were in Cleveland passed most favorable comments upon these machines, the immunity from burning out by overloading appealing strongly to their appreciation. Col. W. S. Rogers and Mr. A. B. Calhoun were in constant attendance at the parlors. Colonel Rogers is special agent of the Brush Company, and his sociability and genial disposition have made him extremely popular among a very extended list of acquaintances throughout the country. Others prominently connected with the Brush Company who were present were S. M. Hamill, general manager; L. H. Rogers, assistant general manager; A. H. Hough, secretary; A. D. Dormon, manager sales department; J. R. Prentiss, superintendent electrical experts; C. W. Phipp, superintendent; C. N. Black, assistant superintendent, and Thomas E. Adams, the inventor of the Brush-Adams lamp.

Electrical Power Transmission.—XV.

BY LOUIS BELL, PH. D.

As regards the general character of transmission lines the most usual arrangement is to employ bare copper wire supported on wooden or iron poles by suitable insulators. Now and then underground construction becomes necessary owing to special conditions. Not infrequently an ærial transmission line must be coupled with underground distribution owing to municipal regulations. Occasionally insulated line wire is used. It is frequently employed in cases where the transmission lines are continued for purposes of distribution through the streets of a town, in fact, is generally required. As such lines are generally of moderate voltage, very seldom exceeding 3,000 volts, good standard insulation may often be effective in lessening the danger to life in case of accidental contacts, and in reducing the trouble from crossing of the lines with other lines, branches of trees, and the like. In case of really high voltages, 5,000 to 10,000 and upwards, no practicable insulation can be trusted for the former purpose, and may in fact create a false sense of security, while it is far better practice to endeavor to avert the danger of short circuits than to take extraordinary precautions to mitigate their severity. Hence bare copper is to be preferred both on the score of safety and economy.

Much can be said in favor of placing transmission lines underground, but there are also strong reasons against it. Such a line is eminently safe and free from danger of accidental injury. At the same time it is very difficult to insulate properly, and if trouble does arise it is exceedingly hard to locate and difficult to remedy. In addition, there are serious electrical difficulties to be encountered, which can only be reduced by very costly construction. The chief objection aside from these is the expense, which in very many cases would be simply prohibitive.

In cities there is an increasing tendency on the part of the authorities to demand underground construction. Overhead wires are objectionable on account of their appearance, danger to persons and property, and their great inconvenience in cases of fire, and these objections apply with almost equal total force to all such wires, whether used for electric light or power or for telegraphic and telephonic purposes, the latter making up by their number for any intrinsic advantage in the matter of safety. The future city will have its electric service completely underground, at least in the more densely inhabited portions. It must be said, however, that it is more important for a city to have electric light and power than to insist on having it in a particular way, and unless the service is very dense so as to abundantly justify the very considerable added cost of underground work, private capital will hesitate to embark in an enterprise so financially overloaded.

Fortunately for city distribution moderate voltages must be employed on account of the intrinsic limits of direct current circuits employed for general distribution, and the undesirability of distributing transformers of moderate size on very high pressure alternating circuits. More than 2,000 to 3,000 volts, save on arc circuits, can seldom be used advantageously in general distribution, and such voltages can be and are successfully insulated without prohibitive expense. They work well in practice and have stood the test of considerable experience. Moreover, with proper care the cables employed as conductors, when thoroughly protected and inspected, probably have a less rate of depreciation than overhead insulated lines, and are less liable to interruption. As the district within which underground service is necessary is usually of no great extent, the electrical difficulties that are to be dreaded in attempting long underground transmissions are not here of serious magnitude.

For this limited service, then, in districts where both population and service are dense, there is no inherent objection to underground lines, and many who have used them are decided in commending them as on the whole more convenient and reliable than aerial lines. Besides a large proportion of underground work is done at low voltages, less than 250, with which the difficulties of insulation except at joints are really trivial. Such work does not belong so much to power transmission proper as to distribution from centres after the transmission is accomplished.

With high voltages and long distances the case is very different. Not only are the difficulties of insulation great, but electrical troubles are introduced of so severe a character as to make success very problematical, even in cases where the cost alone is not prohibitive. The feat of cable insulation for pressures as great as 10,000 volts has been accomplished and this limit could probably be exceeded, but the cost of such work is necessarily high, and the location and repair of faults is troublesome. An overhead line is so much easier to insulate and to maintain that nearly all power transmission will probably continue to be done by this method for some time to come, until, indeed, there are revolutionary changes in underground work of which we now have no suggestion. The possibility of a long interruption of service while a fault is found and repaired is too unpleasant a contingency to be incurred. Duplicate lines are a natural recourse in such case, effective, but very costly. Aerial lines are much cheaper to duplicate, and the labor of finding and repairing faults is comparatively light.

For these reasons underground transmission lines should be avoided, certainly until we have had a long experience with high voltages overhead.

Throughout the foregoing it has been assumed that the conducting line is composed of the best quality of commercial copper wire. Inasmuch as other materials are occasionally proposed it is worth while saying something about the relative properties of certain metals and alloys as conductors. Aside from silver, pure copper is intrinsically the best conductor among the metals. In fact, it is hard to say that it is not the equal of silver. Commercial copper wire is of somewhat variable conductivity, since this property is profoundly affected by very small proportions of other substances. It used to be a very difficult matter to procure commercial wire of good quality, and in the early days of telegraphy much annoyance was experienced on this score. At present the best grades of standard copper wire have a conductivity of fully 98 per cent. of that of the chemically pure metal, and even this figure is not infrequently exceeded. On account of the comparatively low tensile strength of copper, ordinarily about 35,000 lbs. per square inch, very vigorous efforts have been made to exploit various alloys of copper on the theory that their greater strength would more than over-balance the lessened conductivity and increased cost, by enabling less frequent supports to be employed. Aluminium bronze, silicon bronze and phosphor bronze have been tried, together with some other alloys of a similar character exploited under various trade names. The whole matter of high conductivity bronzes has been so saturated with humbug that it is very hard, indeed, to get at the facts in the case. Copper which is hard-drawn probably has greater tensile strength as any so-called bronze of similar conductivity, from 60,000 to 70,000 lbs. per square inch, with a resistance less than 5 per cent. in excess of that of pure copper. The following table gives the conductivity and tensile strength of some of the various materials used or proposed for line wire, pure copper being taken as the standard at 100 per cent. conductivity:

Material	Conductivity.	Strength, Lbs.
Commercial copper wire	98–99	35,000
Good hard drawn copper	96–97	60,000–65,000
1 Silicon bronze....... ..	97	63,200
2 Silicon bronze.	80	76,000
3 Silicon bronze..... .	45	110,000
Phosphor bronze	26	101,000
Iron annealed wire.......	14	55,000
High steel wire .	10–12	120,000–130,000

It is sufficiently evident from this table that where the best combination of strength and conductivity is wanted hard-drawn copper is unexcelled. For all ordinary line work good annealed copper wire is amply strong, and is, besides, easier to manipulate than wire of greater hardness. Occasionally, where it is desirable to use extra long spans, or excessive wind pressure is to be encountered, the hard-drawn wire is preferable. Now and then, in crossing rivers or ravines, spans of great length are desirable—several hundred yards—and in these cases one may advantageously employ silicon or other bronze of great tensile strength, or as an alternative a bearer wire, preferably a steel wire cable, carrying the copper conducting wire.

Compound wires have now and then been used consisting of a steel core with a copper covering. They are, however, costly and inferior to hard-drawn copper for line use. Iron is the only material that replaces copper to any extent. It is cheaper for equal conductivity, but in wire is far less durable, and in rods cannot be strung overhead conveniently, while, even were this possible, the difficulty of making and maintaining joints is most serious. In rare cases iron may prove useful, but for all regular line work copper is the only material to be serously considered.

(To be continued.)

Practical Notes on Dynamo Calculation.—XXVIII.

BY ALFRED E. WIENER.

Calculation of Field Magnet Frame.

Chap. 47.—Permeability of Various Kinds of Iron. Absolute and Practical Limits of Magnetization.—The field magnet of a dynamo has the function of supplying to the interpolar space in which the armature conductors revolve magnetic lines of force in a number sufficient either to cause the generation of the required electromotive force, in case of a generator, or to produce a motion of the desired power, in case of a motor. The cross sections of the various parts of the field magnet frame, that is, of the iron structure constituting the path or paths, for the flow of these magnetic lines, consequently, must be dimensioned with reference of the number of lines of force to be carried, and to the magnetic conductivity of the material used.

The number of lines which by a certain exciting power or magnetomotive force can be passed through a portion of a magnetic circuit depends upon the area of the cross section and on the magnetic conductivity of the material of that part of the circuit. The various magnetic materials, according to their hardness, have a different capability of conducting magnetic lines, the softest material being the best magnetic conductor. The specific magnetic conductance of air being taken as unity, the relative magnetic conductance or the relative *permeance* of the various magnetic materials is indicated by the ratio of the number of lines of force produced in unit cross section of these materials to the number of lines set up by the same magnetizing force in unit cross section of air. This ratio, or coefficient of magnetic induction, is called the *magnetic conductivity*, or the *permeability* of the material.

The number of lines per square centimetre of sectional area set up by a certain magnetizing force in *air* is conventionally designated by $\mathcal{H}$, that in *iron* by $\mathcal{B}$, and the permeability by the symbol μ; between these three quantities, therefore, exists the relation

$$\mu = \frac{\mathcal{B}}{\mathcal{H}}, \text{ or } \mathcal{B} = \mu \times \mathcal{H} \qquad (136)$$

Since for air the permeability $\mu = 1$, the number of lines of force per square centimetre of air is numerically equal to the magnetizing force in magnetic measure, *i. e.*, in current turns. Permeability is therefore often also defined as the ratio of the magnetization produced to the magnetizing force producing it.

While the permeability of air and of all non-magnetic substances is a constant—for air it is 1, and for diamagnetic materials slightly less than 1, for all stages of magnetization —that of magnetic materials varies with the degree of saturation; the more lines a certain cross section of iron carries, the less permeable is it for additional lines. At a certain limit, for every kind of iron, a very material increase in the magnetizing force does not appreciably increase the magnetization induced, and the iron is then *saturated* with lines of force. This limit of magnetization in *annealed wrought iron* is reached at a density of about $\mathcal{B} = 20{,}200$ lines per square centimetre, or 130,000 lines per square inch, in *soft steel* at $\mathcal{B} = 19{,}800$ lines per square centimetre or 127,500 lines per square inch, in *mitis iron* at $\mathcal{B} = 19{,}000$ lines per square centimetre or 122,500 lines per square inch, in *cast iron* with a 6.5 per cent. admixture of *aluminium* at $\mathcal{B} = 13{,}500$ lines per square centimetre or 87,500 lines per square inch, and in *ordinary cast iron* at $\mathcal{B} = 12{,}000$ lines per square centimetre or 77,500 lines per square inch of cross section. The magnetizations, however, to which these materials are subjected in practical electromagnets are taken far below the actual limits of absolute saturation, since "saturation curves" indicating the variation of the induction $\mathcal{B}$, with increasing magnetizing force, $\mathcal{H}$, show that from a certain point—the "knee" of the curve—the magnetization increases much slower than the magnetizing force which causes it. In wrought iron, for instance, an induction of $\mathcal{B} = 13{,}580$ requires a magnetizing force of $\mathcal{H} = 25$, an induction of $\mathcal{B} = 16{,}000$ a magnetomotive force of $\mathcal{H} = 50$, and density of $\mathcal{B} = 16{,}500$ necessitates an exciting power of $\mathcal{H} = 100$; an increase of 100 per cent. in the magnetizing force, consequently, causes a rise in density of 18½ per cent. at the lower magnetization, while again doubling the magnetomotive force at the higher induction only causes an increase in magnetic density of about 3 per cent. In practice, therefore, the limits of the magnetic densities of the different materials are to be fixed with regard to the relative economy of iron and copper. Taking the practical limit of saturation too low means a small saving of copper at a large expense of iron, while too high a density effects a comparatively small saving of iron at a large expense of copper. Since copper costs many times more than iron, the densities should be limited rather low, the tendency toward the former extreme being preferable to that towards the latter. With this point in view, the "*Practical Working Densities*" given in the following Table LIX. are recommended for use in dynamo designing, while under the heading of "*Practical Limits of Magnetization*" the highest densities are tabulated that the author would advise to allow in magnet frames of dynamo-electric machines. For sake of completeness the "*Absolute Saturation*" of the various materials, as given above, are added in Table LIX.

TABLE LIX. PRACTICAL WORKING DENSITIES AND LIMITS OF MAGNETIZATION FOR VARIOUS MATERIALS.

Material.	Practical Working Density.		Practical Limit of Magnetization.		Absolute Saturation.	
	Lines p. sq. inch. $\mathcal{B}_m$.	Lines p. sq. cm. $\mathcal{B}$.	Lines p. sq. inch.	Lines p. sq. cm.	Lines p. sq. inch.	Lines p. sq. cm.
Wrought iron....	90,000	14,000	105,000	16,300	130,000	20,200
Cast steel.........	85,000	13,200	100,000	15,500	127,500	19,800
Mitis iron.........	80,000	12,400	95,000	14,750	122,500	19,000
Cast iron, cont'g 6.5 p. c. alum'm.	45,000	7,000	55,000	8,500	87,500	13,500
Cast iron, ordin'y	40,000	6,200	50,000	7,750	77,500	12,000

Chap. 48—Sectional Area of Magnet Frame.—The magnet frame carries the total flux generated in the machine; according to Chapter 47, consequently, the cross section of any portion of it must be

$$A_m = \frac{\Phi'}{\mathcal{B}_m} = \frac{\lambda \times \phi}{\mathcal{B}_m} \qquad (137)$$

A_m=Area of magnet frame, in square inches;

Φ=Total flux generated in machine, from formula (109), Chapter 36;

ϕ=Useful flux necessary to produce the required E. M. F., from formula (91), Chapter 32;

λ=Factor of magnetic leakage, preliminary value from Table LII., Chap. 40, final value from formula (110), Chapter 37;

$\mathcal{B}_m$= magnetic density in magnet frame, from Table LIX., Chapter 47.

If only one material is used the value found from formula (137) is the uniform cross section of the whole frame, *i. e.*, of the cores, the yoke, and the pole pieces; in case of combination frames, however, the area for each material must be calculated separately:

For Wrought iron, $A_m = \frac{\lambda \times \phi}{90\,000}$; (138)

" Cast steel, $A_m = \frac{\lambda \times \phi}{85{,}000}$; (139)

" Mitis iron, $A_m = \frac{\lambda \times \phi}{80{,}000}$; (140)

" Cast iron, containing 6.5 p. c. of aluminium, $A_m = \frac{\lambda \times \phi}{45{,}000}$; (141)

" Ordinary cast iron, $A = \frac{\lambda \times \phi}{40{,}000}$; (142)

In combining the averages for the useful flux, taken from Table LI., Chapter 35, for the practical conductor velocities given in Tables VIII., IX., and X., respectively, with the leakage coefficients compiled in Table LII., Chapter 40, the average total flux, Φ, for dynamos of various kinds and sizes is obtained, and, by then applying formulæ (138) to (142) the sectional areas of the field frame for various kinds and sizes of machines can be found. In this manner the following Tables LX., LXI. and LXII. have been prepared, which give the cross sections of field magnet frames of different materials for high speed drum machines, high speed ring dynamos, and low speed ring machines, respectively.

The figures given for the areas directly apply to single circuit bipolar dynamos only; for double circuit bipolar, and for multipolar machines they represent the total cross section of all the magnetic circuits in parallel, or—for frames of only one material —the total area of all the cores of same free polarity, the cross sections of the various portions of the field magnet frame are therefore obtained in dividing these figures by the number of magnetic circuits, *i. e.*, by the number of pairs of magnet poles.

TABLE LX.—SECTIONAL AREA OF FIELD MAGNET FRAME FOR HIGH SPEED DRUM DYNAMOS.

Capacity in kilowatts.	Conductor velocity (Table VIII.), Ft. per second.	Average useful flux (Table LI.) Lines of force.	Av'age leak'ge coeffi cient. (Table LII.)	Average total flux, Φ'. Lines of force.	Area of Field Magnet Frame.				
					W'ught iron, $Am = \frac{\phi'}{90,000}$ sq. in.	Cast steel, $Am = \frac{\phi'}{85,000}$ sq. in.	Mitis iron, $Am = \frac{\phi'}{80,000}$ sq. in.	Cast iron, 6.5% al. $Am = \frac{\phi'}{45,000}$ sq. in.	Cast iron, ordin'y $Am = \frac{\phi'}{40,000}$ sq. in.
.1	25	200,000	2.00	400,000	4.5	4.7	5	9	10
.25	30	333,000	1.90	630,000	7	7.4	7.9	14	15.8
.5	32	550,000	1.80	990,000	11	11.7	12.4	22	24.8
1	34	880,000	1.75	1,540,000	17.1	18.1	19.3	34.2	38.6
2	36	1,530,000	1.70	2,600,000	28.9	30.6	32.5	57.8	65
3	40	1,875,000	1.65	3,100,000	34.5	36.5	38.8	69	77.6
5	45	2,550,000	1.60	4,080,000	45.5	48	51	91	102
10	50	4,000,000	1.55	6,200,000	69	73	77.5	138	155
15	50	5,700,000	1.50	8,550,000	95	101	107	190	214
20	50	7,200,000	1.45	10,400,000	115.5	122	130	231	260
25	50	8,500,000	1.40	11,900,000	132	140	149	264	298
30	50	9,900,000	1.40	13,850,000	154	163	173	308	346
50	50	15,500,000	1.35	20,900,000	232	246	261	464	522
75	50	22,000,000	1.35	29,700,000	330	350	371	660	742
100	50	28,000,000	1.30	36,400,000	405	430	455	810	910
150	50	39,500,000	1.30	51,400,000	572	605	643	1,144	1,286
200	50	50,000,000	1.25	62,500,000	695	735	782	1,390	1,564
300	50	70,000,000	1.20	84,000,000	933	990	1,050	1,866	2,100

TABLE LXI.—SECTIONAL AREA OF FIELD MAGNET FRAME FOR HIGH SPEED RING DYNAMOS.

Capacity in kilowatts.	Conductor velocity (Table IX.), Ft. per second	Average useful flux. (Table LI.) Lines of force.	Av'age leak'ge coeffi-cient. (Table LII.)	Average total flux. Φ'. Lines of force.	Area of Field Magnet Frame.				
					W'ught iron, $Am = \frac{\phi'}{90,000}$ sq. in.	Cast steel, $Am = \frac{\phi'}{85,000}$ sq. in.	Mitis iron, $Am = \frac{\phi'}{80,000}$ sq. in	Cast iron, 6.5% al. $Am = \frac{\phi'}{45,000}$ sq. in.	Cast iron, ordin'y $Am = \frac{\phi'}{40,000}$ sq. in.
.1	50	100,000	1.80	180,000	2	2.1	2.2	4	4.5
.25	55	182,000	1.70	310,000	3.5	3.7	3.9	7	7.8
.5	60	292,000	1.60	467,000	5.2	5.5	5.8	10.4	11.6
1	65	462,000	1.55	715,000	8	8.4	8.9	16	17.8
2.5	70	930,000	1.50	1,400,000	15.5	16.5	17.5	31	35
5	75	1,500,000	1.45	2,180,000	24.2	25.6	27.3	48.4	54.5
10	80	2,500,000	1.40	3,500,000	39	41.2	43.8	78	87.5
25	80	5,320,000	1.35	7,200,000	80	85	90	160	180
50	85	9,120,000	1.30	11,900,000	132	140	149	264	298
75	85	13,000,000	1.25	16,250,000	180	191	203	360	406
100	85	16,500,000	1.22	20,100,000	224	236	251	448	502
200	88	28,400,000	1.20	34,000,000	378	400	425	756	850
300	90	39,000,000	1.18	46,000,000	512	542	575	1,024	1,150
400	92	47,800,000	1.18	56,500,000	628	665	707	1,256	1,415
600	95	62,000,000	1.17	72,500,000	806	855	905	1,612	1,810
800	95	74,200,000	1.17	87,000,000	967	1,025	1,085	1,935	2,170
1,000	95	84,200,000	1.16	97,700,000	1,085	1,150	1,240	2,170	2,480
1,500	100	97,500,000	1.16	113,000,000	1,255	1,330	1,410	2,510	2,820
2,000	100	110,000,000	1.15	126,500,000	1,400	1,490	1,580	2,800	3,160

TABLE LXII.—SECTIONAL AREA OF FIELD MAGNET FRAME FOR SLOW SPEED RING DYNAMOS.

Capacity in kilowatts.	Conductor velocity (Table X.). Ft. per second.	Average useful flux. (Table LI.) Lines of force.	Av'age leak'ge coeffi-cient (Table LII.)	Average total flux, Φ'. Lines of force.	Area of Field Magnet Frame.				
					W'ught iron, $Am = \frac{\phi'}{90,000}$ sq. in.	Cast steel, $Am = \frac{\phi'}{85,000}$ sq. in.	Mitis iron, $Am = \frac{\phi'}{80,000}$ sq. in	Cast iron, 6.5% al. $Am = \frac{\phi'}{45,000}$ sq. in	Cast iron, ordin'y $Am = \frac{\phi'}{40,000}$ sq. in
2.5	25	2,600,000	1.50	3,900,000	43.3	46	48.7	86.6	97.5
5	26	4,420,000	1.45	6,400,000	71.2	75.3	80	142.4	160
10	28	7,150,000	1.40	10,000,000	111	117.5	125.7	222	250
25	30	14,200,000	1.35	19,200,000	213.5	226	240	417	480
50	32	24,200,000	1.30	31,500,000	350	360	394	700	788
75	33	33,500,000	1.25	42,000,000	467	495	525	934	1,050
100	35	40,000,000	1.22	48,800,000	543	575	610	1,086	1,220
200	40	62,500,000	1.20	75,000,000	833	883	938	1,666	1,875
300	42	83,300,000	1.18	98,500,000	1,095	1,160	1,220	2,190	2,460
400	44	100,000,000	1.18	118,000,000	1,310	1,390	1,475	2,626	2,950
600	45	131,000,000	1.17	153,500,000	1,725	1,810	1,940	3,450	3,880
800	45	157,000,000	1.17	184,000,000	2,050	2,165	2,300	4,100	4,600
1,000	45	178,000,000	1.16	206,500,000	2,300	2,430	2,580	4,600	5,160
1,500	45	217,000,000	1.16	252,000,000	2,800	2,970	3,150	5,600	6,300
2,000	45	245,000,000	1.15	282,000,000	3,140	3,320	3,525	6,280	7,050

For cases of practical design, in which the fundamental conditions materially differ from those forming the base for the above tables, the areas obtained by formula (137) may also widely vary from the figures given, but, by proper consideration, these tables will answer even for such a case, and will be found useful for comparing the results of calculations.

(To be continued.)

Acetylene Gas.

To the Editor of The Electrical World:

SIR: I notice in your issue of Feb. 16 an editorial on the new gas. The electrolytical production of acetylene is at least 40 years old. The manufacture of calcium carbide direct from calcium and carbon in the electric furnace has been practised for some time, and it is only necessary in this connection to refer to the work of M. Henri Moissan on the metallic borides, silicides, and especially *carbides.* Acetylene can, moreover, be produced *outside* the *electric furnace;* calcium carbide can be produced without the use of electricity, and more cheaply than with it.

The electrical industry will not be seriously injured by this newly aroused interest in acetylene, but, on the contrary, may be much benefited. The gas will no doubt have an extensive use, especially for gas engines, for which it is particularly adapted, after proper strengthening of the parts affected, and, under $30 a ton of carbide, the gas should have considerable sale. Whether it can be made for that price is a grave question. Gas companies may profit by it, but at present cannot suffer, for in order to make the amount of acetylene necessary to enrich simply the gas used daily in New York City alone would require an expenditure of 600,000 horse power of energy daily. Niagaras are not manufactured to order, especially in the neighborhood of large cities, and electricity will last, as an illuminant, at least one more round. ALBERT STETSON.

NEW YORK, N. Y.

Electrical Difference of Potential.

To the Editor of The Electrical World:

Sir—I beg to offer a few more remarks concerning "Electrical Difference of Potential = an Analogy," about which I had hoped to see more discussion than has arisen.

Consider a conductor of such length that it is entirely within the limits of a uniform magnetic field, and consider that this conductor is moved across the lines of force at a uniform velocity. Obviously an E. M. F. will be generated in the conductor (which will be called the inductor) which will establish a difference of potential between the ends of the inductor. Now, if two other conductors are electrically connected, one to each end of the inductor, the difference of potential which exists between these ends will be transferred to every part of the conductors, which transferrence can only take place by reason of a current flowing; this current flowing means work done. (See article by Prof. Anthony, in THE ELECTRICAL WORLD of Feb. 9.)

But in the case of the inductor alone, the difference of potential between its ends is not due to any transferrence of any difference of potential from outside sources, but to the adding together of all the E. M. Fs. (infinite in number) which are generated in the length of the inductor; there is therefore no flow of current required, and consequently no work is done.

I therefore consider that my criticism of Prof. Waddell's mechanical analogy for the establishment of a difference of potential is just, as he expressly stated that in his apparatus the work which must be done upon the inductor in order to move it against the friction of the somewhat too material "lines of force" is analogous to the energy required to move a conductor across the lines of force of an actual magnetic field, and I repeat that I consider the analogy faulty in this respect. A. W K. PEIRCE.

SCRANTON, Pa.

Candle-Power of the Arc Light.

To the Editor of The Electrical World:

SIR:—In your last issue I find an article by W. M. Stine, in which the light of an arc lamp is ascribed to the *arc*, and the statement is made that when Davy tried his classical experiment he for the first time produced an arc filled with a "highly luminous vapor." Since the light of an arc lamp is almost wholly due to the highly heated ends of the solid carbons, especially of the positive carbons, the arc itself giving very little light for less than arcs from metal terminals, I am at a loss to understand his statements. Neither can I understand his reference to the candle and gas flames, where it is *solid* carbon and not carbon vapor, that gives the light. Prevent the carbon of a gas flame from separating as a finally divided solid, and you have the non-luminous flame of the Bunsen burner. Even this, I venture to say, gives more light than the arc proper of an arc lamp. A good idea of the relative illuminating power of the arc and the solid carbon points between which it plays may be obtained by projecting the image upon a screen by means of a lens. A well-darkened room is necessary to bring out the image of the arc at all, while the images of the points may come out strongly in broad daylight.

NEW YORK. WM. A. ANTHONY.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 922 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may, be sent in the English, French or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

Note.—Through the kindness of Mr. G. Georgi, of the leading Italian electrical monthly, "L'Flettricista," abstracts and references to the principal original articles appearing in that journal will hereafter be given in this department.

LIGHTS AND LIGHTING.

Chemical Vacuum Generation.—In the "Elek. Anz.," Jan. 20, Mr. Krueger describes and recommends very highly the system of Malignani, the value of which he says cannot be rated too highly; it is used in Budapest and almost all the large manufacturers are considering its introduction. Besides overcoming the objection to the poisonous mercury vapors, the process is far more rapid and the vacuum produced is better. In this process phosphorus, arsenic, sulphur or iodine vapors are introduced into the lamp after it has been exhausted by means of a mechanical pump; if the filament is then made to glow, a deposit is formed on the inside of the glass which completely exhausts the remaining air; in practice a small piece of one of these materials is placed in a tube connected with the lamp; the lamp is exhausted to 0.5 mm by a mechanical pump and the tube containing this material is then sealed; the filament, which has previously been covered with a thin layer of powdered carbon or graphite, is then brought to a white heat, which vaporizes this carbon; the sulphur or other material is then heated, when the two vapors will combine, depositing themselves on the inside of the glass in a transparent coating which it is claimed does not diminish the amount of light; the filaments need not be covered with carbon dust if they are heated to 15 or 20 per cent. excess of voltage; with one of these pumps 300 lamps can be exhausted per day; there is also a saving in current as the lamps need to glow only for a very short time. Whether this can be applied to all lamps is still a question as the highly efficient lamps are very sensitive to an excess of voltage, while covering them with carbon is not a very rational method. In conclusion he refers to the invention of Waring (in the United States), in which the lamps were filled with a vapor of iodine or bromine in order to prevent the radiation of the heat and the blackening of the lamp; it is suggested that the actions in both may be the same.

Projectors.—A long illustrated article on electric projectors and their use in war is begun in "L'Eclairage Elec.," Jan. 26. It deals exclusively with spherical projectors, which the writer of that article believes have been demonstrated to be superior to the parabolic projectors; the article contains data and descriptions, with illustrations, of portable projector plants with and without the power generator; he gives a list of the projectors in the war departments of the different nations, from which it appears that the United States has 62, while France and England each have about 900.

Tax on Electric Lighting in Italy.—The Italian government has proposed a tax on electric lighting, which amounts to 1.4c per kw hour.

Incandescent Gas Lighting.—The "Lancet Report," mentioned in the Digest, Feb. 9 and 23, is abstracted at some length in the "Progressive Age," Feb. 1.

POWER AND HEAT.

Rudder Motor.—A form recently brought out in England is described and illustrated in the Lond. "Elec. Eng.," Feb. 8; it is arranged so that it can easily be adapted to any rowing boat by simply inserting it in place of the rudder. The motor is enclosed in a water-tight case and drives two propellers through three pairs of bevel gears. The accumulator consists of 12 cells weighing 112 lbs., the motor weighing 60 lbs.; this is said to run a boat containing four persons for eight hours at a speed of four to five miles per hour.

Governing Steam Engines for Central Stations.—A paper by Capt. Sankey is abstracted in the Lond. "Elec.," Feb. 8. The whole paper is being reprinted in Lond. "Engineering," beginning Feb. 8.

Electric Forging.—According to "L'Elettricista," Feb. 1, some interesting experiments with the Lagrange-Hoho system of electrical forging were carried out recently in Milan, Italy.

Electric Furnace.—A reduction furnace devised by Messrs. v. Urbanitzky and Fellner is described and illustrated in the "Elek. Anz.," Jan. 31.

TRACTION.

Accumulator Traction in Vienna.—The "Zeit. f. Elek.," Feb. 1, contains a long, detailed description of the Waddell-Entz copper-zinc accumulator system in Vienna where a temporary plant has been erected. It is shown how the traction coefficient increases with the grade, it being four times as great on a 3 per cent. grade as on a level, and it is claimed that the weight of a lead accumulator, owing to its inability to discharge sufficiently rapidly, would become so great on such roads that its use would not be practical; it is claimed that the copper-zinc accumulators weigh only 0.55 times as much as the lead accumulators of equal capacity, and that the capacity of the former is practically independent of the rate of discharge. A profile of the road is given; the round trip is seven miles long and contains some curves on a 3.6 per cent. grade; one charge runs four hours (this would correspond to three or four round trips) although it is capable of running six hours; the accumulators are heated by steam to about 125 degrees F. while they are being charged; descriptions and illustrations of the various parts are given; the cars will accommodate 32 passengers; each car contains 136 cells, of which eight are used to excite the fields and to run the lights, and the others are divided into four groups of 32 cells each which are connected by the controller in parallel, in multiple series or all in series, for the various speeds; the speeds are furthermore controlled by the field excitation, the field coils being divided into three parts (presumably in parallel), their connections being operated by the controller; there is an additional point on the controller, after the stopping point, at which the car will run backwards very slowly. There is one motor of 15 hp whose normal current is 160 amperes, the voltages being 100, 50 or 25; there is a single reduction of 1 to 6; the weights are as follows: car 10,340 lbs., motor and apparatus 1,760, accumulators 3,960 and passengers 4,224, making a total of 20,284 lbs. A long detailed estimate is given for a plant consisting of 60 cars but the figures are chiefly of local interest; there are 2.5 sets of batteries per car, the cost of which is estimated at $1,000 each; it is stated that in the plant in New York the power consumed, measured at the switchboard terminals, corresponded to a maximum of 0.64 kw hours per car-klm (corresponding to 1.07 per car mile); the total cost of the installation, not including the track, is $420,000 (the length of the road for this estimate is not given but it is assumed that each car per day travels 150 kilometres), the cost of renewing the accumulators including certain parts which wear out or are consumed is about half the cost of the power and slightly more than wages and salaries; besides this there is an amortization of 15 per cent. allowed on the batteries. The object of the commission is to find whether this estimate is correct.

See also another abstract under "Accumulators."

Light Railways.—The discussion of the report of the committee of conference of the Board of Trade is published and discussed editorially in the Lond. "Elec.," "Elec. Eng." and "Engineering," Feb. 8.

Electric Carriage.—The gearing and motor of the Jeantaud electric carriage (see Digest Feb. 16 and 23) is well illustrated in "La Nature" Jan. 26. Some corrections in the former article and further data regarding the power required to run the carriage are given in "L'Energie Elec.," Feb. 1. The one using the Tommasi accumulators is described with data in the Lond. "Elec. Eng.," Feb. 8.

Railroad of the Future.—The "Eng. Mag." for February contains a paper by Mr. Voorhees, devoted almost entirely to steam railroads. Referring to the Baltimore plant he states: "If this can be accomplished, may we not expect to see electricity ultimately supersede steam as the motive power of the locomotive? It will not do to declare it impossible; and yet it is very questionable if it will come in the near future. Electic lighting of passenger trains will doubtless come into general use as soon as a practical and reliable method is devised of generating the power from the axle of the car truck. But the expense involved in generating electricity in quantities sufficient to exercise a power equal to that of a first-class locomotive is so great that its use is at present impracticable."

St. Louis.—The "St. Ry. Rev.," Feb. 15, gives some tabulated data of the power, coal and water consumption of the Cass Ave. & Fair Grounds Railway, which is said to be the first railway plant in the world to use direct connected Corliss engines throughout; the average number of motor cars operated daily was 72, the average daily indicated hp per motor car 16.28, the pounds of coal consumed per motor car mile run 7.69; the trailer is estimated as half a motor car, the average number of trailers being 31. A similar table of results is given for the Citizens' Cable line, which has since been changed to an electrical line.

Swiss Mountain Road.—The "St. Ry. Rev.," Feb. 15, reprints from Lond. "Engineering" some of the illustrations and data from a recent paper by Mr. Preller.

Power Required in Electric Traction Under Varying Conditions.—The article abstracted at some length in the Digest Feb. 16 is reprinted in full in the "West. El." Feb. 16.

Overhead Construction in Chicago.—A well illustrated article describing some of the best and most substantial overhead work in Chicago is contained in the "St. Ry. Rev.," Feb. 15; it describes the overhead line work of three of the trolley lines in that city.

Magnetic Mechanism.—The "Elec. Age," Feb. 9, contains the first part of an article by Prof. Stine in which he attempts to correlate the work of Lodge and other investigators who have sought to explain magnetic and electric actions on the hypothesis of ether stresses. Electromagnetic reactions imply not only vertical motions in the ether surrounding a current but that the tubes of force have another motion coincident with their several axes. The set of the magnetic needle in its orientation implies that a tube of force has a motion of rotation and an axial motion which are represented by a right-handed screw. A magnetic line of force is regarded as a tube or vortex whirl in the ether. The whirl is commonly pictured by saying it resembles a smoke ring; but its motion more nearly resembles that of a screw. It combines a motion of rotation with a forward motion in the line of its axis. The electric current is defined as due to the breaking down of electrostatic stress tubes of force in the matter of the conductor. It is pointed out that the ether can transmit stress but not transform it. The stress energy is transformed in matter with the attendant phenomena of magnetic field, heat or power. The common conception that the ideal unipolar magnet would move along lines of force is shown to be not well founded. This ideal magnet is in a sense bipolar, but differs from the actual magnet in that it has no return lines of force in air. The article is illustrated with five original drawings which show the author's attempt to reduce electromagnetic ether stress to well established principles of mechanism.

ELECTRO-CHEMISTRY AND BATTERIES.

Borcher's Battery.—Mr. Fuge in the Lond. "Elec. Rev.," Feb. 8, gives the results of experiments to ascertain the origin of the E. M. F. A hydrochloric acid solution of cuprous chloride was used; the standard of comparison was a Leclanché cell taken as 1.6 volts; a carbon bell was used into the interior of which the gas was forced; with carbon as the other terminal also, no perceptible deflection was obtained when air was forced into one of them; when two of these carbon bells were used in a cuprous chloride solution the results were presumably as follows: with pure hydrogen and air, below 0.038 volt; with coal gas and no air about 0.038 volt; with coal gas and air the result was the same. With one of the electrodes of copper in a glass bell containing gas the results were as follows: no air in carbon bell and no CO around the copper wire 0.66 volt; with no air and with CO around the copper wire .054; under the same conditions but with air the result was the same; the admission of CO therefore lowered the E. M. F. and the admission of air made no appreciable difference in the E. M. F., from which it follows that the origin of the E. M. F. is the chemical action between the solution and the copper; this was shown also by weighing the copper before and after short circuiting the cell, it was found to have lost weight; he furthermore showed that the solution acted on the copper even when there is no carbon.

Cost of Battery Power.—In the "Elektrochem. Zeit." for February Dr. Ford discusses the cost of the energy produced by batteries, pointing out the importance of getting practical instead of theoretical results. Theoretically the consumption per hp hour (a metric hp is equal to 0.986 English hp) for a Bunsen cell with an E. M. F. of 1.8 is as follows: zinc 1.1 lbs., sulphuric acid 1.65, nitric acid 1.52; for a Daniell cell with an E. M. F. of 1 volt: zinc 2.0, sulphuric acid 2.95, copper sulphate 7.52. At average prices therefore the theoretical cost of a hp hour from a Daniell cell is not quite 24c. and from the Bunsen cell not quite 18c., not including the possible value of the by-products.

Accumulators.—The first part of an article by Mr. Darrieus is begun in "L'Elec.," Feb. 9. He discusses the general principle of reversible cells describing the Grove gas battery and giving the recent results of Messrs. Cailletet and Colardeau (see Digest, Dec. 8 and Jan. 5), in which they show that although the E. M. F. of a gas battery remains the same, the ampere hours which can be stored in platinum sponge increase with the pressure of the gas; he shows that the efficiency of such a couple would only be about 40 per cent. and concludes that such an accumulator would be impracticable; he promises in the next article to show what materials should be chosen and the object which should be borne in mind in selecting them.

Electrometallurgy of Copper in the United States.—An article by Mr. C. A. Hering is abstracted in the "Elektrochem. Zeit." for February; he gives the products of the various companies and brief descriptions of the processes.

Electrometallurgy of Copper.—An article on the Hoepfner process by Mr. Jensch is abstracted briefly in the "Elektrochem. Zeit." for February.

Gilding Porcelain.—According to the "Elektrochem. Zeit." for February Dr. Koenig states that designs on glazed earthenware may be electroplated with bright gold if the design is made with a metallic varnish, then fired and then electroplated.

[illegible]—An article by Mr. Laurie from the "Jour. Chem. Soc.," 50 and 51, Lond., is abstracted at some length with considerable data in the "Elektrochem. Zeit." for February; the results with a large number of alloys seem to point to the fact that some alloys form a chemical combination.

Ions.—An article on ions is begun by Dr. Gerstmann in the "Elektrochem. Zeit." for February; the first part is somewhat elementary in character.

Schafer-Heinemann Accumulator.—The "Eng. and Min. Jour.," Feb. 16, contains an article by Mr. Gibson describing this accumulator, which was developed about the same time as the chloride accumulator invented by Mr. Payen, and he believes that the practical results show that the former is better than the latter. Glycerine has the property of setting when combined with lead oxide; this material, when plastic, is introduced into the usual grids; the plates are then immersed in sulphuric acid to which permanganate of potassium in proportion to the size of the plates is added and an electric current is then applied, converting the compound into peroxide of lead and peroxide of manganese, that is, a lead salt of manganous acid; with the negative plates the process is reversed, forming spongy lead; the electric formation requires from 12 to 24 hours. The manganese has a double function, "it is intended to heighten the electromotor (sic) power given off by the change of the hyperoxide of lead to spongy lead," and also "to make room for the swelling of the molecules of lead through the absorption of oxygen." It is claimed that the discharging current can be increased to the greatest possible limit without injury to the plates. It is stated that the active matter unites firmly with the grid, like a growth. The capacity is given as 8.8 ampere hours per pound with a discharge of 1 ampere per pound of plates, while that for the chloride accumulator is given as 5.5 to 6.5 ampere hours at a discharge of 0.55 ampere per pound; the loss of watts in this accumulator between charge and discharge is said to be 1.4 to 5 per cent. (this means a watt efficiency of 95 to 98.6 per cent., but before this very improbable result can be accepted, the details of the tests and authority should be given; such figures throw a doubt on all the others); accumulators of this kind weighing 2,500 kg will propel a weight of 12,000 kg with a velocity of 20 km per hour for 17 hours. Data are given of tests made on a short line about 3,000 yards long, near Berlin; the speed was 12 km per hour; the car seating 32 passengers weighed 4,500 kg, the motor 2,250 kg, the accumulators 2,550 kg and the passengers 2,400 kg; each car had 150 cells with a capacity of 245 ampere hours at 10.5 amperes discharge rate and 126 at 42 amperes; the average hp is given as 4, equivalent to 9.8 amperes, from which it is calculated that the cars would run 24.5 hours (!); the charging voltage is said to increase from 2 to 2.5 volts (which shows that the above watt efficiency cannot be correct); numerous other figures are given but they are apparently based on estimates as distinguished from observed data; a comparative table is given for the cost of running per km including repairs, as compared with horse, steam and trolley traction, showing that it is from two-thirds to one-half of that of the trolley system and less than a half to about a quarter of that for horse traction (such figures cannot be accepted without better authority).

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Series Incandescent System.—The "Elek. Anz.," Feb. 3, contains an illustrated description of an alternating current system of Siemens & Halske. The primary current is maintained at a constant current strength; each incandescent light has its own transformer, all of the primaries of which are in series; the secondary circuit contains a 50-volt lamp and a 100 incandescent lamp in parallel, and under normal conditions only the former will burn, while only a very small current of half an ampere will be flowing through the other; when the first lamp breaks the voltage of the transformer will immediately rise to 100 and the second lamp will therefore burn normally, as there are a large number of transformers in series; if this second lamp should break the transformers are so proportioned that the rise of voltage will be only 15 to 20 per cent., and the transformer is so proportioned that its core will not heat too much. It is better to have the magnetic circuit of such transformers open, as the secondary voltage is then more independent of the load; the transformers have a transforming ratio of 20 to 50. The same system may be applied to a 50-volt arc lamp with two other like lamps in series as a reserve, the latter being so proportioned that they will not strike an arc with only 25 volts at the terminals of each.

Cost of Operation at the Portsmouth Station.—In Lond. "Lightning," Jan. 31, Mr. Manville gives some detailed statements. The results at this station are said to be of an exceptionally satisfactory nature, and he desires to emphasize this by giving the figures; the figures relate to the first six months and they would therefore probably be even more favorable after the station has been running for some time. The number of kw hours sold during these six months was 180,000, of which about 40 per cent. was supplied to private consumers; the cost of producing was as follows per kw hour: coal, 1.38 cents; oil, waste, carbons, water, etc. .66; all wages and salaries, including office expenses, 2.4; sundries, 0.16; total, 4.6; rent, rates and taxes are not included. He gives the costs for a number of low tension systems in England, which vary from 4.7c. at Bradford to 9.2c. at Hull, also for the high tension system at Dublin 7.8c; he concludes that there is not a single municipal low tension station running as cheaply as the Portsmouth station. He also gives some figures regarding the relative capital expenditure per units sold per year; this is as follows for the low tension systems: Bradford 57c, Glasgow 79, Manchester 63, Brighton 130, Hull 110, San Pancras 78; for the high tension system at Dublin 58, and for Portsmouth 76; it must be considered that the first six months does not represent fairly the output during succeeding periods.

Wolverhampton.—The Lond. "Elec. Rev.," Feb. 8, gives an illustrated description of this station. It is almost identical with the Oxford station, differing in that the voltage is doubled; it is a high tension continuous current, sub-station system of which there are now four in England; all the continuous current transformers in the district of supply may be controlled, stopped or started from one switchboard at some convenient central point; the voltage used is 2,000, and no difficulty whatever has been experienced with the commutators. According to Lond. "Elec. Eng.," Feb. 8, Lord Kelvin commented very favorably on this system.

Thiene.—A description of the new alternating current plant of Thiene, Italy, is given in "L'Elettricista," Feb. 1. The central station, which derives the power from the river Astico by means of a Hercules turbine, is situated four miles from the town; the current generated by a 33 kw Oerlikon alternator at the pressure of 2,000 volts is conveyed by overhead wires to a transformer and distributed by two three-wire conduits in the town. Oil insulation in the line was dispensed with, being thought unnecessary. The plant was started on Jan. 20, with provisions for a large extension which will be required very soon.

Mercury Switch.—A simple form is described and illustrated in the "Zeit. f. Elek.," Feb. 1; the two flexible wires nearly meet in a hollow space inside of a hinged handle which contains mercury; moving this handle up or down will connect or disconnect the ends of the two wires.

Three-Phase Plant at Concord.—The "West. El.," Feb. 16, contains a number of illustrations showing the wiring and some of the architectural features of this plant, which is said to be the first large installation of lights in this country using this system.

Construction of Electric Plants.—The third article of the series by Mr. Armstrong is published in the "Elec. Ind." for February.

Isolated Plant.—"Elec. Ind." for February contains a long and well illustrated description of a "model" arc lighting plant consisting of three dynamos, each connected directly with a Willans engine.

Electricity for Mechanics.—A short, illustrated article by Mr. Cutter, giving the elementary principles of electric distribution, as illustrated by analogies, is published in "Elec. Ind." for February.

WIRES, WIRING AND CONDUITS.

Explosions in Conduits.—Major Cardew's report on the recent Euston Road and Cannon street explosions is published in the Lond. "Elec." and "Elec. Rev.," Feb. 8; his report on the St. Pancras explosion is published in the Lond. "Elec. Eng.," Feb. 8. The Board of Trade Inquiry of the Southwark Bridge explosions is published in the Lond. "Elec.," "Elec. Eng." and "Elec. Rev.," Feb. 8. The subject of gas explosions is also discussed editorially at some length in the Lond. "Elec." and "Elec. Eng."

The same journal gives an illustrated description of a gas testing apparatus by Mr. Clows, in which a sample of air is taken from the conduit and is tested by being passed over a standard flame of hydrogen gas in a specially devised apparatus, and by the appearance in this flame of a pale cap or halo the presence of inflammable matter is shown, the percentage of inflammable matter being measured with considerable accuracy by the height of this flame-cap; the apparatus is well spoken of in an editorial. The test is not affected by the presence of carbonic acid gas up to 5 per cent.

Mr. Jenkinson, in the Lond. "Elec. Rev.," Feb. 8, gives an illustrated description of his proposed ventilating system in which a pipe from the top leads to a ventilator, fresh air being at the same time admitted through a drain pipe at the bottom suitably connected with the open air.

Constructive Features of Transmission Lines.—The "El. Eng'ing" for February contains a very long and well illustrated (100 cuts) article by Mr. Abbott, chief engineer of the Chicago Telephone Company, in which he describes the latest approved methods of constructing overhead and underground circuits for telephone, electric light and street railway lines; the greater part of it is devoted to overhead lines; he does not discuss the calculation of the proper cross section to carry the current, limiting himself to the mechanical arrangements and the insulation; it is of a practical nature and appears to embody the results of considerable experience.

Conduit.—The Cummings & Engleman system is described and illustrated in "Elec. Ind." for February; the conduit contains two angle irons on which two horizontal trolley wheels travel.

ELECTRO-PHYSICS AND MAGNETISM.

Modern Theories of Electricity.—The Lond. "Elec. Rev.," Feb. 8, editorially criticises the recent article of Prof. Rowland (see Digest, Jan. 12). It inclines to favor the reverse of the assertion that electricity is not a fluid; the only objection to the fluid theory is Poynting's theory that the electric energy does not flow through the conductor, but through the dielectric and into the conductor where it is dissipated in heat, but this theory is founded on the elastic solid theory of the dielectric, and Glazebrook has recently admitted that the elastic solid theory has failed.

Electrification Derived from Incandescent Conductors.—The Lond. "Elec.," Feb. 8, abstracts briefly, with an illustration and some curves, a table by Drs. Vicentini and Cinelli, from the "Nuovo Cimento" for December, describing experiments on the transmission of electricity through gases surrounding red hot current conductors. A plate near such a conductor assumed potentials slightly higher than the mean of that of the wire, the excesses varying with the gas and the potential diminishing as the distance increased, especially when the plate was below the wire.

Retardation of the Polarization in Dielectrics.—In an article by Mr. Arno, in "L'Eclairage Elec.," Jan. 26, he shows the analogy of the magnetic hysteresis as pointed out by Ewing and Klaassen, and a similar phenomenon in dielectrics; the article is short and contains a large table of data.

Magnetic Qualities of Iron.—Mr. Lori published in "L'Elettricista," Feb. 1, the results of some investigations on the magnetic qualities of iron. The paper will be concluded in the next issue.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Electroscope.—According to the Lond. "Elec. Rev.," Feb. 8, Dr. Lodge stated that by placing a gold leaf electroscope on a cake of paraffin wax and electrifying it outside, negatively, the leaves will then stand apart for zero potential, diverging more for positive and collapsing for negative charges, thus showing their difference, which ordinarily it does not show; he proposes mounting a projection electroscope in a slightly charged Leyden jar for lecture purposes.

Definition of Reactance.—In "L'Elettricista," Feb. 1, Mr. Giorgi discusses the various definitions proposed for reactance, giving preference to that of the American Institute; he points out the difference between impressed and resultant E. M. F. and between true and apparent reactance.

Units of Light.—An abstract of the paper by Messrs. Lummer and Kurlbaum (see Digest, June 2, Sept. 22, Dec. 1), is published in the "Progressive Age," Feb. 1.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone Switchboard in Paris.—A translation of Mr. Hospitalier's article mentioned in the Digest, Jan. 12, is published in the "Elec. Age," Feb. 16, with illustrations.

Origin and Development of the Telephone Switchboard.—The Institution paper of Mr. Kingsbury is reprinted in the "West. El.," Feb. 16.

MISCELLANEOUS.

Lightning and Telegraph Insulators.—A peculiar case is described in the "Jour. of the Inst. of Elec. Eng." for January, and in the "Elec. Eng.," Feb. 8, in which lightning grounded through a porcelain insulator leaving a brown spot on the outside near the wire and another on the hood near the support; as it did not destroy the insulation it is thought that it must have passed over the whole surface of the porcelain.

Aurora Boreales.—In "L'Eclairage Elec.," Jan. 26, Mr. Zenger gives a large table of dates of recent auroras and points out some striking coincidences of these dates with certain periods in the year, and their apparent connection with the periods of meteoric showers.

Ozone.—In a paper by Messrs. Wiedemann and Schmidt, from the "Ann d. Phys. Chem.," 13, 924, briefly abstracted in the "Elektrochem. Zeit," for February, they show that regular oscillations of a definite period are more active in the generation of ozone than those of irregular periods usually used.

Electrotherapeutics.—In "L'Elettricista," Feb. 1, a description is given of a large electrotherapeutic installation in Milan, Italy; this installation is said to be the largest one in Europe supplied from central stations.

Biographical.—The biography of Hertz is continued at some length in "L'Eclairage Elec.," Jan. 26.

New Book.

A Laboratory Manual of Physics and Applied Electricity. Arranged and Edited by Edward L. Nichols, Professor of Physics in Cornell University. In two volumes. Vol. I. Junior Course in General Physics, by Ernest Merritt and Frederick J. Rogers. 294 pages, 108 illustrations, 2 plates. Price $3. Vol. II. Senior Courses and Outlines of Advanced Work, by Geo. S. Moler, Frederick Bedell, Homer J. Hotchkiss, Charles P. Matthews, and the editor. 436 pages, 245 illustrations, 2 plates. Price $3.25. New York: Macmillan & Co.

This work will undoubtedly be of great value to the modern laboratory. Most students of physics in our universities are preparing to meet the practical problems of every day life. They do not study and investigate for the advancement of pure science only, or to become teachers, but to be able to grapple with the problems occurring in mechanical and electrical engineering, and to bring to bear upon their solution all the skill of the original investigator. To assist in accomplishing this object a corps of teachers at a great university like Cornell, with her unrivaled laboratories, are peculiarly fitted, and have united in the arrangement of experiments in the work before us that have been found by long experience to be most conducive to their students' advancement.

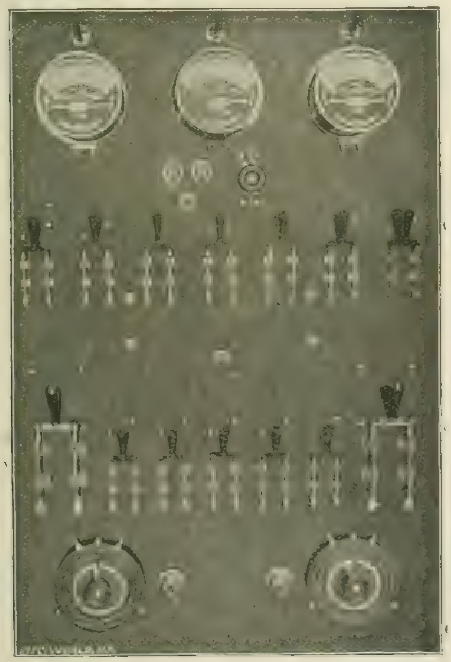
The first volume is intended for beginners and affords explicit directions, together with demonstrations and occasional elementary statements of principles. These are not gotten up for the purpose of filling the book, but are only such as have been in actual use. They do not cover the whole of physics, and consequently before he undertakes this work the student is assumed to possess some knowledge of analytical geometry and of the calculus, and also to have completed a text-book and lecture course in the principles of physics. Care is taken throughout to make clear the object of the experiment in hand, and the means to be employed in accomplishing this object.

In the second volume more is left to the individual effort and to the maturer intelligence of the student. The very nature of the subjects dealt with compels the introduction of new material with necessary accompaniments of freshness and novelty which make reading positively refreshing.

In parts I., II. and III. of Vol. 1 we find a large amount of work in applied electricity, in photometry, and in heat, which seems especially suitable for the training of students in engineering, but may also serve to introduce the student of pure physics to modern appliances. The alternating current experiments are particularly interesting. The last part of the volume is intended for those who have had two years or more of laboratory instruction, and consists of hints for more advanced work. In this connection original memoirs are to be consulted, many are named, and the student is encouraged to read all that bears upon the subject to be investigated. Indexes and catalogues are referred to, by consulting which the student can find what he wants without undue waste of time. Typical results from the labors of those who have gone before, and upon whose foundations it is assumed that other and more complete structures will be built, have been freely used.

Throughout it is clear that the editor has been over the ground himself, not through the medium of books, but in actual experience, and he is therefore entitled to make serious suggestions for the guidance of others. The latter chapters are on "Influence of Temperature," "Efficiency of Artificial Light Services," "Spectrophotometry," "The Invisible Spectrum, Physiological Optics," and "The Earth's Magnetic Field." Many useful tables and curves are given throughout the volumes.

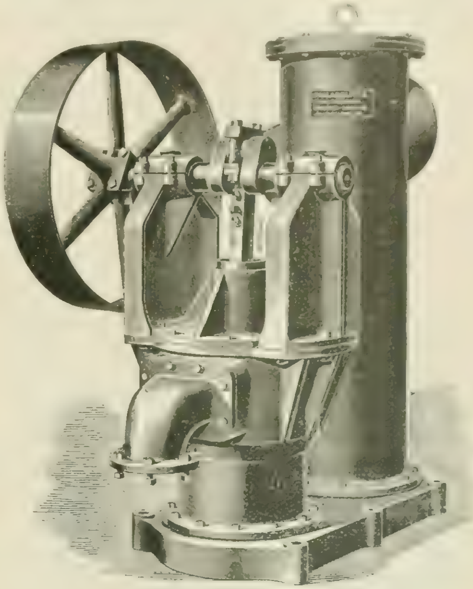
Electrical Discovery is the name of a new English journal devoted to patent interests. While the English *Official Journal* furnishes short abstracts, these do not appear until long after the period for opposing the grant of such patents has expired, and as they do not contain the full title or the claims, they are of little or no business use. The new journal is designed to meet this want. Its abstracts will be published in ample time for any interested party to oppose the grant, and the claims will be inserted in full. Prompt notices of all applications to amend specifications, revive lapsed patents, or extend expiring ones will be inserted. It is intended also to give digests and reports of patent cases of interest to electricians. A small portion of each number will be devoted to lists and notices of new electrical publications.



A Handsome Switchboard.

Belt Driven Air Pump and Jet Condenser.

The belt-driven air pump combined with a jet condenser, illustrated herewith, and made at the Philadelphia Engineering Works, Mifflin street, Philadelphia, Pa., is particularly adapted for use with engines of the Corliss type. The belt-driven arrangement used permits the air pumps to be placed on one side of the foundation and back of the fly wheel, thus securing the shortest and most direct exhaust pipes, making it convenient for examinaion to the engineer and avoiding the cutting into the foundations that would be necessary were the air pump driven from the crank pin. Another advantage is that should wood or other obstacles float into the pumps or any of the parts become loose, the belt would slip or tear before breaking the pump, whereas if positively connected to the crank pin more or less destruction might ensue. Another very notable advantage is the much greater economy of operation that follows owing to the vast superiority of efficiency in generating power from the main engine over small driving engines. The condenser is fitted with baffle plates exposing a large portion of the water to the action of the steam. The valve opening through the plunger and valve plate is ample for more than the rated revolutions. The valves are made of the best vulcanized rubber, which have bored and faced moulded bushings. These in turn are built upon brass stems screwed into and riveted over the brass seats. The valve guard is secured upon the stem by jam nuts; no springs are used, thus giving easy play to the valves. The iron fitted pumps have brass stems and valve seats, brass bush valves, brass inside nuts, piston rod and gland rings. The brass fitted pumps are bushed throughout the barrel, have brass plungers and followers and crossheads and brass lined guides for the crossheads. A vacuum is guaranteed equal to 27 inches with water at 60 degrees F.



Belt-Driven Air Pump and Condenser.

A Handsome Switchboard.

The switchboard we illustrate, made by J. Grant High & Co., 123 North Third street, Philadelphia, has an added interest from being used with the first Edison isolated plant installed in Philadelphia—in the Mill Building, Spring and Twenty-fifth streets.

The board is made up of black enamelled slate, 6 feet by 4 feet by 1 inch thick, and placed on a wrought iron frame, all connections being made on the back of the board. The board is fitted with two Carpenter enamel rheostats, an ammeter and voltmeter of Weston make, and a ground detector. There are also mounted two 200-amp. double pole main switches, twelve 50-amp. circuit switches, two snap switches on the bottom for controlling the rheostat, and one snap switch in the centre for controlling pilot lamps. All parts of the work on the board are machine finished. As will be seen, the board presents a handsome appearance, and gives a good idea of the advance in switchboard work that has recently been made.

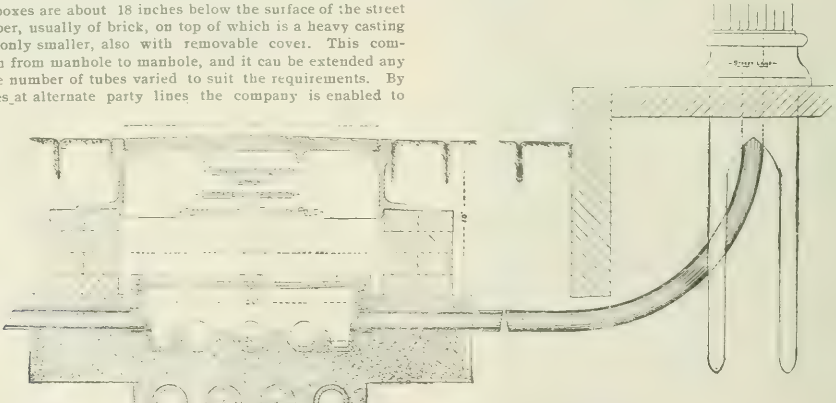
A New Cleat.

A new cleat is being placed on the market by the Anchor Electric Company, 71 Federal street, Boston, which as will be seen from the accompanying cut, presents a neat appearance. Owing to the grooves the conductor is firmly anchored, and the same size is equally suitable for heavy and light work. The cleat is strong, thus obviating loss from breakage, and has the additional advantage of requiring no matching of parts, both halves being alike.

A New Cleat.

Underground Conduit System.

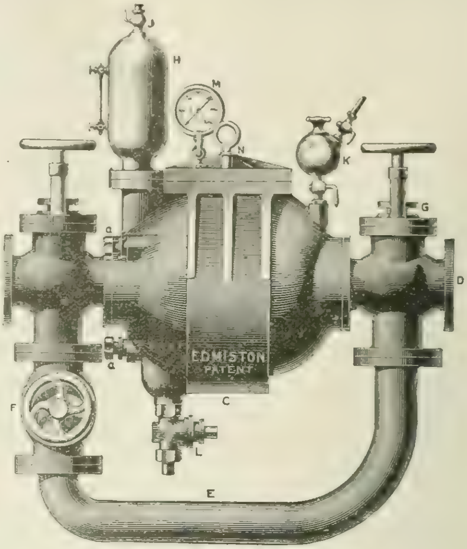
An underground conduit system which has shown itself to be extremely satisfactory in practice is that of the National Conduit Manufacturing Company, Times Building, New York. In this system manholes are constructed about 400 feet apart and in the connecting trench wrought iron cement-lined conduit tubes are placed in one or two layers of four each, being surrounded by a matrix of broken stone, sand and cement, this forming the main or trunk system. On top of these is placed a third layer of three tubes, and at intervals of about 50 feet, corresponding to every alternate house line, is placed a specially designed cast iron box with a removable water-tight cover. These boxes have side outlets and their bottoms are arranged to conform to the lower half of the tubes, thus making a continuous channel for passing the cable from manhole to manhole. The boxes are about 18 inches below the surface of the street in a small chamber, usually of brick, on top of which is a heavy casting like a manhole, only smaller, also with removable cover. This completes the system from manhole to manhole, and it can be extended any distance, and the number of tubes varied to suit the requirements. By placing the boxes at alternate party lines the company is enabled to reach two houses from one box, and three distributing tubes are all that are necessary for any one block. The main trunk cable is tapped in the manhole and the branch cable laid from it to the distributing tubes and boxes. A connection is made to the cellar of the building from the latter by means of a wrought iron tube. This system has been very widely adopted in the large cities of this country, including Chicago, Allegheny and Buffalo.



Underground Conduit System.

Feed-Water Filter.

The Edmiston feed-water filter, made by the Wheeler Condenser and Engineering Company, 39 Cortlandt street, New York, and illustrated herewith, is of the single type, having a by-pass connection and valves. The water from the feed pump enters at the opening *A*, and passes directly into the body of the filter through a series of chambers separated by diaphragms of filtering material and thence out through the outlet nozzle *D* to the boiler. The by-pass pipe *E* and valves *F* and *G* are for use when the filtering material requires cleaning or renewing, thus permitting a continuous operation of the feed pump. The filtration is effected by the feed-water first passing through a perforated plate, then through coarse cloth, the latter being held in place and supported by a perforated brass plate; then through another series of chambers separated by similar diaphrams of filtering material but of finer texture.



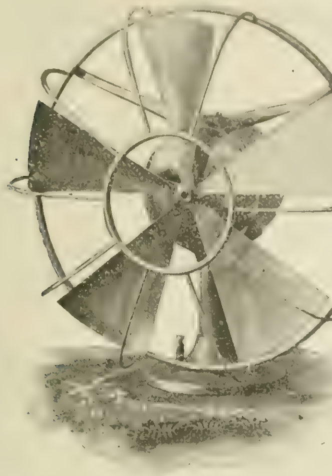
Feed-Water Filter.

The plates to which the filtering materials are secured are carefully fitted and securely held in place by set screws *a*, thus insuring water-tight joints. The air chamber *H* is provided with a scum cock *J*, which is opened when the glass water gauge indicates an accumulation of oil. The soda cock *K* is fitted with a steam connection for the purpose of removing oil and dirt from the filtering material by boiling and blowing out through the sludge cock *L*. The gauge *M* indicates the pressure in the filter chamber, the normal pressure being from two to five pounds above boiler pressure. When the pressure rises above five pounds, the by-pass connection is opened and the filter inlet and outer valves are closed, thus allowing the feed-water to reach the boiler without going through the filter while the latter is being cleaned.

From a large number of experiments made with this filter in connection with high and low pressure boilers, it has been found that the oil or greasy matter is arrested, together with other deposits, including oxide of copper, iron, lead, tin, silica, fine sand, and other foreign matter—all highly injurious to boilers. The apparatus is a simple one, easily looked after, occupying little space, not liable to get out of repair, and moderate in first cost. These filters are in use on several hundred merchant steamships throughout the world, among which are some of the largest transatlantic "flyers," and have been adopted by a large number of governments for naval purposes.

Alternating Fan Motor.

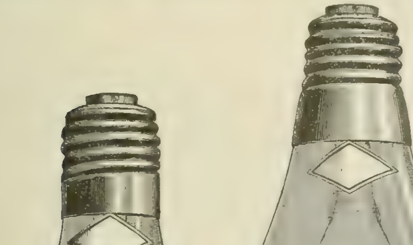
A serious disadvantage of ordinary alternating current fan motors for desk use is the buzzing noise, due partly to the high speed at which such motors usually run, and partly to the vibrations caused by the alternations. The W. J. Davis Electric Company, of Pittsfield, Mass., has endeavored to minimize this drawback in the design of its alternating current fan motor shown in the accompanying illustration, by a substantial construction and comparatively slow speed. The reduction of speed is obtained by making the armature unusually large in diameter, and loss of cooling effect which would ordinarily be entailed is compensated for by making the fan fourteen inches in diameter instead of the usual size. The speed is only 900 revolutions per minute. Other points of merit claimed are small current consumption, light weight, and prompt starting. The commutator is of hard-drawn copper insulated with micanite, and the bearings are of the self-oiling ring type.



Davis Electric Fan.

A New Incandescent Lamp.

A new incandescent lamp is being introduced by J. Jones & Son, 67 Cortlandt street, New York, under the name of the "A. B. C.," for which the claim is made that long life is attained with high efficiency, and sustained candle power. Lamps of 16-cp at 110 volts are said to require but .4 or .5 ampere or .55 ampere when a specially long life is desired. The objectionable feature of sagging of filaments is entirely overcome, and the new A. B. C. may be placed in any position without detriment to the lamp in this respect. Each lamp is accurately measured and carefully tested 30 minutes before leaving the factory. The best of material is used, the glass is clear, the base solid and the workmanship thorough throughout.



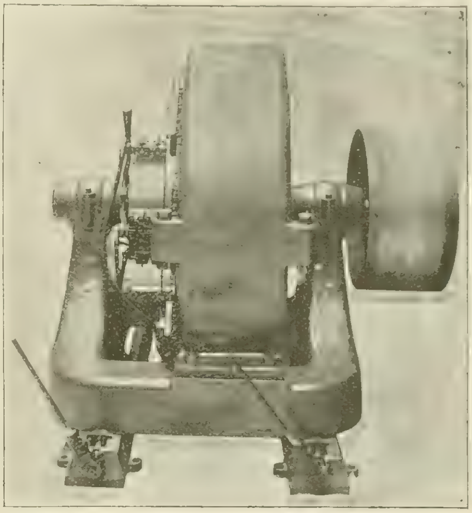
A New Incandescent Lamp.

A guarantee is given that the 4-watt lamp will average a life of 1,500 hours, the 3½-watt lamp 800 to 1,000 hours, and the 3-watt lamp 600 to 800 hours. As shown in Fig. 1, in the regular 3½ and 4-watt lamps the carbon filament is of spiral form, giving by this means a good-sized surface of carbon in a small globe. The material used for the purpose is one selected after a long and tedious process of experiment to get the proper thing for long life and brilliancy, together with freedom from blackening. Fig. 2 represents the special railway lamp, which is made with the double coil filament, no anchor being needed. All styles of lamps are being made from battery lamps up.

A New Multipolar Dynamo.

We illustrate herewith the new street railway and power generator recently brought out by the Commercial Electric Company, of Indianapolis, Ind. The magnet frames are of cast steel, and all parts of the magnetic circuit are so proportioned that the requisite field is obtained with the smallest possible expenditure of energy, thus making a most efficient machine, both under light and heavy loads.

The armature is of the smooth core, Gramme ring type, which is claimed to be the only form that will operate under wide variations of load without sparking at the brushes, and do away with eddy currents in the pole pieces—a serious source of loss in all machines with toothed armatures. Each armature coil is entirely independent of the other, and if one is damaged it can be removed and replaced without disturbing the others. Coils of the 110 and 220-volt generators are wound separately on forms and then assembled on the armature core. These coils can be furnished complete ready to be placed on the armature, and thus repairs are most readily made. Both armature and commutator are thoroughly ventilated, and the fields have a large radiating surface, so that the heat is readily dissipated. The maximum temperature of any part of the machine after a continuous run is less than 40 degrees Centigrade above the air. The regulation is practically perfect, the constant potential machines varying less than 2 per cent. from no load to full load.



A New Multipolar Dynamo.

These machines have self oiling, self aligning bearings of the spherical type, with bronze linings, and the oil reservoirs are of large capacity, so that the oil need not be removed frequently. The commutator has a great number of segments and a large bearing surface so that the currents are collected with scarcely any heating of either commutator or brushes. The segments have a great depth, so that the commutator may be turned down many times before it will have to be renewed.

These generators are furnished for either lighting or power, and are particularly adapted for street railway work on account of their ability to withstand heavy temporary over-loads and their freedom from sparking under wide variations of load, peculiar to this service. They may be either belt driven or arranged for direct connection to any standard make of engine.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Feb. 23, 1895.

THE ELECTRICAL STOCK MARKET, with the whole financial world stagnant pending the settlement of national treasury troubles, must needs have been in a comatose condition during the week ending to-day, and there is but little to note concerning fluctuations or market interpretations of stock values. On the other hand nothing has developed to lessen that faith in the "good times coming" warranted by the conditions outlined in these columns heretofore.

GENERAL ELECTRIC still remains the one active stock of the electrical group, that is, to speak in a comparative sense, for none of the group is conspicuous these days in the trading. Nor is it likely that General Electric will soon enjoy a boom, but there is no reason to fear, on the other hand, that any decline is at hand and that for many good reasons previously herein stated. From hints let fall by insiders, however, it will be a long time ere dividends are again paid on either class of General Electric stock. It is now practically decided that at the annual meeting of the stockholders—to be held at Schenectady on the second Tuesday in May—no action at all will be taken on the question of correcting the impairment of the capital stock. Up to date the company has been allowed to work out its own salvation as best it may, and this policy, it has been decided, will be continued, and as this is a rather slow, though from present indications, a sure method of correcting the deficiency, there can be no distribution of profits for many months to come, though the preferred stock dividends are in the meantime cumulative. The annual report, by a new Stock Exchange ruling, will be issued fifteen days before the date of the annual meeting. In the meantime speculation is rife as to the showing it will make. Officials of the company say they have no idea of the profits made as the result of the 1894 operations, although they assert in a general way that the company has been fairly successful. Most curiosity is evinced as to the amounts, if any, which will be charged off of the patent and franchise account, as a result of the adverse decisions in recent cases, as for instance, the "feeder and main" defeat. The point is made that, while the company has been knocked out in several important instances, its position has been strengthened in other directions by favorable decisions equally as important. Among other things, the company won this week at Cleveland, Ohio, the suit of the Edison Electric Light Company against the Universal Electric Company, both of that city, to enjoin the manufacture of a variety of incandescent lamps, Judge Ricks holding that the plaintiff was entitled to the action prayed for and ordering a decree to be prepared accordingly. The decision is understood to cover very broad principles and to be of great value to the General Electric Company.

ELECTRIC STORAGE has been conspicuous on the Philadelphia Board for both activity and strength. There is still a lot of talk regarding favorable developments soon to come to light, but the interested and knowing ones refuse to divulge the secret, if there is one, and it is impossible to resolve the reports into facts The story most repeated is to the effect that a new consolidation or alliance is at hand that will greatly aid in the introduction of the company's batteries, and enough circumstantial evidence in the way of meetings, etc., exists to lend color to the story. In the meantime the stock rules strong, and quite a healthy demand for it is noted.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	128	130
Edison Electric Ill., New York	100	95	98
" " " Brooklyn	100	105	107½
" " " Boston	100	124	126
" " " Philadelphia	100	120	124
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	32	34
General Electric	100	29⅛	30
General Electric, pref	100	61	66
Westinghouse Consolidated, com	50	30	30½
" " pref	50	48½	49

BONDS

	Par.	Bid.	Asked
Edison Electric Ill., New York	1,000	107½	108
Edison Electric Light of Europe	190	75	85
General Electric Co. deb. 5s	1 000	89	90

TELEGRAPH AND TELEPHONE.

	Par.	Bid.	Asked
American Bell Telephone	100	191½	192½
American District Telegraph	100	45	49
American Telegraph & Cable	100	90	92
Central & South American Telegraph	100	117	120
Commercial Cables	100	130	140
Erie Telephone	100	46	46½
Gold & Stock Telegraph	100	104	110
Mexican Telegraph	100	190	195
Mexican Telephone	100	75	80
New England Telephone	100	67	69
New York & New Jersey Telephone	100	97½	99
Postal Telegraph-Cable	100	55	58
Western Union Telegraph	100	88	88½

WESTINGHOUSE ELECTRIC issue are a little lower, but the changes are of no significance. The scrip just now holds particularly strong. Pittsburgh notes an offer now of several weeks standing for a block of these securities at 97, but none is available at that figure and the order still remains unfilled. The interest due on the scrip March 1 next will be paid to holders of record on that date. Transfer books close to-day.

ELECTRIC CONSTRUCTION & SUPPLY COMPANY'S stock is not worth very much these days, seeing that the company has just been placed in the hands of General Manager Robert Corey as receiver. The company is insolvent, and business has been suspended for lack of funds. Receiver Corey says that the nominal assets may be nearly sufficient to cover the indebtedness, but that, if the assets were put up at forced sale very little would be realized, and the only way of meeting the indebtedness would be by some arrangement between the company and the creditors as to time and forbearance. The company is a New Jersey corporation of some years' standing, succeeding a New York company incorporated a year or so before. It paid 8 per cent. dividends up to a year ago, when the hard times came.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of Brooklyn, reports January gross earnings of $49 335, an increase of $8,916. The net earnings were $24,091, which, after deducting interest on bonds, leaves an amount applicable for dividends of $23,664.

ELECTRIC TRACTION STOCKS.

	Bid.	Asked.
Union Ry. Co. (Huckleberry)	115	125
Brooklyn Traction, com	9½	10⅛
" " pref	53	55
Long Island Traction	7	8
Rochester St. Ry	36	38
Columbus St. Ry	48	50
Louisville St. Ry. com	37	39
" " " pref	87	88
Cleveland Electric Ry.	59	60
Cleveland City Ry.	68	70
North Shore Traction	23	25
New Orleans Traction	15	16
New Orleans Traction pref	55	58
Worcester Traction com	14	16
" " pref	78⅛	80
Metropolitan Traction, Philadelphia	98¼	98½
Philadelphia Traction	89	89⅛
People's Traction	49½	50
Binghamton R. R. common	100	—

BONDS

	Bid.	Asked
*Union Ry. 1st. mtge 6s.	105	108
*Westchester Electric 1st. mtge. 5s.	98	101
Rochester St. Ry. 1st. 5s	95	97
*Columbus St. Ry. 1st 5s.	95	97
Columbus Crosstown 1st. 5s.	95	97
*Binghamton Railroad Co. 5s	99	100

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* With accrued interest.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD.
253 BROADWAY, NEW YORK, Feb. 25, 1895.

MR. WM B. VANSIZE, Counselor-at-Law and Patent Solicitor, has removed his office to the Postal Telegraph Building, where he will do a general patent soliciting and patent litigating business.

BROOKLYN, N. Y.—Commissioner White has submitted specifications for furnishing electric lights for lighting the streets for the current year. He recommends that bids be taken separately for lighting the streets and for lighting the public buildings, instead of taking both on the same proposal, as heretofore.

MR. W. A. STADELMAN, who was formerly with the Sprague Electric Company, and more recently special representative for the Niles Tool Works Company, has been appointed general eastern manager for the Brown Hoisting and Conveying Machine Company, and the Elwell-Parker Electric Company of America, of Cleveland, O., with headquarters in New York, and to take effect the 1st of March.

NINE HUNDRED MEMBERS of Local Union No. 3 of the Brotherhood of Electrical Workers are idle. The men have been working under an agreement which made nine hours constitute a day's work. This agreement expired Saturday, Feb. 18, and the men asked for a new arrangement specifying eight hours as a day's work, claiming that ample notice had been served on the Contractors' Association, that this demand would be made. The latter denied having received such notification, and offered to adopt the eight-hour standard on and after May 18, which was declined by the workmen, and a deadlock followed. The workers claim it is a lockout, while the contractors contend it is a strike.

BROOKLYN ALDERMEN are discussing municipal ownership of electric lighting. At a meeting on Feb. 18 a vote of 14 to 2 was in favor of extending the rights of the Municipal Electric Light Company over the entire city, with these conditions: The company is to charge 40 cents per night for each light ordered by the city, and is to pay $20,000 in money to the city for the extension allowed; at the end of ten years the city is to have the power to become the owner of the plant of the company upon the payment of a sum of money equal to its original cost. The Brooklyn *Eagle* says the scheme is the surrender of the whole of Brooklyn's territory to one concern, the outlawry of the Edison Company, which has been the only square dealer with the city on this subject, and the finical exaction of $20,000 as a sop or premium or toll from the benefited organization.

THE STATEN ISLAND ELECTRIC RAILWAY WRANGLE is still in full swing. In Brooklyn last Wednesday application was made to Judge Smith of the Supreme Court, by Julien T. Davies, on behalf of the Staten Island Electric Railroad Company, known as the "Thomas Syndicate," to vacate the temporary injunction obtained by Richard B. Whittmore, restraining a number of the Supervisors of Richmond county from granting permission to the syndicate to build and operate a trolley line in the Shore Road and Richmond Terrace. The application was denounced by John Crook, lawyer for the plaintiff, as "a bare-faced attempt to legalize a monster grab, robbing the people of Staten Island of hundreds of thousands of dollars." He stated that the four supervisors against whom the injunction is directed have publicly declared their intention of giving the franchises to the syndicate without any compensation whatever, on the sole condition that they obtain the franchise now held by the Staten Island Belt Line, a company which has been insolvent for years, and which is now in the hands of a receiver. Judge Smith denied the motion to vacate the injunction, but allowed a slight modification of the order.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Feb. 25, 1895.

MR. JOHN O. HEINZE, JR., of Lynn, Mass., has associated himself with the Thompson-Brown Electric Company, as its electrical engineer, and is a valuable acquisition to this company.

THE THOMPSON-BROWN ELECTRIC COMPANY, Boston, has closed a contract with the Bijou Theatre of that city to furnish the switchboard in connection with its magnificent lighting plant, now in course of construction. The company is to be congratulated upon having secured this order, and says it will be one of the handsomest ever built.

THE PETTINGELL-ANDREWS COMPANY of Boston, is just about placing on the market a new line of drop forged overhead material. The company is also making a specialty of supplies for fire alarm and police signal systems, and with its usual energetic methods, results are already proving this to be a wise move. Vice-President Andrews and General Manager Price report business as exceedingly good, so much so that neither of them were able to attend the Cleveland Convention.

THE ANCHOR ELECTRIC COMPANY, Boston, continues to forge ahead. Its trade-mark, made entirely of porcelain insulators, is now to be seen in its display windows, and certainly presents a "nobby" appearance. This company has recently secured the control of the Dow adjusting ball, which has gained such a widespread popularity. It is, moreover, sole New England agent for the Ohio Brass Company, Helios Electric Company, the Crescent ceiling fan and many other specialties, and the prospects for the spring trade are already so favorable as to tax severely its present quarters. The demand for the "Anchor Cleat," its latest production, is said to be so great that it is almost impossible to turn them out fast enough.

CANADIAN NOTES.

OTTAWA, Feb. 23, 1895.

MILTON, ONT.—The Milton Electric Light & Power Company, with a capital of $15,000, is applying for a charter.

WINNEPEG.—The city corporation is applying to the legislature for power to own and operate electric plants for street lighting.

QUEBEC.—The Montmorency Electric Power Company has received over 200 applications for the vacant position of secretary-treasurer.

HULL, QUE.—Peter Ryan, of Toronto, has secured the option of purchase of the charter of the Hull & Aylmer electric railway for $50,000.

GUELPH, ONT.—Application is being made to the legislature for a charter to construct and operate an electric street railway in this city.

TORONTO.—The earnings of the Toronto Electric Street Railway during January were $70,431, while operating expenses are placed at $42,000.

OTTAWA.—The Ottawa Electric Street Railway Company will make extensive extensions to their lines in this city as soon as the spring opens.

HAMILTON, ONT.—The Hamilton Radial Electric Railway is applying for power to operate the Guelph and Berlin branches by either electricity or steam.

MIDLAND, ONT.—The Midland Electric Company, with a capital of $10,000, is applying for a charter for supplying electricity for light, heat or power purposes.

CORNWALL, ONT.—The Stormont Electric Light & Power Company is applying to the legislature for an act ratifying its purchase of the Cornwall Gas Works.

OTTAWA, ONT.—The Hubbell Primary Battery Company, with a capital of $45,000, has received a charter from the Ontario Government. It will start a factory in this city.

MORRISBURG, ONT.—A telephone war is in progress here between the Bell Company and the Dundas Company. Free service is likely to drive out the weakest competitor.

HAMILTON, ONT.—The Hamilton, Burlington & Lake Shore Electric Railway Company is applying for a charter to construct a line of railway from Hamilton to Burlington.

OTTAWA, ONT.—Robert Anderson, of this city, has finished his contract for introducing an electric light service throughout Rideau Hall, the residence of the Governor-General at the Capital.

TORONTO.—The annual report of the street railway company gives gross earnings at [illegible], and operating expenses 4 per cent. Net income was [illegible], or 4 per cent. on capital of [illegible].

OTTAWA.—The Ottawa Porcelain & Carbon Company has just purchased a site for the erection of its factory in this city. The factory will be [illegible] feet long, 100 feet wide, and three stories high.

KINGSTON, ONT.—The Kingston & Gananoque Electric Railway Company is applying to the legislature for power to construct a line of railway from Kingston to Gananoque, Brockville and Westport.

GALT AND PRESTON.—The powers of the Galt & Preston street railway have been extended to enable the company to construct and operate electric railways through the township of Waterloo to Hespeler.

MONTREAL.—Chas. W. Hagar, general manager of the Royal Electric Company, has been succeeded by W. H. Browne, of New York, formerly manager of the United Electric Light & Power Company, of that city.

WINDSOR, ONT.—The Windsor, Amherstburg & Lake Erie Railway Company is applying for a charter to construct and operate a line of railway, steam or electric, from Windsor to Sandwich, thence to Amherstburg.

MONTREAL.—The St. Jean Baptiste Electric Company is arranging for an extension of its lines. Tenders are to be receivd for new engines and dynamos to be added to their plant. Their capital has been raised to $500,000.

BRANTFORD, ONT.—The Brantford, Port Dover & Galt Radial Electric Railway Company is applying to the legislature for a charter to construct a line of electric railway from Brantford to Paris, Galt, Oakland, Townsend, Simcoe and Port Dover.

HAMILTON, ONT.—The Hamilton, Valley City & Waterloo Railway Company is applying to the Ontario Legislature for power to construct an electric railway from the city of Hamilton to Guelph, passing through the townships of Boston, Ancastar, West Flamboro, etc.

OTTAWA, ONT.—The electrical display which attracted so much attention during Carnival week in this city was designed and carried out by Robert Anderson, who recently received the contract from the Dominion Government for introducing an electric plant in the Government House in this city.

PETERBOROUGH, ONT.—J. Kendry, Thos. Catrill, G. W. Halton, Robert Fair and T. A. S. Hay are applying to the Ontario Legislature, under the name of the Peterborough & Chemong Park Railway Company, for a charter to build an electric railway from the town of Peterborough to Chemong Park. Capital $100,000.

OTTAWA.—The question whether electricity should be admitted free of duty into Canada is now being considered by the Canadian Controller of Customs. The question was raised by a deputation from Niagara Falls who want electricity generated on the American side admitted free at the falls on the Canadian side.

ST. THOMAS, ONT.—K. W. McKay, J. A. Bell, James Fulton, W. R. Jackson, John Campbell and others, under the name of the St. Thomas Radial Electric Railway Company, are applying to the Ontario Legislature for a charter to construct a line of electric railway from St. Thomas to Union, Sparta, Port Bruce, Port Stanley, Fingal, Dutton, Wallacetown, Bismarck, Rodney, Almer and Port Burwell.

ST. JOHN, N. B.—At a general meeting of the stockholders in the Maritime Auer Light Company the following directors were elected: S. Hayward, W. H. Thorne, R. K. Jones, W. C. Pitfield, G. S. Fisher, St. John; A. O. Granger, Montreal; L. L. Beer, Charlottetown; F. W. Summer, Moncton; F. B. Edgecome, Fredericton. At a subsequent meeting W. C. Pitfield was elected president, and R. K. Jones vice-president.

LONDON, ONT.—Application has been made by the London & Western Ontario Electric Railway Company, with a capital of $1,000,000, for a charter with power to construct lines of electric railway running from the city of London to St. Thomas, Aylmer, Port Stanley, Dorchester, Ingersoll, Woodstock, Tilsonburg, Delaware, Mount Brydges, Glencoe, Strathroy, Lucan, St. Mary's and Stratford. Among the applicants are H. A. Everett, E. W. Moore, T. H. Smallman, S. R. Break and Chas. Ivey.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, Feb. 13, 1895.

ELECTRIC RAILWAY ENTERPRISE IN LONDON.—Notwithstanding the great support given by the Great Northern Railway Company to the electric railway proposed to be run from its junction at Finsbury Park into the heart of the city, the public, for reasons best known to themselves, have failed to subscribe sufficient capital. This is a great blow at the progress of electric traction, and it is all the more regrettable since there is reason to suppose that with a little financial diplomacy on the part of the Great Northern Railway Company the money would have been obtained with ease. Had the direct importance of this line been made clearer to the shareholders of that company, they would, in all probability, have subscribed the necessary capital among themselves, the public would not have been appealed to, and this loss of prestige to electric traction would not have arisen.

ELECTRIC LIGHT CONDUIT EXPLOSIONS.—Hardly a day now passes without an explosion of some sort connected with electric light conduits. Last week there were explosions at Dover, Eastbourne and Rochester, and more recently there has been a severe explosion on Southwark Bridge (London). This explosion, which more or less injured five people, had only indirect connection with the electric light mains. In the course of some repairs to a roadway a large gas main was injured. Gas, escaping from this main, got into the rain water drain across which the gas main ran, and this drain was also crossed by a sheaf of iron pipes containing the mains of the City of London Electric Lighting Company. A passerby carelessly deposited a match in a gulley connected with the drain. This careless act resulted in the firing of the explosive mixture in the drain, and the explosion passed along the interstices between the electric light pipes and blew in the walls of a succession of junction boxes, hurling their lids into the air. The usual Board of Trade inquiry was promptly held into the matter, and if these explosions continue at their present rate we may expect a few more ukases from the Board of Trade.

ELECTRIC RAILWAYS IN LONDON.—A decision of considerable importance to underground electric railways was given last week by Mr. Justice Kekewich. The fact that these schemes were by their Acts of Parliament exempted from the necessity of granting compensation to landlords for the use of the subsoil, has been made much of in all the prospectuses of these undertakings. On Friday last, however, Mr. Justice Kekewich granted an injunction against the promoters of the Waterloo-City line—now in course of construction—restraining them from disturbing the subsoil belonging to one Farmer, without making compensation. The reasons given for this extraordinary decision are, to a layman, incomprehensible. No doubt the amount of compensation allowed for the minute disturbance of proprietorial rights, caused by a tunnel 80 feet below the surface, will be proportionally minute, but the amount will now in each case be an unknown amount, and will therefore tend to have a decidedly detrimental influence on the prospects of electric underground railways in this country. Just previous to this decision, the public was asked to subscribe toward an electric underground railway running from the Finsbury Park station of the Great Northern Railway Company into the heart of the city. This line is intended to relieve the congestion of the suburban traffic of this company. The tunnels will be of sufficient diameter to take the ordinary rolling stock of the Great Northern Railway Company and a handsome minimum annual income is guaranteed by the Great Northern Company. This line is expected to be in operation within a couple of years.

General News.

NEW INCORPORATIONS.

THE TIFFIN EDISON ELECTRIC ILLUMINATING COMPANY, Tiffin, O. has increased its capital stock from $25,000 to $50,000.

THE VICKSBURG ELECTRIC LIGHT COMPANY, Vicksburg, Miss., capital stock $125,000, has been incorporated by Joseph Hirsch, Chas. F. Armstrong and others.

THE MARSEILLES TELEPHONE COMPANY, Marseilles, Ill., capital stock $2,000, has been incorporated by H. R. Adams, E. T. Nett, I. N. Jennings and R. F. Knott.

THE UNION TELEPHONE COMPANY, Union, S. C., capital stock $1,000, has been incorporated by T. C. Duncan, George H. Oetzel, W. E. Thomason and others to construct an exchange.

PHENIX TELEPHONE AND MANUFACTURING COMPANY, Chicago, incorporated by Lee R. Brown, E. E. Yaxler and others, to manufacture electrical apparatus. Capital stock $100,000.

THE WEST CHARLES STREET RAILWAY COMPANY has been incorporated by G. S. Laidley, G. S. Couch and J. W. Raike, of Charleston, W.Va., to build a road in the suburbs about five miles long.

THE LOS ANGELES TRACTION COMPANY, Jacksonville, Ill., capital stock $100,000, has been incorporated by Thomas J. Hock, Francis Hook and Marcus Hook to operate street railways in California.

THE CITIZENS' TELEPHONE COMPANY, Washington C. H., O., capital stock $1,000, has been organized by W. H. Dial, John N. Van Deman and others for the purpose of operating a telephone business in Ohio.

PITTSBURGH, PA.—A.W. Mellon, of this city, and associates who had secured right of way for the erection of an electric street railroad from here to Greensburg, have notified their attorney that they have abandoned the project.

THE HOME TELEPHONE COMPANY Chillicothe, O., incorporated by A. H. Rentinger, David Auch and others for the purpose of operating a telephone business in the county of Ross and the city of Chillicothe. Capital stock $25,000.

THE CUERO (TEXAS) TELEPHONE COMPANY has been organized by C. L. Stadtler, president; Sam C. Lackey, secretary, and W.R. Rathbone, treasurer and manager. A system will be constructed immediately. Capital stock $4,000.

THE SUBURBAN GAS & ELECTRIC COMPANY, Revere, Mass., capital stock $75,000, has been formed to generate and furnish electricity for light, heat and power. Arthur Perry, Wm. H. Whitney and Allston Burr are the interested parties.

THE SILOAM SPRINGS (ARK.) IMPROVEMENT COMPANY has been incorporated by E. T. Wisner, president; R. S. Morris, Z. T. Conley R. G. Alfrey F. M. Axtell and E. B. Watson, directors, to establish an electric light plant. Capital stock, $100,000.

THE CITIZENS' ELECTRIC LIGHT AND POWER COMPANY, Hughesville, Pa., capital stock $6,000, has been formed to supply light, heat and power by means of electricity. The incorporators are Wm. Frontz, Peter Reede, Hughesville, and Jas. K. Boak.

THE OXLEY GIDDINGS & ENOS CO., New York City, capital stock $200,000, has been formed to deal in gas and electric light fixtures etc. The promoters are W. F. Moody, Bayonne, N.J.; Frederick Wilcock, Brooklyn, N. Y., and W. N. Robertson, Jersey City, N. J.

THE HARRISBURG AND CUMBERLAND ELECTRIC RAILWAY COMPANY, Harrisburg, Pa., capital stock $36,000, has been formed to construct and operate an electric railway. Wm L. Gorgas, Frank R. Leib and S. W. Fleming, Harrisburg, Pa., are all interested.

THE HICKORY LAUNCH AND ELECTRICAL MANUFACTURING COMPANY, Asbury Park, N. J., capital stock $100,000, has been formed to supply power for electric light, heat and other electrical appliances, etc. Arthur S. Hickley, Myron S. Gould, Cook Howland, Asbury Park, and Claude V. Guerin, Ocean Grove, N. J., are interested.

THE CITIZENS' TELEPHONE COMPANY, Pensacola, Fla., has been incorporated by T. E. Welles, president; H. T. Wright, vice-president; L. H. Jacobs secretary, and W. A. D'Alemberte treasurer, for the purpose of constructing a telephone system. Capital stock $5,000.

O. I. NEWTON'S SONS COMPANY, Sparta, N. Y., capital stock $50,000, has been incorporated to own and operate an electric light plant, manufacture paper, flour, buy and sell lumber, etc., etc. The promoters are Harry N. Newton, Geo. M. Newton and F. N. Newton, all of Sparta.

THE NANTASKET ELECTRIC STREET RAILWAY COMPANY, Hull, Mass., capital stock $12,500, has been incorporated to operate and construct an electric street railway from Hull. John L. Mitchell, Geo. E. David, Wm. F. Taylor, Hull, and John C. Flood, Boston, Mass., are interested.

THE PENNSYLVANIA HEAT, LIGHT AND POWER COMPANY, Philadelphia, Pa., capital stock $10,000, has been formed to manufacture and supply light, heat and power by means of electricity. Robert Reaves, C. W. McKinney and John Taylor, all of Scranton, Pa., are the promoters.

THE HILLSBOROUGH ELECTRIC LIGHT AND POWER COMPANY, Hillsborough Bridge, N. H., capital stock $25,000, has been formed to generate and supply electricity for light, heat and power. Jas. F. Grimes, Harvey Jones, Geo. W. Lincoln, and Wilson D. Forsaith, Hillsborough Bridge, are the promoters.

THE NEW YORK, WESTCHESTER & CONNECTICUT TRACTION COMPANY, New Rochelle, N. Y., has been incorporated to build and operate a street surface line sixteen miles long in Westchester County. M. J. Keogh, New Rochelle; F. A. Wilcox, D. F. Cohalam and J. A. Bensel, all of New York, are the promoters.

THE WEST CHESTER & DOWNINGTOWN STREET RAILWAY COMPANY, West Chester, Pa., capital stock $100,000, has been incorporated to operate an electric street railway. The promoters are James McGraw, West Chester; R. J. Malone, 837 Windson street, and J. W. Clark, 2307 Christian street, Philadelphia, Pa.

THE FORT WAYNE-HARRISON TELEPHONE COMPANY, Fort Wayne, Ind., has been organized by George P. Haywood, of Lafayette, president; Edward G. Leysinski, of Chicago, vice-president; Edward H. Andress, of Lafayette, secretary; Wm. P. Breen, of Fort Wayne, treasurer. This company will establish a cheap telephone service in Fort Wayne, to be in use June 15.

THE HOWARD H. BOWEN COMPANY, San Francisco, Cal., capital stock $50,000, has been formed to manufacture and deal in gas, electric and combination fixtures, and to do electroplating and art metal work and a general plumbing and supply business. Howard H. Bowen, Sam Soloman, Carl Rector, J. L. Franklin, and Chas. A. Partridge, San Francisco, Cal., are the promoters.

THE FELTS ELECTRIC LIGHT & POWER COMPANY, Colusa, Cal., capital stock $100,000, has been incorporated to purchase, lease or sell electrical rights, patents, licenses, etc., and other property pertaining to electric lighting, telegraphy, telephony, and electroplating. The incorporators are W. W. Felts, F. Peart, George F. Scott, J. K. Bartholomew, C.C. Felts, George B. Marden, W. F. Ford, and W. W. Brown, of Colusa, and E. E. Scott, of Marden, Cal.

THE RAHWAY ELECTRIC LIGHT AND POWER COMPANY, Rahway, N. J., capital stock $200,000, has been incorporated to construct, maintain and operate works for the supply and distribution of electricity for light, heat and power. Cassimer Q. Boynton, Woodbridge, N. J.; Henry Maurer, Frank A. Pattison Robert W. DeForest, New York City; Jackson Jacques, Rahway, N. J.; J. H. W. Douty, Asbury Park, N. J., and Herman W. T. Thiele, Brooklyn, N. Y. are the interested parties.

THE PACIFIC STORAGE BATTERY COMPANY, San Francisco, Cal., capital stock $20,000, has been formed to manufacture, buy, sell, rent and deal in electric storage batteries, dynamos and electrical supplies, machinery and apparatus, and to act as agents and factor for other corporations, firms and persons transacting similar business. Thomas Addison, Berkley; Robert B. Elder, San Francisco; Fred. F. Barbour, F. M. Ray, Oakland, and Samuel E. Kearney, San Francisco, Cal., are the interested parties.

TELEGRAPH AND TELEPHONE.

WINCHESTER, IND.—Winchester will have a telephone system in the spring.

STAUNTON, VA.—The Staunton Mutual Telephone Company is being organized.

CRANFORD, N. J.—Steps have been taken to organize a telephone and fire alarm system.

ORLANDO, FLA.—A. F. Williams and others have obtained a franchise for an electric light plant.

TAYLOR, TEX.—The Southwestern Telegraph & Telephone Company has been granted a franchise.

ATLANTA, GA.—A. J. West; J. R. Collins and others have applied for a franchise to establish a telephone system.

LOUISVILLE, KY.—A new telephone system is about to be established here. M. S. Forbus, of Cincinnati, Ohio, is interested.

ATCHISON, KAN.—The Western Telephone Company has been granted a franchise to put in an exchange, which will be done at once.

EATON, O.—A telephone company has been formed here with a stock of $5,000. The local managers are L. D. Lesh and Frank Thompson.

ROANOKE VA.—James S. Simmons & Co. may be addressed for information concerning the Co-operative Telephone Company, now being organized by Hoover & Plumley.

NORWALK, OHIO.—The Central Union Telephone Company is reported as soliciting subscribers at a nominal rate of $1 per year. This is in competition with the Harrison Company who fixed its business rates at $30 and residence rates at $18 per year originally. The Central Union Company cut these rates to $18 and $12, respectively, and now make the $1 rate.

ELECTRIC LIGHT AND POWER.

WOODBINE, N J.—The electric light plant has been destroyed by fire.

WAVERLY, O.—The citizens have voted in favor of having electric lights.

WALLINGFORD, CONN.—The borough voted in favor of electric lighting.

FROSTBURG, MD.—J. J. Jones has purchased the Frostburg electric light plant.

PARK RAPIDS, MINN.—J. H. O'Neil may add a small dynamo to light the Northern Hotel.

FLORENCE, S. C.—The Florence electric light plant, recently damaged by fire, will be rebuilt.

MENASHA, WIS., is advertising for electric lighting proposals. Address W. W. Reed, city engineer.

FAYETTEVILLE, N. C.—Address the Mayor regarding the establishment of an electric light plant.

COLUMBIA, ALA.—Address Geo. L. Campbell concerning the establishment of an electric light plant.

PITTSBURGH, TEX.—Address the mayor concerning machinery wanted for new electric light works.

FULTON, KY.—Bids for the erection of an electric light plant are being advertised for by the City Council.

WINCHESTER, IND.—The electric light plant has been destroyed by fire. Loss $10,000; insurance $3,500.

ELBERTON, GA.—Address P. M. Hawes concerning machinery for new electric light plant about to be erected.

ABERDEEN, MISS.—The Southern Equipment Company has leased and will operate the city electric light plant.

CLAY CITY, IND.—Clay City is considering the lighting question and expects to soon be the possessor of an electric plant.

FLORENCE, S. C.—The electric power house was destroyed by fire at an estimated loss of $25,000, and an insurance of $6 000.

WEATHERFORD, TEX.—The Weatherford Electric Light, Power and Water Company has appointed D. R. Fant as receiver.

FREMONT, NEB.—Fremont will appropriate $18,000 this year for constructing a plant that will give the city the light it needs.

LANSING, MICH.—A bill has been introduced for the appropriation of $7,000 for an electric light plant for the insane asylum.

CHATTANOOGA, TENN.—The Queen & Cresent Railway will build a $6,000 electric light plant, and has purchased the machinery.

WINNIPEG, MAN., asks for proposals for the city electric lighting. Address B. E. Chaffey, chairman of fire, water and light committeee.

LANSINGBURGH, N. Y.—Philip S. Dorlon has petitioned the Board of Trustees for permission to furnish electric lights for commercial use.

SOUTHINGTON, CONN.—The Peck, Stow and Wilcox Company is considering the advisability of welding carpenters' squares by electricity.

SWEET SPRINGS, MO.—F. H. Trisdale, city clerk, may be addressed concerning the establishment of an electric light plant and water works.

WEYAUWEGA, WIS.—W. H. Wood and Warren Hinchey have been granted a franchise for an electric light and power plant, for a term of 20 years.

ROSEVILLE, O.—The Council has called an election to vote on the issue of $20 000 in bonds for the purpose of establishing a water and light plant.

JACKSONVILLE, ILL., is asking for bids for the construction o a plant to furnish electric lights for the city. Address Henry Schoenfield, Mayor.

MEDIA, PA.—The members of Media Borough Council are talking seriously of putting in an electric light plant for lighting the streets of the borough.

NEWBERNE, N. C.—R. P. Williams and others will apply for incorporation as a stock company, to generate and sell electricity for power, lighting, etc.

WHITEWATER, WIS.—Proposals are invited to light the city for five years next after April 1, 1895. Address A. W. Martin, city clerk, Whitewater, Wis.

STANTON, MICH.—Stanton has decided to submit to the people the question of bonding the city for $6,000 for the purpose of putting in an electric light plant.

CHIPPEWA FALLS, WIS.—That the city of Chippewa Falls will eventually purchase the plants of the Water, Light & Power Company is practically decided.

CHESANING, MICH.—The plans and specifications for the electric light and water works plants are now being put out. Feb. 27 at 4 p. m. is the last day for bidding.

UNION SPRINGS, ALA.—It is stated that $30,000 worth of bonds will probably be issued by the city for the purpose of establishing an electric light plant and water works.

PHILADELPHIA, PA.—The Schuylkill Valley Illuminating Company of Phœnixville have purchased buildings on Vanderslice street, and will remove its plant to this city.

MILLEDGEVILLE, GA.—The important matter of street lights is now pending in the city and the probability is that a contract will be made for five years at $3,200 per annum.

EDWARDSVILLE, PA.—The question of lighting the streets has been agitated in the Council rooms, but so far there has been no action taken to make it a success on election day.

NEWPORT, TENN.—The Newport Mill Company will establish an electric light plant, and is now in the market for a 40-light dynamo, with wire and all equipments for lighting.

ALLEGHENY, PA.—At meeting of Select Council the matter of engines for the new electric light plant was referred back to the Committee of Public Works with directions to readvertise for bids.

RICHMOND, VA.—At a meeting of the Board of Aldermen the resolution appropriating the sum of [illegible] for the establishment of an electric light plant was referred to the finance committee.

MEXIA, TEX.—J. W. Sheat of Lockhart, Tex., president of the Mexia Lighting Company, desires to purchase a [illegible] kw alternator [illegible] assortment of material and supplies for an electric plant.

MERIDEN, MISS.—Sealed proposals will be received until March 21 for lighting the streets of the city for a term ending June 1, 1900, and with 25 additional lights after Jan. 8 1897. Address I. A. Mooser, city clerk.

BELLEVUE, PA.—An ordinance has granted the Bellevue Electric Light Company the right to erect and maintain an electric light plant. The company agrees to commence work in 60 days and finish it in nine months.

CHATTANOOGA, TENN.—The Chattanooga Electric Company, it is reported, will extend its line to Chickamauga Park a distance of about nine miles. The expense will be about $90,000. Receiver Divine may be addressed.

ELBERTON, GA.—The City Council having some funds on hand invested $1,500 of it in a water power on Beaver Dam Creek, three miles from the city. The power will be used to furnish water and electric lights to the city.

GREENFIELD, IND.—The Greenfield electric light plant has been sold to a company headed by Hon. Chas. L. Henry, of Anderson. Mr. Corcoran will continue as business manager. It is the purpose of the new owners to enlarge the plant.

MANCHESTER, N. H.—An electric power plant will be erected at Garvin's Falls, two miles below the city of Concord. Wm. A. Russell, an extensive paper manufacturer of Lawrence, Mass., and the Manchester Electric Light Company are interested.

HEMPSTEAD, L. I., N. Y.—The village board will hold a special meeting to determine whether there shall be submitted the question of bonding the village for the sum of $65,000 to establish a water works system and later install an electric light plant.

JEFFERSON, MO.—Jefferson City Light, Heat & Power Company has decided to enlarge its plant by adding one 1 000-light machine to furnish current for power and light. After the additional equipment is put in, the company will furnish current night and day.

CARROLLTON, ILL.—The Carrollton City Council has appointed a special committee to consider the matter of electric lighting. A proposition has been made to the city to put in 25 arc lamps of 2,000-cp each, and run them on moonlight schedule at $35 each per year.

WACO, TEX.—Francis L. Jewett, ex-Mayor of Lowell, Mass; C. E. Adams, president of the Massachusetts State Board of Trade, and A. C. Russell, directors of the Southwestern Telephone & Telegraph Company, intend to improve the Waco plant and made arrangements to connect Waco with Austin.

PORTAGE, WIS.—At the regular monthly meeting of the Common Council, the Council concurred in the resolution of the Board of Aldermen of Manitowoc asking for legislation to enable cities and towns to own and operate electric light plants, and directed that Senator Conger and Assemblyman Mohr be so notified.

PHILADELPHIA PA.—Upon the site of the Empire Theatre, at Broad and Locust streets, Robt. Goelet, 9 West Seventeenth street, New York City, intends to erect a palatial hotel. Angus S. Wade is architect. Five electric elevators will be employed and everything new in electric lighting, call bell system and other improvements.

COLUMBUS, O.—The penitentiary will have an electric light plant, in accordance with the appropriation of $22,000 made by the legislature for that purpose. Managers Whiting, Hay and Apthorp, of the penitentiary board, in connection with Adjutant-General Howe, have been appointed a special committee to make preparations for the construction of the plant.

KANSAS CITY, MO.—An electric light race track will be opened in Kansas City in the near future. Robert J. Holmes has leased the Exposition Driving Park for $4,000 and is negotiating for the purchase of an electric light plant with which to illuminate the track. As soon as the weather permits work will be begun remodeling the park for the new regime.

ONTARIO, CAL.—The Ontario Electric Company has been incorporated with a capital stock of $100,000 and will absorb the Ontario & San Heights Railway, which will be electrically equipped. A complete lighting, heating and power plant will also be installed. The officers are: John Jenkins, president; Charles Frankish, vice-president and manager; F. B. Stamm, secretary; C. W. Foote, consulting engineer.

BALTIMORE, MD.—Mayor Latrobe has sent the following ordinance to the City Council: That $100,000 more be taken from the $600,000 loan to continue the construction of conduits for electric wires, and also authorizing the Electrical Subway Commission to prepare a plan for a general system of subways for all electric wires except the trolley wires, to be rented out, the receipts to pay the interest and principal of bonds to be authorized by the next legislature for the subway construction.

THE ELECTRIC RAILWAY.

ALGIERS, LA.—The City Council is about to sell the franchise for building an electric railway.

GREENSBURG, PA.—The Saddler Electric Railway to Pittsburgh is to be constructed immediately.

PORTLAND, ME.—The Portland Railroad Company has been granted permission to operate its cars by electricity.

WINONA, MINN.—S. B Livermore, of St. Paul, has been appointed receiver of the Winona General Electric Company.

NARRAGANSETT PIER, R. I.—The Narragansett Pier Railroad has decided to change its motive power from steam to electricity.

JEFFERSON CITY, MO.—The Jefferson City Light, Heat & Power Company will extend its plant so as to furnish light and fans day and night.

NEWMANSTOWN, PA.—A new electric railway is to be constructed from [illegible] to [illegible] and $[illegible] has been subscribed for it.

EAST ST. LOUIS, MO.—The East St. Louis Electric Railway Company has decided to extend the double track electric railway to the city limits.

RICHMOND, VA.—A company is being formed to construct an electric railway along Broad street to Chimboraza Park. Julian Bryant is interested.

KEYSVILLE, VA.—The proposed electric road to Farmville will be 21 miles long. About ten miles of the distance are graded and ready for ties.

PARK CITY, KY.—An effort is being made to build an electric line through Park City, to connect several towns in its vicinity. Messrs. Cramp & Holliday are interested.

PINE BLUFF, ARK.—John O'Connell, president of the Citizens' Street Railway Company, states that arrangements are being made to change the motive power to electricity.

PONTIAC, MICH.—Franchises have been granted to the Electric Street Railway Company to operate a street railway. Wm. H. Heinman, J. D. Norton and others are interested.

NUTLEY, N. J.—The trolley ordinance was finally passed by the Franklin township committee, under which a franchise will be granted to the Passaic & Newark Electric Railway Company.

AUSTIN, TEX.—The electric line from Austin to the dam on the Colorado River is to be operated by a syndicate including Frank Hamilton and Henry Metzger, who will place trolley cars upon it.

NEWTON, MASS.—The car house of the Newton & Boston Street Railway Company on Walnut street, Newtonville, has been completely destroyed by fire. A large quantity of electrical apparatus and supplies were ruined.

BURLINGTON, IA.—The Burlington Electric Street Railway has passed into the control of the Burlington Electric Light & Steam Supply Company, and the line will be extended to West Burlington and other improvements made.

SELMER, TENN.—Secretary Jopling, of the Selmer & Tennessee River Electric road, states that its exact length is to be 18 miles, and will begin operations in April. The line will extend from Selmer to the Tennessee River.

SHARON, PA.—The Shenango Valley Electric Railway Company is in the hands of the sheriff on execution of a $500 suit of J. P. Stone, of Beaver Falls, as stockholder of the company. The line is advertised for sale on the first Monday in March.

BUFFALO, N. Y.—The old project of an electric railway line from Buffalo to Niagara Falls is being revived. A franchise is being sought for a double track railway through North Tonawanda, the remainder of the route havng been provided for.

SOUTH ORANGE, N. J.—The South Orange township committee has instructed Township Counsel Price to draw an ordinance for an electric railway franchise on Valley Road, the provisions to be the same as that framed for Springfield avenue.

NORFOLK, VA.—The Norfolk & Ocean View Railroad is reported sold for $88,000 to Pottsville, Pa., parties, who will make an electric line of it and also extend it from Ocean View to Willoughby Spit, where it will connect with a ferry to Old Point.

PARSONS, KAN.—A special meeting of the stockholders of the M., K. & T. Railway will be held in Parsons, Kan., to ratify the issue of $1,000,000 gold fives authorized by the directors, for the purpose of building two new connections fifty miles in length in all.

BUFFALO, N. Y.—The State Railway Commission will meet at the Iroquois Hotel in Buffalo, to give a hearing on the application of the International & Orchard Harbor Railroad Company and the Batavia & Northern Railway Company for permission to construct their roads.

IRVINGTON, N. J.—At a meeting of the trustees of Irvington the franchise to operate an electric railroad on Springfield avenue, from the terminus of the tracks of the Consolidated Traction Company to the village line, applied for by the New York & Philadelphia Traction Company, was passed.

NORTH TONAWANDA, N. Y.—Two franchises were asked for at a recent North Tonawanda County meeting, one by Geo. P. Smith for an electric line to the village limits and another by Hon. W. Caryl Ely, of Niagara Falls, to lay tracks and operate a trolley line upon the River Road, Ward Road, to Payne avenue.

DULUTH, MINN.—The Duluth Street Railway Company is making extensive preparations for doing a good deal of improving the coming season. The most marked improvement will be the extension of the line from West Duluth to New Duluth, a distance of about two and a half miles, as soon as it is possible to work in the spring.

JERSEY CITY, N. J.—The New Jersey Electric Company has received the formal transfer of the six electric trolley lines composing what is known as the Morisse system, extending from Saginac to Jersey City. The lines are completed only from Saginac to Rutherford. It is said they will be in operation to Jersey City by April 1.

NORFOLK, VA.—The South Norfolk Railroad Company has been organized. The president is J. P. A. Mottu, and secretary and treasurer, Parke L. Poindexter. This railway will connect with the Norfolk City Railway at or near Campostella bridge, for which negotiations are now in progress, with every indication of ultimate success.

FLORENCE, COL.—The Florence Belt Line Railway has been granted a franchise. In addition to constructing a street railway for Florence, the company expects to connect with the adjacent coal mining towns of Williamsburg, Rockvale and Coal Creek. The company is composed of E. N. Weil and C. L. Huff, of this city, and S. Seiss, of Denver.

SAN FRANCISCO, CAL.—D. R. P. Thomas, a San Francisco capitalist, proposes to build what he calls an aerial road from San Francisco to Los Angeles, up to the celebrated San Joaquin Valley. The cars will be suspended on cables and operated by electricity, and run 100 miles an hour. No grading will be necessary for the construction of this road.

BOSTON, MASS. (State House).—J. H. Bickford has petitioned for the incorporation of the Metropolitan Elevated Railway Company, with a capital of not less than $15,000 000, nor more than $25,000,000, the corporation to be authorized to construct, maintain and operate by electricity or other power elevated railways in the city of Boston and other cities and towns.

BILOXI, MISS.—E. G. Burklin has been granted a franchise for an electric street railroad for a period of 50 years, covering nearly all the principal streets of the city, including both the front and back bay and from Point Cadet to the lighthouse. A company is to be formed and work on the proposed line will be at once commenced. The franchise requires that the road be in operation one year from date of granting same.

MISCELLANEOUS NOTES.

THE NEW ORLEANS ELECTRICAL SOCIETY is in a flourishing condition, having a membership of 94. One of its features is a night class in electrical engineering, under Mr. Ed. Hynes as instructor, in which there are 22 pupils.

WM. J. RICHARDSON, secretary American Street Railway Association, and president of the Atlantic Aid Association, delivered an address on Feb. 6 before a meeting of the latter organization at Grand Union Hall Brooklyn, in which he criticised the action of the State legislature toward street railway companies, and deplored the apathy manifested by the better class of citizens at election times. He urged upon the members of the association the necessity and righteousness of moderation and peaceable conduct in the matter of disagreements between employers and employes, and submitted resolutions, which were adopted, deploring the existing state of affairs due to the strike on the Atlantic Avenue Company's lines, and reminding the members of the Aid Association of its motto: "Affection and Assistance in Adversity."

Trade and Industrial Notes.

THE ANSONIA ELECTRIC COMPANY'S plant sold for $41 444. There are claims of $277,000 against the company.

METROPOLITAN ELECTRIC COMPANY, Chicago, is sending out circulars advising the trade that they carry in stock the celebrated Hoffman rod polish.

HARRY S. SMITH, of Philadelphia, has succeeded to the entire business of Harry S. Smith & Co., Ltd., and will in future conduct it under his own name at 607 Chestnut street.

THE BERLIN IRON BRIDGE COMPANY, New Britain, Conn., has lately completed an addition to the engine room of the Narragansett Electric Lighting Company, at Providence R. I.

M. E. BLASIER & Co., manufacturers of gas and electric fixtures, etc., have dissolved partnership. Business will be continued by M. E. Blasier under the present firm name.

THE EFFINGER & RUSSELL CO., Long Island City, has published a pamphlet descriptive of its creosoted wood product, which includes railway cross-ties and underground electrical conduit.

THE OTTAWA CAR COMPANY, Ottawa Can., Ahearn & Soper, agents, is sending out copies of a neat pamphlet illustrating various styles of its street cars now in use in the Dominion.

THE DRESSEL RAILWAY LAMP WORKS, New York City, report an order from the Metropolitan West Side Elevated Railroad, Chicago, for equipping their line with electric head and side lights or classification signals, tail lamps and switch lamps.

MR. G. S. A. GARDINER, the genial and popular vice-president of the Graham Equipment Company, Boston, has retired from his ticket business in Providence and will devote his entire attention in the future to the sale of the Graham street car truck.

THE GOULDS MANUFACTURING COMPANY, Seneca Falls, N. Y., has just brought out a very handsome illustrated price list of its widely known pumps for all kinds of service. The catalogue is gotten up in a style seldom equalled by books of its class.

ELLIOTT BROTHERS, London, have issued an elaborate catalogue of testing instruments, including chronographs goniometers, magnetometers, Thomson balances and electrometers. The typographical work is very fine, and the book is provided with substantial board covers.

THE MT. WASHINGTON GLASS COMPANY, of New Bedford, Mass., has consolidated with the Pairpoint Manufacturing Company, the well-known manufacturer of McCreary's silvered reflectors. The Mt. Washington Company reports a lively demand for its incandescent lamp bulbs.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has gladdened the hearts of its employees by the announcement that 10 per cent. of the net profits from the business of the current year will be divided among all those who remain with the company throughout the year, the distribution being made in proportion to the respective salaries paid.

THE CUTTER ELECTRICAL & MANUFACTURING COMPANY, of Philadelphia, has again been forced by the demands of an increasing business to seek larger quarters, and has removed from 27 South Eleventh street to 1112 Sansom street. It is now in better shape to carry into effect its persistent effort to always give to its patrons the highest grade of electrical work possible.

THE WASHINGTON CARBON COMPANY, Washington, Pa., is calling the attention of users of arc lamps on incandescent circuits to the fact that they can now purchase in this country the highest grade of cored carbons, for both direct and alternating currents. The Washington company has erected a special plant for this branch of its business, and is now running it day and night.

CHAS. A. SCHIEREN & CO., 45 Ferry street, New York, have just received an order for 125 feet of 68-inch three-ply belt for the Trenton Passenger Railway Company, Trenton, N. J.; also for 78 feet of 42-inch three-ply belt for the Brookline Gas Light Company, Brookline, Mass The demand for their goods seems to be increasing, and quality is being kept up to highest possible standard

THE McLEAN ARMATURE COMPANY, incorporated, Chicago, has been organized to succeed to the business of the McLean Armature Works, heretofore conducted as a co-partnership by Jas. McLean and others. The officers are James McLean, president; Martin R. Nelson, vice-president, and John S. Parmele, secretary and treasurer. The new concern assumes the obligations and receives the assets of the old one.

THE AUTOMATIC SWITCH COMPANY, Baltimore, Md, has received the following letter from Mr. H B. Beckman, of Newburgh, N. Y.: "The automatic non-reversible motor starter, purchased of you last May, has been in constant use in one of our largest storehouses, operating a large elevator, and we are pleased to say that it has given perfect satisfaction. It is simple, strong and durable, and thoroughly reliable."

PARTRICK & CARTER COMPANY, 125 South Second street, Philadelphia, have prepared a very handsome sample board of some of their house goods specialties, designed especially for small dealers and those who do not as yet carry a stock of such supplies. Everything is connected and in complete working order for practical exhibition. The board is made of hard wood with dealer's name and address in gilt letters.

ADAM COOK'S SONS, 313 West Street, New York, is one of the few American firms that can boast of a world-wide reputation for its products. Albany grease being for sale by ship chandlers in perhaps every seaport on the globe. What has proved so good for marine use should show the same superiority for electrical purposes, and that it does is shown by its rapidly increasing use in generating stations.

THE INTERIOR WIRING & FIXTURE COMPANY, 60 West Twenty-sixth street, New York, is placing on the market a parabola aluminium reflector shade, which will undoubtedly prove a popular addition to the reflector line. The shade is held firmly between the neck and top of any incandescent lamp, no shade holder being required, and is self-adjusting. It is made of pure aluminium, is highly polished inside and enamelled outside.

THE BRUSH ELECTRIC COMPANY has just issued a couple of pamphlets entitled respectively "Arc Lighting Extraordinary" and "Seventeen Years' Use of Brush Arc Apparatus." The former is descriptive of the latest type of Brush direct connected arc dynamos, and the latter, as the title implies, comprises a list of users of Brush apparatus and a large number of testimonials, together with illustrations of the different types of arc dynamos, lamps, etc., etc.

THE JEWELL BELTING COMPANY, of Hartford, Conn., reports the following sales of extra wide belts for the month ending Jan. 14: 118 ft. of 78 in. four ply, 105 4-12 ft. of 62 in. three ply, 105 4-12 ft. of 62 in. three ply, 88 4-12 ft. of 62 in. three ply, 88 4 12 ft. of 62 in. three ply, 88 4-12 ft. of 62 in. three ply, 86 ft. of 26 in. double, 117 ft. of 42 in. double, 67 ft. of 30 in. double, 110 ft. of 34 in. three ply, 115 ft. of 24 in. double, 58 ft. of 24 in. double, 92 ft. of 40 in. double, 99 ft. of 26 in. double, 90 ft. of 36 in. double, 113 ft. of 40 in. double, 136 ft. of 36 in. double, and 130 ft. of 24 in. double.

THE WALLACE ELECTRIC COMPANY, 307 Dearborn street, Chicago, is meeting with much success in introducing the Wood flexible pole bracket, of which this company is the sole owner and manufacturer. It is approved not only by interurban and high speed roads but by those who have adopted same where bracket suspension is in use. By its use a flexible support for the insulator is secured same as in cross suspension, and the hammering effect of the trolley wheel is entirely eliminated. The device is practical, very simple and admits of an easy and quick adjustment. This bracket is in use on the New York and Brooklyn Bridge, and they were placed there recently in connection with the lighting of the bridge cars. This is only one of the many places where a flexible support was desired in place of the ordinary rigid construction.

W. R. FLEMING & CO., 203 Broadway, New York, and 620 Atlantic avenue, Boston, Mass., representatives of the Harrisburg Foundry & Machine Works, have been so successful in the management of the business and territory in their charge that they have been prevailed upon to assume the responsibilities of an office for Philadelphia and surrounding territory. Mr. David Longenecker, of Harrisburg has assumed the duties of manager for W. R. Fleming & Co. and has leased offices in the "Betz" Building in that city. Mr Longenecker is very well-known in the steam and electrical lines, having been for a very long time connected with the outside business of the Harrisburg Foundry & Machine Works. W. R Fleming & Co. report business as unusually satisfactory, the number of Ide and Ideal engines installed in the past year being fully 50 per cent. greater than in the year 1893, and 100 per cent. greater than in 1892.

THE BALL ENGINE COMPANY, Erie, Pa., reports the following recent shipments of Ball engines to electric light plants: Siemans-Halske Electric Company, Chicago, two 160-hp and one 70-hp engines, direct connected to Siemens & Halske generators; Macy & Wales, Converse, Ind., one 100-hp tandem compound; LeCran Fundicion Nacional Mexicana, Monterey, Mexico, one 60 hp engine; Knight Bros., Fayette, Ia., one 50-hp engine; Texas Pacific Mercantile Manufacturing Company, one 50-hp engine; Receivers of Union Pacific Railway Company, Pocatello, Ia., one 40-hp engine; Atlantic Refinery, Point Breeze, Philadelphia, one 135-hp engine; Ballston Electric Light Company, Ballston Spa, N. Y., one 100-hp tandem compound; D. M. Fulmer Lumber Company, Florence Wis., one 70-hp engine; Forest City Electric Light Company, Forest City, Ia., one 70-hp engine.; Hahne & Co., Newark, N J., one 125-hp engine; Tootle, Wheeler & Motter, St. Joseph, Mo., one 80-hp engine; J. W. Warner, Oneida, N. Y, one 60-hp engine; Crook, Horner & Co, Baltimore., Md., one 80-hp engine;, Charles E. White, Philadelphia, Pa., one 60-hp engine.

Business Notices.

WOVEN WIRE BRUSHES.—The Belknap Motor Company, of Portland, Me., are the patentees and manufacturers of the best woven wire commutator brush on the market.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEBRUARY 9, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

534,254. COFFIN; Franz Egerland and John M. Freese, Sioux Falls, So. Dak. App. filed Nov. 15, 1894. The combination with a coffin, of an air inlet pipe leading from the inside of the coffin to the surface of the earth provided midway of its length with a globe in which disinfecting substances are placed, an electric battery in the coffin and an alarm or annunciator on the outside of the earth in circuit with the battery, a circuit closer on the inside of the coffin with a device for normally holding it open and having cords attached thereto and to the corpse, whereby upon the movement of the corpse the bar is pulled out of engagement with the spring and the alarm actuated.

534,269. ELECTRIC LIGHT SWITCH; H. W. Lawrence, Denver, Col. App. filed May 31, 1894. The combination in a switch of a base, provided with resilient contact terminals adapted to engage the teeth of a ratchet cylinder having its teeth divided by one or more collars interposed between the contact terminals, and every other tooth of which is provided with a conductor passing through the collars, and adapted by resilient contact with the terminals to close the circuit, and a push button and mechanism for imparting therewith to the rachet cylinder a predetermined partial rotative motion.

534,281. ELECTRIC CURRENT DISTRIBUTING SYSTEM; Geo. B. Pennock, Boston, Mass. App. filed June 1, 1894. The combination of an electric source, a voltage distributor connected therewith, a plurality of consuming circuits connected with the voltage distributor, a negative pole stepback, a plurality of return wires connecting the consuming circuits with the stepback, one or more return wires including two or more of the circuits, and a final return wire connecting the stepback and electric source.

534,288. MAGNETO-ELECTRIC MACHINE; H. J. Smith, Pompton Lakes, N. J. App. filed June 8, 1894. In a dynamo-electric machine the combination with the armature operating device and a switch located relatively to the armature operating device, to have mechanical connection established with, and to be actuated by the movement to rotate the armature of the operating device and adapted to pass the developed current from the circuit in the machine in which the current is generated and condensed to an outside or working circuit by said mechanical connection of the device with the switch, of an additional switch or switches, terminal or terminals, one or more, adapted to successively pass the current from the first working circuit to an additional independent working circuit or circuits, one or more, and located to have electrical contact successively established with the said first switch and with each other, by a continuance of the movement of the armature operating device before the potentiality successively imparted by the current to the ignitible devices interposed respectively in the several circuits is therein respectively exhausted.

534,311. ALARM GAUGE TESTING MECHANISM; Wm. H. Brandt, Troy, N. Y. App. filed Feb. 10, 1894. In an alarm gauge having electrodes arranged to be brought into contact by the movement of the index operating mechanism, the combination with the index operating mechanism, and apertured case-wall of the gauge, of a handle accessible from without the case, and a link connection between the handle and index operating mechanism freely movable through the case-wall aperture.

534,318. ELECTRIC WINDING AND SYNCHRONIZING DEVICE FOR CLOCKS; C. M. Crook, Chicago, Ill. App. filed June 23, 1894. In combination with a train and mechanical motor for same and winding mechanism therefor, a fixed electromagnet having its poles in juxtaposition, a vibrating armature to the magnet connected to the winding devices and operating it by its vibration, the armature comprising a portion adapted to pass between the poles of the magnet and a portion rigid with the first portion and extending beyond it at the ends in position to pass the ends of the poles as the armature vibrates.

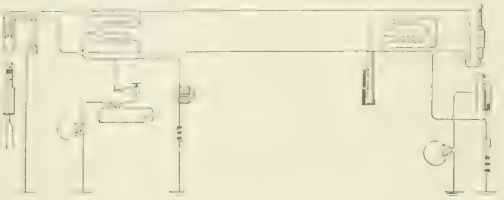
534,319. ELECTRIC CLOCK SYNCHRONIZER; C. M. Crook, Chicago, Ill. App. filed July 2, 1894. The combination with the main driving train, the minute hand and the seconds hand both frictionally connected with the train and an independent train connecting the minute hand and second, hand, whereby the motion of either is communicated to the other independently of the driving train.

534,320. ELECTRIC WINDING MECHANISM FOR CLOCKS; C. M. Crook, Chicago, Ill. App. filed Dec. 15, 1894. In a chronometer, in combination with a winding-up shaft, drum or barrel, a lever pivoted concentrically therewith and having an eccentric cam track; the pawl and ratchet device by which it may rotate the shaft, drum or barrel in one direction; an electromagnet and its armature and a lever which carries the latter having an abutment which engages the cam track of the other lever.

[illegible] ELECTRIC BELL; Wm. A. Harvey, Scranton, Pa. App. filed Oct. [illegible], 1894. [illegible] apparatus an electromagnet supported so as [illegible] extending levers [illegible] ends of its [illegible] laterally to the protruding ends, upon [illegible] the magnet is supported, and a spring carried by the magnet for alternately opening and closing the circuit through its coil.

[illegible] SWITCH DEVICE FOR TELEPHONE CIRCUITS; Chas. Clamond, Paris, France. App. filed July [illegible], 1894. A receiver, an alarm, a suitable [illegible] and speaking circuit, the combination with the receiver, of a movable arm mounted within the receiver casing and in permanent connection with the line wire, the switch being adapted in its normal position to establish the speaking circuit only and when shifted to break the speaking circuit and present a terminal for contact with the alarm circuit; a rigid support in electrical connection with the alarm circuit, and means whereby engagement between the receiver and support forces the switch to break the speaking circuit and establishes connection between the arm and terminal.

534,364. SIGNALING SYSTEM; Wm. E. Decrow, Boston, Mass. App. filed Dec. 31, 1892. The combination with a transmitter of a receiver consisting of a train controlling a normally short circuited bell and a magnet for releasing the train by two movements of its armature, the releasing magnet being included in a circuit which may or may not be closed through the bell when a signal is received.



No. 534,373.

534,373. TELEPHONE AND SIGNALING CIRCUIT; F. A. Pickernell, Newark, N. J. App. filed May 3, 1894. The combination of a trunk line extending between two stations and having two conductors adapted to form portions of the going and return conductors of a metallic conversation circuit, means at the terminals of the trunk line for connecting the same at will with any subscriber's station, an independent instruction circuit including operators' telephones, and an independent signaling circuit, including suitable signal sending and receiving devices, the two conductors of the trunk line constituting jointly the main line or direct conductor of the instruction and signaling circuits. (See illustration.)

534,374. ELECTRICAL APPARATUS FOR OPERATING DENTAL IMPLEMENTS; O. H. Pieper and A. P. Pieper, San Jose, Cal. App. filed April 30, 1894. An electromotor mounted in a closed case suspended on a swivel bearing attached to a swinging wall bracket, the containing case flexibly supported by springs so as to move and be adjusted in a vertical plane.

534,405. ELECTRIC SIGNALING APPARATUS; J. D. Price, Chicago, Ill. App. filed May 5, 1894. A signaling device in circuit with the electric current generator of the apparatus and a receiving instrument on the main line, contact making and breaking means for the main line circuit and primary actuating means controllably connected with the contact making and breaking means and operating by pressure in one direction to close the receiver circuit and by release of the pressure to open the receiver circuit.

534,411. TROLLEY WIRE SUPPORT; M. F. Van-Buren, Philadelphia, Pa. App. filed Oct. 5, 1894. The combination of a U-shaped hanger provided with screw threaded lugs, a nut, and clamping piece fitting into the U-shaped hanger and having on the under side an opening for the reception of the enlarged or bent up ends of the trolley wires.

534,414. RAILWAY SIGNALING APPARATUS; W. H. Walsh, Albany, N. Y. App. filed Sept. 26, 1894. This comprises crossing insulated track sections, electric conductors extending along the insulated crossing track sections but not with the track sections along which they extend, electric conductors between the electric conductors of one track section and the rails, of a crossing track section and circuits closers, including batteries and signals, carried by trains passing along the tracks.

534,454. CONDUIT ELECTRIC RAILWAY; Wilhelm Simon, Nuremburg, Germany. App. filed March 3, 1894. The combination with a conduit having supporting and conductor rails, of a motor carriage in the conduit, from which conduit the ends of the motor carriage are suspended, means for raising either end of the carriage from the car, an electric motor on the carriage and combined contact and driving wheels on the carriage and in gear with the motor.

534,475. CONDUIT ELECTRIC RAILWAY SYSTEM; Wm. L. Hedenberg, New York. App. filed June 5, 1894. A contact or surface plate having a depending web or arm combined with a conductor, and means for moving the conductor against the web or arm by a passing car.

534,485. ELECTRIC BELL SYSTEM FOR STREET RAILWAYS; E. L. Stansberry and Jacob Bettinger, St. Louis, Mo. App. filed May 7, 1894. This comprises two electric bells, one at each end of a car, and proper electrical connections whereby the bell at one end of the car may be rung simultaneously with the bell at the opposite end of the car by any one of a number of passengers while occupying a seat on either side of the car.

534,495. CONDUIT ELECTRIC RAILWAY; Octavus Cohen, New York. App. filed May 15, 1894. The combination with a grooved rail of the bracket in the groove, a mortised socket in the bracket, an insulating block having a tenon for engaging the mortise, a plate for securing the block in the socket and a line wire supported by the block.

534,519. CONDUIT ELECTRIC RAILWAY; Alfred Rosenholz, San Francisco, Cal. App. filed May 22, 1894. A tilting non-conducting casing, main conducting wire, extending parallel with the line of track, an electromagnet fixed within the non-conducting casing and having connection between it and the main conducting wire, armatures consisting of rollers movable in a chamber so as to form contact with the electromagnet when the chamber has been tilted, and a plate upon which the armature is moved which is in communication with a hanger and the wire within the tunnel.

534,528. ELECTRICAL BRUSH; A. L. Sonn, Lansingburg, N. Y. App. filed Oct. 15, 1894. In combination with the wooden body part a metallic plate constructed to receive the inner ends of the bristles; a handle of wood grooved for the passage of one of the circuit wires and with a central passage for the other circuit wire; this handle being provided with a wooden cap having an insulated passage for both wires, and a metallic tube-form covering for the handle where between the body and cap, a tube-form metallic plate in circuit with the wire within the handle groove, and the other wire in circuit connection with the metallic plate containing the bristles, and with the wires connected to the opposite poles of a battery.

534,529. ELECTRIC BRUSH; A. L. Sonn, Lansingburg, N. Y. A brush with body and handle of wood, with a metal plate perforated for the passage of bristles, a wire constituting one pole of a battery connected at one of its ends with the latter and its other end passing through the brush handle to connect with the inner ends of the bristles, then passed through the brush body to connect with the metallic plate on the bristle side of the brush and then back through the brush body to connect with itself; a wire connecting the other metallic plate with a battery.

534,536. ELECTRICALLY OPERATED DENTAL ENGINE; W. E. Wheeler, Dayton, Tenn. App. filed Oct. 6, 1893. In a dental engine a combined automatic switch and cable rest, the switch being governed by the insertion and withdrawal of the cable to stop and start the engine.

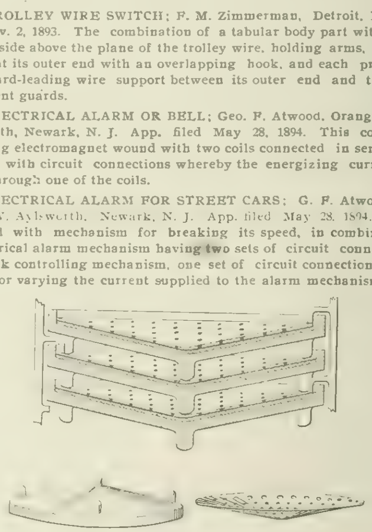
534,547. TELEPHONE APPARATUS; N. L. Burchell, Washington, D. C. App. filed Sept. 20, 1894. The combination with a pivoted arm supporting the transmitter and receiver of a magneto mechanism operated by the arm and supporting it at different angles by the resistance to rotation of its armature.

534,586. CIRCUIT MAKING AND BREAKING DEVICE; S. W. Stratton, Chicago, Ill. App. filed July 2, 1894. A receiving socket connected with one terminal and in combination with a plug connected with the other terminal, the plug being a solid bar or rod with a series of sheet metal parts thereabout separated along longitudinal lines and conforming in cross section substantially to the cross section of the socket.

534,592. TROLLEY WIRE SWITCH; F. M. Zimmerman, Detroit, Mich. App. filed Nov. 2, 1893. The combination of a tabular body part with its under tabular side above the plane of the trolley wire, holding arms, each terminating at its outer end with an overlapping hook, and each provided with an upward-leading wire support between its outer end and the body and dependent guards.

534,595. ELECTRICAL ALARM OR BELL; Geo. F. Atwood, Orange, and J. W. Aylsworth, Newark, N. J. App. filed May 28, 1894. This comprises an operating electromagnet wound with two coils connected in series, in combination with circuit connections whereby the energizing current is conveyed through one of the coils.

534,597. ELECTRICAL ALARM FOR STREET CARS; G. F. Atwood, Orange, and J. W. Aylsworth, Newark, N. J. App. filed May 28, 1894. A vehicle provided with mechanism for breaking its speed, in combination with an electrical alarm mechanism having two sets of circuit connections with the break controlling mechanism, one set of circuit connections including means for varying the current supplied to the alarm mechanism.



No. 534,603.

534,603. STORAGE BATTERY; Geo. A. Ford, Cleveland, O. App. filed Aug. 11, 1894. A porous pan having its bottom deepest at its centre and inclined from this deepest point to the edge of the pan and projections on the bottom of the pan. (See illustration.)

534,605. TROLLEY WIRE CROSSING; C. S. Hersh and E. F. Weaver, Philadelphia, Pa. App. filed March 13, 1894. In a trolley wire crossing, a frame having an open base with an arm adapted to close the base, the section carrying the arm being reversible.

534,613. TROLLEY WIRE SUPPORT; M. T. Murphy, New Orleans, La. App. filed Sept. 14, 1894. A trolley wire support, comprising a post, a laterally extending arm thereon, a bracket on the arm, a slide rod movable vertically in the bracket and a wire carrying hanger on the slide rod.

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ELECTRICAL EXECUTION.

The pathological examination of blood and tissues from the body of the recently executed murderer Hampton, the results of which we give elsewhere, strongly confirms the conclusion of Dr. A. H. Goelet and Mr. A. E. Kennelly as printed in our columns several weeks ago. The most important determination is in regard to the rupture of the tissues and smaller vessels of the brain which, by producing universal hemorrhages into its substance, must necessarily cause death. That the electric current, as employed in the New York State prisons for the execution of criminals, produces instantaneous and painless death is now so thoroughly established that its further discussion can only be in the interest of sensationalism.

A NEW DEFINITION.

There can be no doubt but that the monocyclic system described elsewhere will perform the functions claimed for it, and this whether it be a monophased or multiphased system. The discussion, therefore, as to whether it belongs to the first named class or the last named has no bearing on its practical merits, being a mere question of scientific definition, and one which might with benefit have been omitted from a paper having mainly a commercial end in view. The new definition of a multiphased system given in the discussion and endorsed by Dr. Bell will not pass by unchallenged. The accepted meaning is the one offered by another speaker at the time, namely, a system in which the apparatus operates through differences of phase. E. M. Fs. of different phase are produced in the monocyclic generator and it is through this that the system derives its distinctive character. The motors, also, in starting are given torque by a shifting field due to this feature of the generator. It is true that when in normal operation the system is monophased, and though this forms its most valuable point, yet we cannot see that it affects the other characteristic, subordinated though it may be to this main function. The new definition offered of a multiphased system—that it is one in which the flow of energy does not pass through zero—is not only singular in including continuous current systems, but most singular of all by eliminating from its terms the idea of differences in phase.

THE BATE REFRIGERATING CASE.

The decision of the United States Supreme Court in the Bate Refrigerating case, which we print elsewhere with a resume of the accompanying opinion, removes one of the last disturbing elements affecting the incandescent lamp and telephone interests, and the free development of these is no longer menaced by the possibility of adverse judicial decisions. As we have pointed out repeatedly in our columns, the Bate case was a forlorn hope, there being no probability that the decision of the Supreme Court would reverse the lower courts; nevertheless much apprehension seems to have existed as to the final result, which perhaps was not unreasonable in view of the apparently erratic course of our Federal Courts in dealing with patent law. The point is now definitely decided that an American inventor jeopardizes several years of the life of his domestic patent by taking out foreign patents, and the only recourse left is an appeal to Congress to right the great injustice that this involves. Had the Supreme Court been able to consider the case just decided on its equity, there can be no doubt but that an opposite result would have been arrived at. Congress, however, will not be hampered by legal trammels in its consideration of the just plea of inventors, and we believe it may be relied upon, now that the courts hold forth no more promise of remedy, to speedily right the wrong to which inventors are now subjected, provided the matter is clearly presented before it and kept in prominence by intelligent advocacy.

THE MONOCYCLIC SYSTEM.

The paper of Dr. Bell, read before the Cleveland Convention and reprinted in full elsewhere with the following discussion, is in many respects a model of what such a paper should be for the occasion that brought it forth. Without being expressed in highly technical language it yet gives a clear idea of the technical points involved, the simple diagrams employed also largely assisting in this result. In reading the paper, however, it should be borne in mind that its object was to introduce a new system commercially before prospective purchasers, and therefore "selling points" rather than purely technical ones are naturally brought to the fore. We give this caution as otherwse it might be thought from some parts of the paper and discussion that the two and three-phased systems have been discredited in practice, which we believe to be not the case. Accepting all of the claims made for the new system, it does not propose to displace the two and three-phased systems for all work, and it would be unfortunate if its claims led to their injury. The system described is certainly a most interesting one and a beautiful example of the flexibility of the alternating current, while, owing to the manner in which it is adapted for all of the conditions of simultaneous lighting and power distribution from central stations, it promises to remove a great reproach from the alternating current due to its former lack of use for these combined purposes. Whether the weight of the objections to the employment of the two and three-phased systems for general light and power distribution, on account of lack of balance and unequal inductive drop, be of great practical moment or not, the monocyclic system offers itself as free of these objections and therefore ready to be taken up at once with confidence by central station men, who do not, as a rule, care to experiment with matters yet in dispute. The comparative simplicity of the system will also recommend it, for when the motors are once started there is no difference between it and a simple alternating system—a fact that will appeal to station managers familiar with the latter and mystified by the apparently complicated character of multiphased systems, which has been accentuated by the intricate mathematics with which their exposition has too often been accompanied. The introduction of a new armature in machines already in use, the running of a small auxiliary wire through power districts and no disturbance of present transformers or lighting circuits, are points that will have great weight, and therefore tend to make the new system a valuable adjunct in extending the usefulness of the electrical industry.

COST OF NIAGARA POWER.

We print elsewhere the offer recently made by the Niagara Falls Power Company to the municipal authorities of Buffalo as to the terms for supplying power to the latter, and which has an added interest from being the first authoritative public statement made as to proposed prices of Niagara power. While the prices quoted seem to be reasonable, considering the vast expenditure of money for rendering the power available, yet they will probably be disappointing to the public in general, in view of the popular misconception existing as to water power being immeasurably cheaper than steam power. As it is not probable that the Buffalo authorities would care to put in a generating plant at the Falls, the figure of most interest is the price of electrical power at the generator house—$18.00 per year. Assuming a loss of 10 per cent. in transmission and distribution, the cost of power would become $20.00, exclusive of capital charges on the transmission and distributing lines, transformers, etc., depreciation on the same, cost of maintenance, superintendence, management, etc. With these items included, the final cost would not be much below the cost of steam power generated in large quantities at the Buffalo lake front. As there are, however, few or no plants in Buffalo using power in such large quantities as to involve the latter consideration, the price at which electrical power could be delivered under the terms offered would therefore result in a very considerable saving over steam power. The position of the Niagara Company in refusing to consider the acceptance of any franchise fixing a maximum or any other price at which power is to be sold, is well founded and cannot reasonably be objected to in the interests of power users. The cost of steam power varies within such wide limits, depending upon the quantity in which it is generated, that any fixed maximum price would be an arbitrary figure, and very unequally affect different users. As stated by the company, those who wish to buy electric power will only do so because of its being more economical than their present source of power, and the making of the bargain should therefore be left, as in other business matters, with the private interests involved. Should the municipal authorities consider that the public ought to receive a return for the franchise to be enjoyed by the distributing company, the charges for this should be so placed that the entire public and not merely the users of power will be benefited, and the company thus left free to negotiate with the latter on a purely business basis. The results given of tests of large steam plants are interesting, and that of the Buffalo plant, recently thoroughly investigated by a competent expert, confirms the figures by Mr. C. E. Emery, it having been found that the annual cost of a horse power was $32.70 on a basis of 11 hours per day and a quantity of over 1,000 horse power. The prices given of power at pumping stations are in surprising contrast to the claims usually made, and offer a sigificant commentary upon engine tests in general as made by "disinterested" experts in this country.

MEASURING ILLUMINATION.

Of all the factors connected with the practical applications of electricity, that relating to the measurement of light is the most unsatisfactory. One cause of this has been that heretofore such measurements have been confined to the source of light, which has been unsatisfactory for several reasons. What is desired to know is the lighting effect at given surfaces, and this can only be indirectly determined by measurements of the source of light, and then not in a very satisfactory manner. With incandescent lighting it has been necessary either to resort to inconvenient calculations or to roughly estimate the effect of a given distribution of light by trial. With arc lighting it has been still more unsatisfactory, on account of the variable distribution and the differences in the intensity of the rays from an arc lamp; the direct measurement of this source is ordinarily so complicated as to be impracticable, and consequently the user has had no means of learning that he was receiving the light paid for, while the company has been unable to know if the carbons used were or were not giving within 50 per cent. of the light to be expected from the energy supplied. If we were able to measure the illumination at a surface, then lighting would at once assume a scientific condition and the selection of proper arc carbons would be a matter of no difficulty, instead of one of mere guesswork, as at present. To accomplish these most desired ends a simple and practicable apparatus for measuring illumination is desired, and therefore the announcement of such an instrument at the Cleveland Convention was an important feature of that meeting. In other columns we print the paper of Messrs. Houston and Kennelly on "A New Method of Measuring Illumination," which contains a description of an illuminometer extremely simple in its details and operation. As will be seen, the apparatus rests upon the physiological principle that a certain intensity of illumination is required to render a definite object, viewed at a definite distance, just legible. While it is granted that the eyes of different persons may vary as to the limit of legibility, it is asserted that this range will not introduce an error greater than 10 per cent., which will not militate against the use of the apparatus for practical purposes. The objection urged against the instrument proposed, through errors that may be introduced by the imperfection of the human eye and different qualities of light, would seem to apply to any form of apparatus involving the use of the eye and a comparison with a fixed standard of illumination. Another source of error noted is that arising from familiarity with the test characters, thus rendering them more easily distinguished; this may be valid as concerns a new observer, but after some experience with the instrument an intelligent man should be able to largely or entirely eliminate this factor, though, we confess, it might not be so easy for one of small intelligence not able to prevent ulterior considerations from affecting the judgment of his faculties. After all, the only valid criticism will be that based upon actual experiment with the instrument, and every one will strongly hope that the great promise it holds forth may be most fully realized.

The Bate Refrigerating Case.

The decision of the United States Supreme Court in the case of the Bate Refrigerating Company vs. Ferdinand Sulzberger et al, was handed down on March 3, and sustains the view of the lower courts that the date of issue and not the date of application shall prevail in applying to a domestic patent the limitation as to life through the expiration of a foreign patent. The opinion was written by Judge Harlan and the decision was unanimously supported by the Court.

Judge Harlan in setting forth the positions of the parties in the suit says the plaintiff insists that, under a proper construction of the statute, an invention, patented or caused to be patented in a foreign country before being patented in this country, should not be deemed to have been "previously patented in a foreign country," unless the foreign patent was issued prior to the application for the American patent. The defendants contend that the respective dates of the American and foreign patents, and not the date of the American application, determine the question whether an invention, patented here, has been "previously patented in a foreign country."

The history of legislation relating to patents is given fully in the opinion with citations from the several statutes. From this history it appeared to the Court that Congress had always in mind the date of an application for a patent, the date of the filing of specifications, and the date of the patent.

Under the act of 1836, a patent could not be granted if it appeared that the applicant was not the original and first inventor or discoverer, or that any part of that which was claimed as new had before been invented or discovered or patented or described in any foreign publication in use in this or any foreign country; yet, an original and true inventor was not to be deprived of a patent for his invention "by reason of his having previously taken out letters patent therefor in a foreign country, and the same having been published at any time within six months next preceding the filing of his specifications and drawings."

Under the act of 1839, an inventor, whose invention had not been introduced into public and common use in the United States prior to the application for a patent, should not be debarred from receiving a patent, by reason of his invention "having been patented in a foreign country within six months prior to his application."

Under the act of 1870, an inventor whose invention had not been introduced into public use in the United States for more than two years prior to the application should not be debarred from receiving a patent by reason of its having been first patented or caused to be patented in a foreign country—these words not being qualified, as in the act of 1839, by any reference to the date of the application.

When an American patent was granted, in conformity with the sixth section of the act of 1839, for an invention "patented in a foreign country more than six months prior to his application," it expired, in every case, at the end of fourteen years "from the date or publication of such foreign letters patent;" and when, in conformity with the twenty-fifth section of the act of 1870, a patent was granted for an invention "first patented or caused to be patented in a foreign country," it expired "at the same time with the foreign patent, or, if there be more than one, at the same time with the one having the shortest term."

Under the Revised Statutes, while a patent for an invention can not be withheld nor deemed invalid "by reason of its having been first patented or caused to be patented in a foreign country, unless the same has been introduced into public use in the United States more than two years prior to the application," yet "every patent granted for an invention previously patented in a foreign country shall be so limited as to expire at the same time" with the one having the shortest term, in no case to remain in force longer than seventeen years.

After an elaborate review of previous decisions, the Court says that it is of opinion that Congress intended, by the twenty-fifth section of the act of 1870, preserved in Section 4,887 of the Revised Statutes, to introduce a new test in respect of the term of an American patent where the same invention was the subject of a foreign patent first issued. It has already been observed that the statutes relating to patents show upon their face that Congress always had in mind the difference between an application for a patent and the patent itself. And that difference is apparent in the act of 1870.

The Court says it cannot superadd, in Section 4,887 of the Revised Statutes, the words "prior to the application" either after the words "first patented or caused to be patented in a foreign country," or after the words "previously patented in a foreign country" without defeating the intention of Congress as manifested by the language it selected to indicate its purpose. And the express command of the existing statute is that every American patent for an invention "previously patented in a foreign country," that is, "first patented or caused to be patented in a foreign country," shall expire at the same time with the foreign patent. No words are used that will justify the Court in holding that an invention patented in a foreign country before being patented here is to be exempt from the operation of the provision limiting the term of the American patent to expire with the foreign patent.

Referring to what has been said about the intention of Congress, as manifested by its legislation, to deal liberally with inventors, especially those who were citizens of the United States, the Court says that while this is true, it is for Congress to prescribe the conditions upon which it will secure to inventors the exclusive right to their inventions. What may be due to inventors is a matter about which there may well exist differences of opinion. It is the province of the legislative branch of the Government to say when a patent to an inventor shall expire, and, therefore, when the public may enjoy, without charge, the benefit of the invention covered by it. It can be very well understood how the existing statute may, in circumstances, operate injuriously to an American inventor, who, in addition to the exclusive rights granted to him in this country for the term of seventeen years, wishes to secure a monopoly for his invention in other countries; for, if he obtains foreign patents for his invention before obtaining one here, the American patent is limited by law, whether it is so expressed or not in the patent itself, to expire with the foreign patent having the shortest term. This is the case as it appears from the standpoint of the patentee, without regard to the interests of the American public.

In conclusion the opinion holds that it must be presumed that the Revised Statutes of 1874 were adopted with the knowledge on the part of Congress of the construction previously placed by the Patent Office upon the twenty-fifth section of the act of 1870. This presumption is strengthened by an examination of the act approved Feb. 18, 1875, entitled "An act to correct errors and to supply omissions in the Revised Statutes." That act, upon its face, shows that the entire revision of 1874 was carefully re-examined, after it was adopted, for the purpose of ascertaining whether errors or omissions in the work of revision had been committed. Now it is inconceivable that the difference in the wording of the twenty-fifth section of the act of 1870, or of section 4,887 of the Revised Statutes, when compared with the act of 1839, could have escaped the attention of Congress, especially as the act of 1870 had been interpreted as introducing a new rule in respect of the term of an American patent, where the same invention was covered by a foreign patent previously issued. The act of 1875, for the purpose of correcting errors and omissions, amends nearly seventy sections of the Revised Statutes. But there was no alteration of Section 4,887.

The rule prescribed by the twenty-fifth section of the act of 1870 having been reproduced in Section 4,887 of the Revised Statutes, and the latter section never having been amended, the Court states that it ought not, after the lapse of nearly twenty-five years from the passage of the act of 1870, place upon its twenty-fifth section, or upon Section 4,887 of the Revised Statutes which took its place, any interpretation other than that which the ordinary natural meaning of their words impart.

The decision of the Court in its answers to the questions certified is that the invention for which a United States patent to Bate was issued was, under the facts stated, "previously patented in a foreign country," within the meaning of these words in Section 4,887 of the Revised Statutes, and that the United States patent to him expired, under the terms of that section, before the expiration of seventeen years from its date.

Meeting of the American Institute of Electrical Engineers.

At the meeting of the American Institute of Electrical Engineers held at 12 West Thirty-first street, Wednesday evening, February 27, Mr. H. Ward Leonard presented a paper entitled "Notes on Recent Electrical Development in France and England." Mr. Leonard considers that we are rapidly losing the lead in the electrical field which we have thus far held, and this he ascribes to the effect of so-called fundamental patents and the result of enormous aggregations of capital and engineering forces under one management. He thinks that the practical development of electrical engineering is almost impossible because of these gigantic corporations, in that they have such a large proportion of capital represented by patents, the value of which they do not wish to have destroyed by improvements which they do not control, and which they therefore depreciate.

Mr. Leonard states that in his opinion we have no alternating central station or electric railway system in this country which is a credit to the profession. He condemns our present alternating distribution practice and commends the foreign use of the three-wire secondary with 100 volts on each side. The foreign practice of placing in the hands of consulting electrical engineers the design of large plants is highly spoken of, as well as the employment of rotary transformers in connection with continuous current stations for the supply of distant territory.

The Parsons and Laval steam turbines are described and a reference made to the Newcastle-on-Tyne central station, where 25,000 lights have been operated solely from the former since 1890 with good financial results. In this station all the conductors are of vulcanized rubber cables drawn through gas and water-tight cast-iron underground pipes, through which chemically dried air is forced by a blower. There are six miles of piping and over 25 miles of cable, and in the five years of the operation of the plant there has not been a single instance of failure of operation, of an explosion, or of other trouble. The simplicity of the steam turbine is dwelt upon and Mr. Leonard thinks that this type of motor is likely to become an important factor in the electrical field, while the design of a dynamo for use with it offers an opportunity for the ingenuity of inventors. Several London central stations are described, one of which uses four 350-kw Parsons turbines running at 3,000 revolutions per minute. These also give great satisfaction, being accompanied by no vibration, and working at an economy equal to that of the compound-condensing reciprocating engines which they displaced. The absence in England of electric motor services and the poor design of switchboards are referred to.

A French substation with a capacity of 30,000 lights is described. This is supplied from a distant central station with a constant current of 250 amperes, all devices being in series, the total E. M. F. running as high as 6,000 volts at times. Power is furnished thereby through rotary transformers to feed a five-wire system of conductors at 110 volts. The station also includes a storage battery plant with a capacity of 24,000 10-cp lamp hours. The price of this battery was $107 per kw-hour of output. Mr. Leonard does not deem this to be an economical adjunct, and says that the craze for storage batteries for central stations seems to be on the wane in Europe.

In France Mr. Leonard examined the Heilmann locomotive, which he pronounces the most important electrical engineering development of all he saw abroad. Among its advantages are the greater efficiency of the boiler and engine in use with it over that of the locomotive boiler and engine, the greater control over the tractive power, and the less destructive effect on the roadbed of the "hammer blow" and side thrust. He says that a locomotive of this type would be able to pull 50 per cent. more weight than the present steam locomotive, and could pull the same weight at 50 per cent. higher speed. The remarks of Mr. Leonard on the importance of the load factor in central stations are reprinted in full elsewhere. The paper was discussed by Messrs. Townsend Wolcott, J. W. Lieb, Jr., C. E. Emery, Herbert Lloyd, A. E. Kennelly, Wm. Maver, Jr., M. W. Forney, Cary T. Hutchinson, Richard Fleming, Joseph Sachs, Profs. F. B. Crocker and E. J. Houston.

At the regular monthly meeting of the council on the same date it was voted that the general meeting of the institute be held at Niagara Falls, beginning June 18. It is proposed to devote this meeting principally to the question of power transmission.

A Straight-Line Accumulator Characteristic.

BY CARL HERING.

In plotting the results of a recent set of accumulator tests, a number of different curves were obtained, depending on the choice of the quantities used as co-ordinates, one of which, and a very important one, was found to be practically a straight line. Not having seen this result published before, I thought it might be new and of interest to those working with accumulators, as it enables one to find by a very simple calculation the capacities for different rates of discharge. The result will probably be different for different types of accumulators, and each maker will therefore have to determine for his particular type of cell whether this relation is a straight line function, and if not, then whether it approximates sufficiently close to it for the calculations occurring in practice. It should be stated here that this accumulator differed somewhat from the usual types, it being specially suited for rapid discharges.

In the tests referred to, the same cell was fully charged for each test, and was then discharged at each of a number of different rates, from a very rapid to a very slow one, the discharge being considered ended when the difference of potential had fallen a certain fixed percentage of that at a few minutes after the beginning; the current was kept constant by adjusting the external resistance. As the cell was intended for power purposes it would have been more correct to have kept the watts constant instead of the current, but this involves difficulties. besides introduces errors; the differences in the results are probably quite negligible.

The curve usually constructed is the one connecting the capacity with the *time* of discharge, but as this is far from being a straight line it is at first sight discouraging to try to reduce it to a convenient formula for calculations. But if instead of making the abscissas represent the *time*, they are made to show the rates in *watts*, the ordinates being the capacities in *watt hours*, then the curve for this particular cell approximated within 2 per cent. to a straight line having the general form:

$$\text{watt hours} = a - b \text{ watts},$$

the values of the constants for this particular accumulator being $a=228.$ and $b=.272$ (or ^{3}). This enables the output for any particular rate of discharge to be calculated very easily, and as the results were obtained between a very rapid and a relatively slow discharge, they include practically all the cases occurring in practice.

For a theoretically perfect accumulator, having a constant capacity and no internal resistance, this line should not only be straight but also horizontal. The inclination of this line, therefore, also shows how nearly it approaches to the theoretically perfect conditions.

From the above equation it is also very easy to calculate how long the discharge will continue at any desired rate in watts, even though the curve connecting the watts and the time is by no means a straight line. Dividing by the watts gives

$$\text{time in hours} = \frac{a}{\text{watts}} - b.$$

The curve connecting the capacity in ampere hours with the rate in amperes is somewhat similar, but for this accumulator it is not so close an approximation to a straight line; perhaps it may be for other types, but if it is not, it may be sufficiently so for many practical purposes.

As it is often required to know the capacity at a certain rate, or perhaps the rate for a certain capacity or time, the above simple relation may be of use to those working with accumulators. The desired information can, of course, be obtained even without calculation from the curve itself, but it may often happen that the curve is not at hand while the constants are easily remembered or noted.

The constants must, of course, be determined for each type of cell, as they will probably differ considerably, depending mainly on the thickness of the active material, and on its porosity.

Importance of the Load Factor in Central Stations.*

BY H. WARD LEONARD.

All central station people have known for years that the most profitable consumers were those who used their lamps for the greatest number of hours.

In other words, that the net profit due to a consumer was largely dependent upon the relation between his average load and his maximum load, which Mr. Crompton in England has aptly called the "load factor." Yet, while appreciating this fact, central station companies make their rates dependent upon the kilowatt hours used, and independent of the maximum kilowatts used.

Mr. Arthur Wright, at Brighton in England, deserves the credit, as far as I know, for having first given commercial recognition to this load factor of the consumer. Mr. Wright supplies each consumer not only with a meter which registers the kilowatt hours used, but also a second meter of simple construction which registers the maximum kilowatts used at any time during the month, and the discount which the consumer gets is very largely due to the relation between his average and his maximum kilowatts.

Suppose that there are two customers connected to a central station and that the monthly readings show that each has used 900 kilowatt hours. By the usual practice in this country the bill would be the same, yet one bill may be due to the use of one and one-quarter kilowatts for 24 hours per day, and for 30 days per month, and the second bill may be due to the use of 30 kilowatts, an average of one hour per day for 30 days per month. That is, the first bill may be due to a steady load, such as a few lamps in a basement of a hotel or a ventilating fan, while the second bill may be due to a larger load of lamps used only occasionally, as in an office building or an electric elevator requiring 30 kw for a few seconds to start it up, and after starting requiring only 15 kw.

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* Extracted from a paper read before the February meeting of the American Institute of Electrical Engineers.

With the same 900 kw hours per month for the two cases, the central station company should charge at least five times as much for the case having the elevator and small load factor as in the other case.

It is a fact not generally appreciated that in any central station the cost of producing a kilowatt hour can be divided into two portions, one of which, such as interest on cost, depreciation, salaries, a small part of the labor and coal, vary with the kilowatt capacity of the plant, that is proportionately to the maximum load, and are independent of the number of kilowatt hours produced, and the other portion of the cost of producing 1 kw hour represented by the larger portion of the coal, labor, water, etc., is dependent upon the number of kilowatt hours produced, and is independent of the maximum load.

The fact about this matter which is least appreciated is, that the portion of the total cost of 1 kw-hour produced, which depends upon the maximum load, is about two-thirds of the total cost, and the part dependent upon the output is only about one-third.

In a modern central station 1 kw of its capacity represents about $300 invested. Consider the two consumers cited above. Both loads are in use at the time of maximum daily load. For the elevator, the central station has to provide an investment of $9,000, for the ventilating fan $375. Assuming interest, depreciation and similar charges, at 10 per cent. we have $900 to deduct from our gross earnings in the elevator case before we reach net profits, and $37.50 in the other case.

Suppose we get 10 cents per kilowatt hour in each case, and that the cost of production, independent of general expenses, interest, depreciation, etc., is 50 per cent. of the gross receipts, etc. This would mean that if we get 10 cents for each kilowatt hour in both cases our gross revenue would be $90 per month in each case and our gross profit $45 per month, or $540 per year in each case. But in the elevator case we have interest and depreciation charges of $900 a year, and hence have actually lost considerable money in supplying this customer, while in the other case we have made a net profit of over $500 per annum.

We would have to charge more than ten times the rate per kilowatt hour to the elevator that we charge to the ventilating fan to make the same net profit on $1 of capital invested.

This load factor is a most vital question, and it is the difference in load factors in English and American central stations which makes storage batteries commercially possible there and impossible here.

The average load factor of an English central station is less than 15 per cent., and even in London in December it is only 33 per cent., while in most American cities the load factor, which averages 40 per cent., will, in December, in many cases, be above 50 per cent.

This difference is due almost wholly to our motor load, which is an almost unknown quantity abroad. With a 15 per cent. load factor a storage battery may pay, but not with a load factor of 40 per cent., especially when the load factor in our central stations is rising each year.

If central station companies would offer such a discount due to load factor as to warrant an individual customer's installing at his own expense a storage plant which he would charge at the minimum rate per kilowatt hour by a steady current for 24 hours per day, and then used this stored energy to supply his occasional demands of an occasionally very large rate of energy, I believe it is possible that the central station companies, the storage battery companies and the consumers might all derive a profit from the arrangement. I have no doubt that a central station company could afford to make a rate of four cents per kilowatt hour for a continuous service night and day, and make a satisfactory profit, while it would surely lose money in supplying an elevator, such as described above, at even 15 cents per kilowatt hour.

I believe that the following schedule of rates fairly represents the charges per kilowatt hour that should be made to customers of various load factors.

It must be noticed that this argument would lose most of its force if the maximum load of the consumer did not occur at the time of day when the maximum load was upon the central station; but in elevators, and similar loads which call for their maximum load in starting up every few seconds, the maximum loads will not only occur together occasionally, but this will sometimes occur at the time of maximum load on the central station, and when this accumulated load is put upon the central station, the kilowatts must be there to meet the demand.

Load Factor	Rate per kw hour in cents	Resultant Gross Income per annum per kw of plant.
5	30	$131.40
10	20	175.20
15	16	210.24
20	13	227.76
25	11.2	245.28
30	10	262.80
35	9.2	281.07
40	8.5	297.84
50	7	306.60
60	6	315.36
70	5.3	325.00
80	4.8	336.38
90	4.4	346.89
100	4	350.40

Electrical Transmission from Niagara to Buffalo.

A meeting was held Feb. 21, at Buffalo, between Secretary W. B. Rankin, of the Niagara Falls Power Company, and a committee of Buffalo municipal representatives, at which Mr. Rankin presented for consideration a statement of the views of his company with respect to the transmission of electrical power from Niagara to Buffalo.

The application made by the Niagara Falls Power Company as to transmitting to and distribution in Buffalo 10,000 hp generated in its power house at Niagara Falls was stated to be necessary as a basis for a decision. To be ready to do this will involve the extension of the present wheel pit by at least 140 feet, and the installation of three 5,000-hp turbines and three 5,000-hp dynamos in addition to those already ordered and partly installed (one being a reserve); also, the building of transformers, transmission lines and a distributing system. The company is advised that such extension of wheel pit and the necessary hydraulic and electrical installation can be made within eight months from the time the order is given for the work and plant. Before the order is given it is necessary, therefore, for the company to know, and at an early day, what action the city of Buffalo will take in regard to a franchise.

The power company has found that it cannot economically transmit to Buffalo less than 10,000 hp, and it cannot consider the transmission of any less amount. If a proper franchise be granted, the company is prepared to institute the arrangements necessary to effect the proposed transmission and distribution of 10,000 electrical horse power generated at Niagara.

While the company recognizes the propriety of provisions for the protection of property and the public safety, there have been suggested some restrictions which, if incorporated in the franchise, will absolutely prevent its acceptance by the company.

First—The company cannot accept a time-limit less than the term of its bonds. Such a restriction would deprive the company of any proper or usual basis for estimating the propriety, security or extent of its proposed investment; and

Second—The company cannot consent to the fixing of a maximum or other price for power within the city. The price must be left as a matter of negotiation in each instance between the company and the taker of the power, who will find adequate protection in the fact that unless the electrical power can be used at a cost below that of steam power it will not be used. The company will be prepared to sell, and can sell, power in Buffalo to those who wish to buy it, only because they find it more economical than any other power.

As to the city purchasing the power from the company at Niagara, the company is now ready to execute a contract in either one of three forms for the sale to the City of Buffalo of 10,000 hp, deliverable on the lands of the company at Niagara, upon the following terms and at the following prices:

First—10,000 hp undeveloped on lands of the company at Niagara at $10 per hp per annum, 24-hour power; the City of Buffalo to make its own wheel pits and side tunnels and to put in its own wheels. The necessary water, the inlets and the necessary discharge space in the completed tunnel of the company are now ready to produce this power. This form of contract is of public record at Lockport with the Niagara Falls Paper Company, by whom this form of power has been in satisfactory use for over one year, showing that interruptions from ice or other causes are not to be feared.

Second—Or 10,000 hp developed on the shaft of turbines furnished by the company on the company's lands at Niagara, at $13 per hp per annum, 24-hour power; so to be delivered within six months from the execution of the contract.

Third—Or 10,000 electrical horse power, alternating current, at a voltage of 2,000 as it comes from the company's generators at the power house, 24-hour power, at $18 per horse power per annum, to be delivered within eight months from the execution of the contract.

In the event of the city making a contract for power in either of the above forms the company will place at its disposal all the data which it has gathered in a five-years' study of the problems of transmission, and will arrange for a satisfactory use by the city of the rights of way between Niagara Falls and Buffalo which the company has acquired. These rights of way are three in number and are practically complete.

The company cannot name a price for electrical power transmitted to the Buffalo city line, as in the question of transmission are involved the uncertainties of the losses and cost of operation and maintenance.

The company has made a contract with a large electrical power user for not less than $20,000 per annum for 1,000 electrical hp delivered on the company's land in Niagara. As this statement has been called in question, the company offered to submit this contract to the inspection of the Mayor of the City of Buffalo.

Referring to the tabulated statement said to have been prepared by Mr. Richard Hammond and recently published in the Buffalo *Courier*, showing the cost of 1,000 hp ten hours per day to be $21 per horse power per annum, the company is prepared to prove that for the city of Buffalo and under the conditions assumed in that statement, the annual cost of such 10-hour power is not less than $32. If there were any plants existing under the same conditions and of the other sizes mentioned in the publication, the discrepancy between the figures estimated for the larger units and the actual figures would be even greater.

With a determination to avoid all arbitrary estimates, consideration has been given to actual facts and actual conditions in the cities hereafter mentioned, and the following figures are submitted, which the company considers as indisputable:

A recent test by a disinterested expert of the cost of steam power, ranging over a period of 18 months, in a Buffalo plant using considerably over 1,000 hp under excellent condition as to economy, shows the annual cost of such 11-hour power to be $32.70.

At the Buffalo City Water Works, with engine capacity of 3,600 hp, the average cost of all the engines in use for the years 1893 and 1894, as stated by their engineer, for over 2,000 hp, is $77.55, and Mr. Knapp estimates that for 1895 the cost of 3,000 hp will be over $60; this is pump horse power, and the average efficiency of the engines having been found to be 80 per cent., the average cost of the steam horse power of the pumping engines for the years 1893 and 1894 is $62.04.

In Milwaukee, Wis., as the result of a year's work at the North Point plant of the city's water works with steam pumping engines of 500 hp (a plant which Prof. R. H. Thurston, the recognized American authority on the cost of steam power, pronounces one of the most economical steam plants in existence), a careful examination shows the cost of pump horse power to be $75.83, and for steam power to be $68.25, and this exclusive of any allowance for insurance and taxes.

In Urban & Company's flouring mill in Buffalo, a recent expert test of a 400-hp plant covering the year 1894, shows the cost of this 24-hour power to be not less than $45.

Mr. Huntley, the general manager of the General Electric Company, of Buffalo, states that it is safe to say that in nearly every factory in the city the cost of steam power is not less than $45 to $60.

If the city does not desire to purchase power at Niagara, as above suggested, then, within the limits and to the extent above stated, but not otherwise, the Niagara Falls Power Company renews its application for a franchise in the city of Buffalo.

After reading the statement given above, in reply to questions Mr. Rankin said that the time limit referred to, dependent upon the duration of its 50 per cent. bonds, was for 40 years from 1892. He also said that there would be no difficulty in furnishing Buffalo with any amount of power up to 30,000 hp, and that after the first 10,000 hp it could be sent in blocks of 5,000 hp. The company has contracted to furnish over 10,000 hp upon call, and most of this is to be furnished as soon as the company is ready to supply it. He also said that if Buffalo wanted more than from 30,000 to 50,000 hp the Niagara Company would probably build another tunnel.

The Monocyclic System.

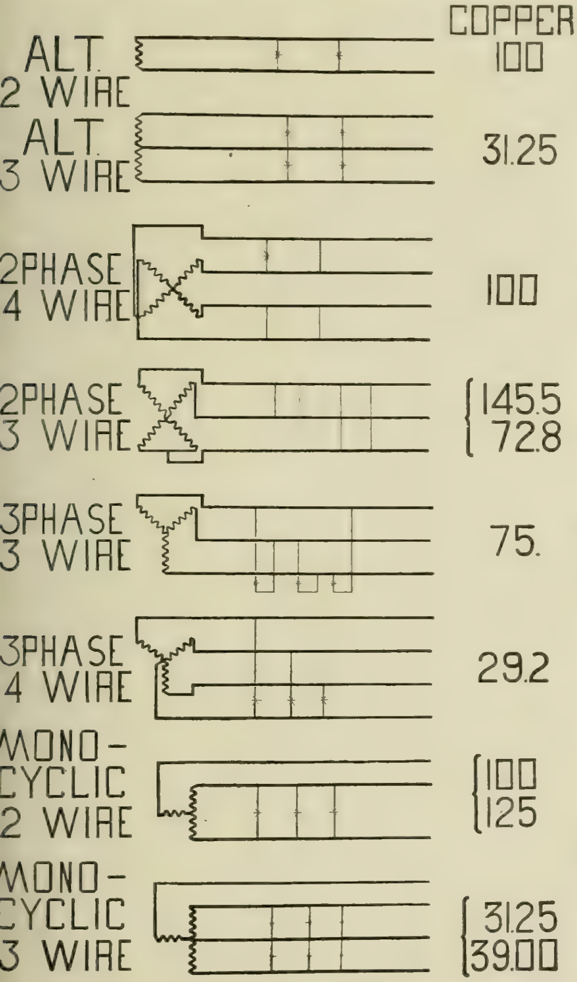
BY DR. LOUIS BELL.

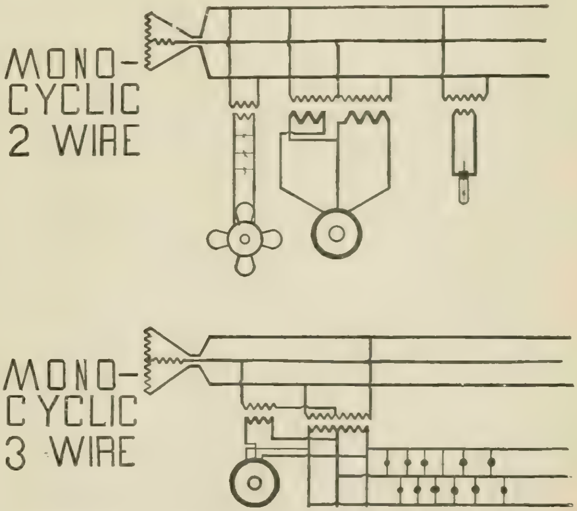
To the central station man no recent change in engineering practice can have more interest than the renaissance of alternating current work which is now in progress. Truth to tell, until quite recently the alternating current was somewhat under a cloud in the estimation of both station managers and engineers. It had served an immensely useful purpose in the extension of electric lighting to places where it would have been utterly impracticable to install a direct current system of any sort, on account of the scattered nature of the work. A very large number of stations have been installed on the alternating system, and I am sorry to say that a large proportion of them have been somewhat unsatisfactory, not in their general operation, but in the character of their service and the commercial results. It is quite common to find alternating stations with a plant efficiency considerably below 50 per cent., and in which the regulation is maintained only within, perhaps, about 10 per cent. Under these circumstances, it is small wonder that the advocates of the direct current, the uses of which as an engineering problem have been very completely worked out, have been often somewhat violent in their animadversions on alternating currents in general. Nevertheless, in the last two or three years there has been a vast change for the better in alternating practice; a change not yet rapid, but bidding fair to be far-reaching. This change has taken up a three-fold path toward progress:

First, the use of large transformers is becoming more frequent. Next, these transformers are more and more used in conjunction with systems of secondary mains; and, finally, it is now possible to install an alternating plant that shall be able to operate motors as successfully as can be done with direct current. In ordinary central station practice the motor service does not usually play a very important part; nevertheless, the ability to run motors is most valuable. It is more profitable, speaking broadly, to sell current for light, for a better price per kilowatt hour can be obtained; at the same time, if motors can be readily furnished, a useful day load can be obtained when it is needed, and the plant becomes of greater service to the community, a thing which, in these days of more or less friction with common councils, is of no small importance. Not only can motors now be successfully worked off alternating circuits, but off a wide variety of such circuits. As yet, however, there is no successful motor for use on the simple alternating system, which has, for the most part, been installed in this country. While it is possible to construct a single-phase motor even for 120 to 130 cycles per second, the frequency most used in America, it is at present very doubtful whether such a motor can be made to start and run in a way which will be generally satisfactory. Abroad, where low periodicities are used, better results may be obtained, but, even there, there is a noticeable silence on several important points in describing alternating motor practice. Appearances indicate that even with the advantage of low frequency, motors for use on simple alternating circuits still start badly, and particularly require enormous currents at the moment of starting; hence the growth of various modified alternating systems, of which the polyphase are the best known, by the use of which it becomes possible to avoid this difficulty entirely and to work alternating current motors in every respect as satisfactory as those operated by direct current.

The polyphase motor has solved the problem of securing good motor service with alternating currents in a very complete manner, although at the cost of slight complications which, while generally overestimated, are, nevertheless, distasteful to central station men, especially where the use of such a system would involve an extensive and costly re-arrangement of the distribution service. It is the purpose of this paper to call your attention to the various methods of central station distribution, involving motor service on the alternating current system, and more especially to a modified single-phase alternating system which lends itself very readily to a very simple and straightforward distribution for lighting without sacrificing the excellent motor service which makes the true polyphase systems so desirable. For all-around central station work, the lighting service is of most fundamental importance, and convenience and economy in this particular must, in a vast majority of cases, be the first consideration. Fig. 1 shows in a diagrammatic manner the general arrangement of various alternating circuits, including those already familiar and the polyphase and monocyclic systems. First in order, both of time and extended use, comes the simple alternating system, single phase, with an ordinary two-wire distributing circuit. In operating the secondaries of such a system, we run immediately into limitations imposed by the feasible voltage for lamps, limitations which have acted as a brake on alternating current work, and which are responsible for a good many difficulties in the operation of alternating plants. Opposite the diagram of this circuit is placed the relative amount of copper required for lighting with such a distribution.

Next comes the alternating circuit modified for Edison three-wire distribution, which is so familiar in its character that it needs no description here. The amount of copper needed, on the supposition that neutral is half the size of either of the others, is, of course, enormously reduced, amounting, as you see, to less than one-third of that needed with the two-wire system; consequently, the secondary main distribution, so important to economical operation, can be carried out with the greatest facility. We are justified, at present, in saying that neither of these systems lend themselves to the ready operation of motors.





DIAGRAMS REPRESENTING ALTERNATING SYSTEMS.

We may next consider the two-phase alternating system worked with four wires, giving, if desired, two separate circuits for each machine. The copper here required is the same as that used with the single phase, and so long as the four wires are kept together motors can be freely operated. Here is assuredly a step in advance. The operation of two separate circuits, however, from a single machine, involves certain complications. In the first place, unless the circuits are balanced as to load, the operation of the system is somewhat difficult to make satisfactory in point of regulation. The circuits themselves have absolutely no influence on each other, but they are derived from the same machine, and with a given excitation of that machine, unless the loss in the two circuits is the same, the voltage must necessarily be different, consequently the generator cannot be compounded for both circuits unless the circuits are balanced. There are three ways out of this difficulty; none of them, unfortunately, is altogether unobjectionable.

In the first place, one can make the loss on the line so small that the difference in voltage, due to any reasonable difference in load, is of no moment. This can sometimes successfully be done, but more often it involves a very unnecessary cost for copper, and even at its best is likely to give regulation which, although better than that found on most simple alternating systems, is yet not good enough to suit the requirements of the best modern engineering.

Second, the machine can be compounded for loss on one of the lines, a feeder regulator being used on the other. This practically means hand regulation of one circuit.

Or, finally, both circuits can be operated by such regulators. In any case, if motors are to be operated, the two-phase must be interlinked at least by one wire.

A somewhat simpler two-phase distribution is that shown in Fig. 2, where the two phases unite into a common three-wire circuit. The amount of copper here required differs very materially according to the limitations of voltage that one chooses to fix. If the maximum voltage of the system is limited to the same maximum voltage used on the single-phase two-wire or two-phase four-wire system, the amount of copper required is very largely increased by the use of the third wire, owing to the fact that the two circuits combined are out of phase with each other by 90 degrees. The relative amount of copper required here is, as you see, 145.5. If, on the other hand, the question of maximum voltage between wires is neglected, and the voltage is determined by the use of lamps of the same voltages as on the other systems, then the amount of copper is materially reduced, being a trifle less than three-fourths of that required on the systems before mentioned. In this case we neglect the fact of there being an excessive voltage between the outside wires, and connect lamps between the middle wire and the two outside ones, much in the manner of an Edison three-wire system, with the exception, of course, that the saving in copper is not anything like the same amount. Such a system allows the distribution of the whole load for lights and power in a single circuit containing only three wires. It therefore avoids the difficulty of regulating two separate circuits. On the other hand, it causes a new and very curious difficulty, owing to the fact that the two combined phases are unsymmetrical with regards to the inductance of the system. The voltages between the middle wire and the two outside wires are unequal, when the systems are equally loaded, by an amount depending on the inductive loss on the line. Consequently, when in balance for regulation, the system is unbalanced as regards the load on the two sides, a condition which, although it may not lead to trouble in some cases, is still a menace to the successful operation of the system, unless the distribution be skillfully engineered. There is, however, the possibility of a noticeable saving in copper.

We may next pass to the three-phase alternating system. The system which corresponds to the two-phase four-wire system will not be considered, as the use of three separate circuits would be even more troublesome than that of two, and would have no compensating advantages. The ordinary three-phase circuit is that shown in the figure, wherein the three phases are united into three wires and taken everywhere where the motors and lights are wanted. In this case, for the same voltage between wires, the amount of copper demanded is just three-fourths of that demanded for a single-phase two-wire or two-phase four-wire circuit. To compensate for this, there is the possibility of unequal voltages in case the three legs of the circuit are unequally loaded, owing to interaction in transformers and in the generator. So far as inductance on the line is concerned, the system is symmetrical and balanced.

If the load on the three branches is very unequal, as, for example, if one branch is entirely unloaded or very lightly loaded, while the other two are worked to their full capacity, there will be a perceptible unbalancing of the voltage. Experience, however, shows that with anything like the same care in balancing that would apply to an Edison three-wire system, this theoretical difficulty of balance is absolutely negligible. I say this advisedly, as the question has been so often raised that I have taken pains to investigate the conditions in three plants operating lights with reference to this particular thing, and the statement just made is the result of actual practice. It might be thought at first sight that good results could be obtained by combining with either a two-phase or three-phase system the Edison three-wire distribution. As a matter of fact, such a system would be unreasonably complicated with either two or three phases, as any central station man will readily appreciate, inasmuch as it would be necessary to have two or three wire systems, each balanced, and mutually balanced with respect to each other, covering the territory if motors are to be run, or at least interlinked in a somewhat complicated way.

There is, however, a three-phase system which does secure a very great advantage in copper. This is the three-phase four-wire system shown in the figure. It consists of the ordinary three wires employed on the three-phase system, with the addition of a balance wire proceeding from the common connection of the generator or the transformer and forming a part of the general distribution system. The lights are, as can be seen from the figure, connected between either of the three-phase wires and the balance wire. Between each of the outside wires there are, therefore, what may be considered two lamps in series, having, however, a phase difference of 120 degrees. The voltage of transmission, then, between each of the three main wires, is 1.73 times the voltage employed in the lamp connected, nearly 200 volts for 110 volt lamps. This necessarily means a large saving in copper, which is still further enhanced by the fact that the three-phase three-wire system requires intrinsically only 75 per cent. of the copper used on the single phase or direct current system. The total result with this particular connection is but 29½ per cent. of the copper required on the single-phase system, supposing, as in the Edison three-wire distribution, the neutral wire to be half the size of either of the others. Such a system is in successful use at St. Hyacinthe, Canada, in connection with long secondary mains. The price paid for this saving in copper is the introduction of a fourth wire into the distributing system.

Comparing, then, the lighting distributions on the two and three-phase systems, we find that if three wires only are used, both save very nearly the same amount of copper. The extreme voltage between wires on the two-phase circuit is, however, considerably greater, and both are liable, but not likely, to become unbalanced.

There is this difference, however, that if we are to balance a three-phase system in respect to voltage, we need only to see that the load is unequally distributed between the three branches. If we are to balance a two-phase, three-wire system, we must see that this load is unequally distributed between the three branches by an amount depending on the inductance of the line. We therefore see, comparing the polyphase with the single-phase system, that the price we have to pay for the privilege of successfully operating motors is a certain amount of complication in circuits, which, while not of great importance in new installations, hinders the ready adaptation of a polyphase system in a plant having already a large number of circuits installed. Attractive as the single-phase is in its beautiful simplicity of wiring, we cannot yet successfully run motors from it. It was for the purpose of preserving that simplicity of distribution which is peculiarly valuable in connection with large central stations, especially those already installed, and joining to this the same ability of running motors found on the polyphase system, that the monocyclic system, to which I am about to call your attention, has been perfected. You see it first in its two-wire form. Here, so far as the lighting distribution is concerned, it is absolutely identical with any of the alternating systems now installed, in simplicity, convenience and in the amount of copper necessary. The main circuit of the monocyclic machine constitutes a simple single-phase alternator, and so far as the lighting on the system is concerned is identical with it, connected in precisely the same way, feeding, if desirable, into the same circuits without change. There is, however, on the armature of the monocyclic machine a supplemental coil, shown on the diagram as connected to the middle point of the main winding on the monocyclic machine, from which a power wire may be led. This need be of small cross section, and only has to be carried to those points in the system at which it is desired to operate motors, and, as I shall presently show, this power wire enables one to run motors possessing the same desirable characteristics as the polyphase motors, and, indeed, generally identical with them, without in any way disturbing the lighting distribution, except in so far as Ohm's law is a necessary limitation on all combined power and lighting circuits. In the last diagram here we see the same device applied to an Edison three-wire system for the distribution of lights, along with which is carried the same insignificant power wire which permits the successful operation of motors. The value of the three-wire feature in the distribution of lights is evident, the amount of copper being the same as in the Edison system of the same voltage. With this monocyclic system we can compound the generators for any reasonable loss in the line, and can arrange the lighting system without incurring any troublesome questions of balance, so as to give as good regulation even as can be obtained on a direct-current system. Beyond this, we have the power of running motors.

It is instructive to glance over this list of alternating lighting systems to see their relative complexity and advantages. It is especially noteworthy that any and every method of distribution that saves copper introduces in some form or other the question of balance. This is the price we pay for reduction in cost of conductors. It has not seriously interfered with the use of the Edison three-wire system; in fact, those most familiar with that system were the first to make light of the difficulty; nor do I think it stands as a valid objection to the use of the polyphase systems in cases where they are desirable, as none of them are more sensitive in the matter of balance than the Edison three-wire system which is now in such extensive and uniformly successful use. We may further note that in each of the alternating systems where a very great saving of copper is accomplished, a fourth is necessary, at least if both lights and motors are to be operated; in each case, however, of trifling size.

Having now looked over the field in general, we may pass to the more minute consideration of the somewhat striking electrical peculiarities of the monocyclic system; peculiarities which, although they do not involve any particular complexity, are yet of decided interest.

The general principle of the system is well shown in this diagram. So far as the main work of the generator is concerned, its winding is closely similar to that of any well-designed alternator. The armature is of the iron-clad type and the winding is made in machine-wound coils which are invariably insulated, and can be very readily slipped into place. There is, however, upon the armature a second set of coils of cross section equivalent to that of the main coil, but composed of comparatively few turns, so that the room taken up on the armature is very small, and owing to the shallowness of the slots necessary to accommodate this second or teaser coil, the output of the machine, considered as a single-phase generator, is not affected. This teaser coil is located with reference to the main coil, as shown in the diagram. Its place on the armature is midway between the other coils and the electromotive force generated is in a direction at right angles to that of the principal coil. It is evident now that if we connect the terminal of this teaser coil with either of the terminals of the main coil we shall get an electromotive force compounded of the two, and in some intermediate direction. In general, by varying the proportions of the two coils, and hence their electromotive forces, we could obtain a resultant electromotive force between their terminals having any angle we pleased with either the main or the teaser coil. If, then, wires are taken upon the line from the terminals of the main coil, and also from the teaser coil, we can obtain from the main line three electromotive forces, two of which are symmetrically situated with reference to the E.M.F. of the teaser coil, and bear to it any phase relation that we please. One of the most convenient arrangements, and that which is most generally adopted, involves such a relation of the electromotive force of the teaser coil to that of the main coils that we shall have on the line three electromotive forces approximately 60 degrees apart. In other words, the resultant E.M.Fs. between teasers and main coils are each 60 degrees from the E.M.F. of the teaser coil. Such an arrangement is that shown in the diagram. Under these circumstances, it is clear that if one of these electromotive forces were reversed, either in transformers or anywhere in the translating devices, the result would be three electromotive forces 120 degrees apart, one of them having been turned through an angle of 180 degrees. Meanwhile, the relation between the power wire, which is connected to the teaser coil, and the outside wire has no effect upon the electromotive force between these outside wires, since the electromotive force of the main coil itself does not interact with the power wire, except in so far as a portion of it may act with the power wire to form a resultant phase and electromotive force for running motors. Consequently, so far as lights are concerned, the two outside wires behave precisely like the leads from any other alternating generator, while so far as motors are concerned, we have the power of getting our three electromotive forces 120 degrees apart, and hence have the same magnetic effect as with a three-phase system. The arrangement of lights and motors with this device is clearly shown in the diagram. It is evident that we can take from the outside wires of the monocyclic system either arc or incandescent lights anywhere and to any extent the capacity of the machine permits, working for the incandescents either two or three-wire distribution at option. For a motor, two transformers are connected anywhere we please, one between the power wire and each of the outside wires. At this point the resultant phases come into play, and the necessary reversal of one of the electromotive forces is accomplished by the very simple and obvious device of reversing one of the secondaries, as shown in the diagram. To the secondary circuit thus constituted, we can connect a standard induction motor which will start and run as well as if connected to a regular three-phase system, or instead of reversing one of the transformer secondaries we may accomplish the same virtual reversal of the electromotive force by reversing one of the coils in the motor itself. We, therefore, have a system which, so far as lights are concerned, is a simple alternating system; so far as motors are concerned, the dynamical equivalent of a polyphase system. With a differently proportioned transformation we could place upon the secondaries two electromotive forces 90 degrees apart if necessary, and then run two-phase motors instead of three-phase motors if there were any object in so doing. Such an arrangement, however, would be less desirable than that of the quasi three-phase system, for the reason that without gaining anything in the motors we should have to generate a larger electromotive force in the teaser coil, and hence take up more room on the armature with it; perhaps enough to have an effect upon the output of the machine considered as a single-phase generator. It is sufficiently evident that the method shown would not be the only way of getting the same result. For example, in this second diagram a somewhat different arrangement is shown accomplishing precisely the same end. Here our object is to operate secondary mains on the Edison three-wire system, and in connection with them to run motors at any point we please. A large transformer to which the secondary is connected on the three-wire system is therefore installed and the secondary mains distributed in any manner we please. A second and small transformer, proportioned to the total amount of motor service desired, is connected as shown in the diagram, and the power wire leading from it is taken through the whole or part of the three-wire system. The device is analogous to the arrangement of the generating coils themselves, and the result is the ability to operate a standard induction motor by connecting it anywhere on the three-wire system to the two inside wires and to the power wire. Such an arrangement as this is immensely convenient in distributing power and light in cities where, for example, it is desired to establish an extensive system of secondary mains through Edison tubes or other convenient underground distribution. It is, furthermore, interesting to know that one is not confined to the use of either two or three-phase induction motors, since a monocyclic generator connected to the primary circuit makes an excellent synchronous speed without the assistance of a starting motor, in this particular being vastly superior to the pure single phase synchronous machine. But, it may be asked, how about this power wire? In case, for example, of a transmission over a considerable distance before the distributing point is reached, must the power wire be part of the transmission system? In answer, I need only call your attention to the fact that the essential point of the monocyclic system, so far as motors are concerned, is the establishing of an electromotive force bearing the same relation to the system as is borne by the teaser coil of the generator. Consequently, in case of a transmission plant, the main generators at the distant station may be simple single-phase machines, the subsidiary electromotive force being furnished by a synchronous motor or similar device at any point in the system. So we might readily have an extensive transmission with a monocyclic machine in the sub-station of such size as is necessary to furnish current for what motors may be upon the system. The power wire would then run only to the sub-station. Another interesting peculiarity of the monocyclic system, and one which is not without importance in case of an extensive power distribution, is the following:

Under ordinary circumstances, induction and synchronous motors are wound so that the counter electromotive force affects the system in a perfectly symmetrical manner, and the current flows over all the wires with some degree of symmetry in response to the demands of the motors on the system. It is customary, however, in the monocyclic system to employ motors so wound as to throw a high counter electromotive force into the power wire when the motor is at speed and loaded, thereby reducing the normal current carried over the power wire to a purely nominal amount, and this can evidently be done without sacrificing much in the matter of starting, since at the start all the counter electromotive forces in the motors are zero. We have, then, a motor system of a type really peculiar to the monocyclic system, in that each motor will start under the same conditions of impressed electromotive force as if it were a polyphase motor; while, when at speed and loaded, it would be operating virtually as a single-phase machine. If, however, it were overloaded so that it would tend to slow down or stop, sufficient energy would flow over the power wire to bring it back to speed, just as if it were a polyphase machine. This is only one of various interesting ramifications in the systems when developed to meet special conditions.

The connections shown in the diagrams, however, are those of the most direct applicability, and probably which would be most extensively used for central station service. At this point it may be appropriate to ask what is the disadvantage of such a system. It evidently secures exceedingly marked advantages in the ability to operate the lights on existing circuits or with the simplest possible kind of distribution, and at the same time to run at any point in the system synchronous or induction motors of well-tried and familiar types. The question can be readily answered; in fact, the answer is almost obvious. The price which we have to pay for this advantage is the installation of the power wire, which necessarily adds something to the weight of copper in the system and to the trouble of installation. Under all ordinary circumstances the power wire need be of trivial cross section compared to that of the other wires, since, as a rule, the energy required for operating the motors from the given central station is small compared with the total capacity of the station, and further, it is worth remarking that the monocyclic motors, either synchronous or induction, will run perfectly well if the power wire is disconnected after the motor is at speed operating them as single-phase machines. It is, of course, well known that the single-phase synchronous motor gives admirable results, and it is also true that a single-phase induction motor can be constructed of excellent efficiency and other electrical properties. The only material difficulty in this case is to get the motor to start with a good torque. The monocyclic connection enables this to be accomplished. After the motor is at speed the power wire becomes no longer necessary to successful operation, so that in spite of the necessary existence of the power wire it is easy to see that the additional amount of copper is not likely to be burdensome in central station operation. It would hardly ever be necessary to install a power wire of more than one-fourth the joint cross section of the others, as given in the diagram, and generally a much smaller wire will suffice.

I have thus endeavored in a brief space to give a good working idea of the monocyclic method of combined light and power distribution, which has been devised and is urged upon the public as specially adapted for the work of central station distribution on account of its unique simplicity in practice. As to what has already been done in the installation of such apparatus, a considerable number of these monocyclic generators are in daily use in central stations, for the most part operating over circuits already established and displacing the higher frequency alternators which had been previously used. They are giving excellent results, and the operation of the motors, wherever employed, has been highly satisfactory. The system, therefore, needs no extensive exploitation on paper. After once pointing out here the principal and general advantages of the system, it is better to let the plants already running speak for themselves, and let their verdict be final.

DISCUSSION.

Mr. Kelly: I suppose I can honestly begin by paying a tribute to the ingenuity of the devisers of the system; but it is scarcely necessary, because we all know what they can do—they have already proved themselves. I cannot help feeling, however, that in this case their ingenuity has been somewhat misapplied. The most serious fault with the system is that it did not come soon enough. If it had come before the polyphase systems had been worked out, perhaps we would not have needed any polyphase system, but, coming when it does, it seems to me a step backward. In the first place, the generator, as Dr. Bell explained, is substantially a single-phase generator. Now, in any given generator of given magnitude it is not possible to get the same output and regulation as it is from the polyphase—when worked single-phase as when worked two-phase. Dr. Bell seemed to think that the two-phase was in trouble, because of the difficulty of balancing the two circuits. I am more familiar with that system than any other, and my own reason for preferring it is because the regulation is better than if the work was thrown on one circuit. We have found that there is no more difficulty in balancing than in the Edison three-wire system. When it comes to the lines I suppose it is in this point that the chief advantage of the monocyclic system is supposed to lie; but the system requires at least three wires and any polyphase system does not require more. Where lights only and not power are required, it only needs two; in practice that is all that any polyphase does in any district where lights only are required. You need only run a pair of wires, so that in this respect there does not seem to be any gain in the monocyclic system, but the cost for copper is, at the least, according to Dr. Bell's diagram, higher than it is with the plain single phase, while the cost of copper in the two-phase three-wire system is very materially reduced. In the circular distributed I see it is stated that where power only is to be transmitted by means of the monocyclic system, the third wire is of the same section as the other two, making an addition of 50 per cent., but if the system is so working that this third wire is really a power wire and conveying energy, then there is not only this additional cost, but the percentage of drop in the circuits is increased beyond that in the single-phase system. As to the question raised by Dr. Bell in regard to the periodicity at which motors can be worked, there are undoubtedly great advantages in cases of long distances, or transmission with low periodicity, but one of them is not the possibility of operating motors. There is no difficulty in making polyphase motors of 16,000 alternations which will have high efficiency and start with large torque. As to the efficiency of the motor in the monocyclic system, there is nothing to be said against it, because the motor is substantially a polyphase motor, and whatever the polpybase motor will do the monocyclic will do.

Mr. Steinmetz: I am very much honored by being able to speak before such an association as this, and may say that I have heard with very great interest Dr. Bell's interesting paper, and with much greater interest Mr. Kelly's remarks. I can, however, not quite agree with his statement that the single-phase alternating current system is antiquated and superseded by the polpyhase system, and that therefore the monocyclic system is behind the times. The polyphase system has been before us now for nearly ten years. It made its appearance shortly after the single-phase system, and at a certain time after the Frankfort exhibition, when our electricians came back from Europe and talked excitedly of what they had seen, everybody seemed to think that the single-phase system would soon disappear altogether. Nevertheless, we have now thousands of single-phase stations running, while the polyphase system is only just beginning to be used in special cases. Therefore I feel confident that the polpyhase system will never be able to supersede the well-known single-phase system of old, but find that it possesses a limited application, although being very valuable at the proper place. The monocyclic system is entirely single phase; that is to say, the total flow of energy issuing from the generator passes through zero and is fluctuating; while the polyphase systems share with the continuous system the common feature that the flow of energy is never at zero, but more or less constant. E. M. Fs. of different phases or currents of different phases do not constitute the polyphase system; for in the ordinary single-phase system if an induction coil is connected in series to incandescent lamps you get E. M. Fs. displaced from each other by 90 degrees, that is quarterphase E. M. F.; and in a loaded transformer and in a transformer running light the currents are displaced in phase. In neither case, however, we speak of a polyphase system. The polyphase system is indicated when both E. M. Fs. as well as currents differ in phase from each other.

Now, with regard to the statement of Mr. Kelly that the output of a polyphase machine is larger than that of a single-phase machine, that is a common mistake repeated now for years. It means that in the polyphase armature more wire can be put than on the single phase armature. However, the output of an alternator is not limited by the amount of wire you can put on the armature, but by the armature reaction; or rather, by that amount of armature reaction which can be taken care of by the field; and in a single-phase machine you can, by compounding, take care of a very great armature reaction which you cannot take care of in the polyphase machine, where small armature reaction causes unbalancing of the circuit. In consequence of which the output of a polyphase is less than that of a single phase of the same size and speed; or at least not greater.

Prof. Thomson: The paper of Dr. Bell has been so full and so clear that it leaves very little for me to say, except that I can express my agreement with the statements of the paper, and that furthermore, after due consideration, I think Mr. Steinmetz has the right of it. He has given an enormous amount of time and attention and close study to the question of polyphase, single-phase and other systems, and has originated a number of remarkable combinations, one of which is the monocyclic system. I think the system undoubtedly accomplishes all that has been stated by Dr. Bell to be its advantages.

Mr. Scott: I have been, and I am sure all of you have been, very much interested in the presentation which has been made by Dr. Bell of the monocyclic system. We can take it, I think, as a carrying out of the remark that was made in an association a year and a half ago, that when we have an alternating polyphase system, we have something that we can do something with. It is flexible, we can twist it about, we can make a two-phase and three-phase system—and now a monocyclic system—variations of the polyphase system, and go from one to another and get the different advantages which any one of these may present for different kinds of work.

We have had the characteristics and advantages and merits of this system pointed out. It may be well, it seems to me, to bring forward some of the questions which arise with respect to the points which have been brought out so that they may be answered now, and that we may determine the relation of this system to the other systems. To these who are not immediately and technically familiar with the subject, there is apt to be a sort of haziness about it. We hear first about the two-phase and then about the three-phase systems, as if they were entirely new and different. As a matter of fact there is no fundamental difference between the two. Then we have a monocyclic system. What relation does it bear to the other systems? Is it radically and entirely new? Does this euphonious name mean something which is a departure from what has gone before, or is it a modification, and if so, of what is it a modification?

Starting with the source, the generator itself is just now somewhat in doubt. The single-phase generator is best, because it regulates better and has a better output. The polyphase generator, it is also stated, regulates well and has a good output, and without carrying that further we can all be satisfied by taking our choice. We will consider a few points made with respect to the transmission circuit. There are one or two statements of Dr. Bell which can either be called in question or certainly a little modification made to them. A two-phase four-wire system, which he has given as the third figure, he has considered as the correspondent of the alternating two-wire circuit only, and has not considered it applicable to use in a three-wire connection, in which the amount of copper is so much less. The reason of this was the added complication of running two three-wire circuits. That might be true if the area to be covered were quite small, but as central stations are usually run the lines are carried out in different directions. In alternating stations there are anywhere from three or four to a dozen of several dozen feeding circuits running in different directions and supplying different territories. It is just as easy to divide these up into three-wire circuits for lighting, as the different parts of the city to be supplied, or the districts, are separated, as it would be if all of the circuits were of the same phase. If, therefore, the distribution can be carried on by the three-wire plan, the cost of copper here would be materially reduced and be made equal to that of the three-wire single-phase system. Considering the two-phase three-wire system, the figure 145.5 was stated as the relative amount of copper used, and that a possible reduction of 72.8 if the extreme E.M.F. can be increased above that for the first figure upon the diagram, which is for the two-wire single-phase system. The assumption upon which all these figures have evidently been made is that there has to be a definite E.M.F. for the carrying of lamps. If that is to be carried through the various diagrams, then the 72.8 is a proper figure. If, on the other hand, a limited voltage is the consideration to be met, we have in the ordinary three-wire circuit twice the E.M.F. of the single-phase circuit. If the same be applied to the two-phase three-wire circuits then the amount of copper would not be 72.8 but one-half, or about 36, so that the figure 145.5 in connection with that diagram is not in accordance with the assumption of the E.M.F. being controlled by the lamps in circuit, and if the highest E.M.F. allowed is that of the three-wire circuit, then the additional figure for the weight of copper for the two-phase three-wire system should be 36 in comparison with the other figures.

Another point in connection with the lines is the unbalancing of circuits. It was stated that the two-phase three-wire circuit is one which is liable to unbalancing because of the reaction of one circuit upon another. While this is true in certain cases, in ordinary working these would be met with but seldom. The next point in the system, after going through our transmission circuits, is the transformer. The transformers for transforming a given amount of energy for lighting or for power, by the two-phase system, in which one transformer is placed on each of the two phases, is the same as that for the single-phase system. For the three-phase system, in which transformers are connected across each pair of mains, the converter capacity is the same; that is to say, if we have six transformers, we may connect them in parallel across the single-phase circuit, or we may connect them in two sets of three each on a two-phase system, or we may divide them into three groups of two each on the three-phase circuits, and each transformer will have the same individual capacity in each position. When, however, these transformers are connected as in the diagram illustrating the monocyclic two-wire system, then, as has already been pointed out, they do not operate in their ordinary way. Although the E. M. F. upon them may be normal, the currents flowing through the transformers differ from those in ordinary cases. They are not in phase with the E. M. F. upon the transformers, and the output of the transformers is reduced by a very appreciable amount—if I am correct in my present recollections, some 16 per cent. Thus, transformers of about one-sixth greater capacity would be required for operating a motor under this system above that which would be required if the same motor were operated by two-phase or three-phase systems.

The transformers in the monocyclic three-wire system also seem to require an excess capacity. If the large transformer in that diagram is the one which supplies the lights and operates the motor when the motor is doing something, then the little auxiliary or teaser transformer is one which is useful only at the start, and contributes nothing to the regular working of the motor, according to the assumptions which have been made. This transformer, therefore, is an additional piece of apparatus which must be provided in the system.

With regard to the motor itself, I observe that the motor in the monocyclic two-wire system is a three-phase motor and nothing else. I understand that the motors used are the standard three-wire motors, and the motor itself does not know the difference, where it is getting its supply, whether from a regular three-phase system or a two-wire monocyclic system. The transformers for this motor on the three-wire three-phase system would naturally be the three. We seem here to have cut off a part of this system by cutting out one of the transformers. We are not keeping the symmetrical arrangement now, but are supplying the motor by but two transformers, leading to the result to which I have just called attention, that is, a larger transformer capacity. The reversing of the secondary coil of one of the transformers, if I understand the connections and arrangement, would be obviated, and the transformer would be connected directly without this crossing if the primaries of these transformers were directly connected to three-phase mains. Suppose we have a system, then, with three-phase mains with three transformers connected, feeding respectively the three circuits of the motor. Now we cut out one of these transformers, but our motor will still run, but without the same efficient performance of the transformers. If we change the relation of the middle wire at the dynamo, or change the voltage of this wire, we can do so in such a proportion that the phases of the two primary circuits will not have their former relation—will not be 120 degrees apart, but 90 degrees apart. In this case, it becomes necessary to reverse one of the secondaries in order to obtain two currents 120 degrees apart for operating the motor. If, therefore, the teaser coil were wound with a different number of turns to give a higher E.M.F. we might have a three-phase generator supplying directly three-phase mains. What this seems to be, then, is really the elements of the three-phase system distorted somewhat by changing the E.M.F. on the middle or teaser wire and reversing the secondary of one of the transformers and leaving out the third transformer. So much for the motor which operates from the two-wire monocyclic system.

The motor on the three-wire system seems to have somewhat different relations. This is not a three-phase motor, but, I take it, is a two-phase motor, and it is rather interesting.

Dr. Bell: It is a three phase—the same motor as the other.

Mr. Scott: Very good, but on the diagrams I have seen of this monocyclic motor, I have taken it as a two-phase motor, the two windings being given in the diagram as two coils placed at right angles to one another. The very reason for bringing up this discussion and making it so full at this time, is to get a correct understanding of these motors. The understanding which I got from the diagrams and explanations which I have seen of the system, seem to me to represent a two-phase motor, one of the circuits being wound through directly similar to the monocyclic generator. This motor has been pointed out—I do not remember whether in the paper Dr. Bell has just read, or not—as similar to the monocyclic generator, which is stated to be a single-phase machine, wound with one winding straight through from one end to the other, with this little auxiliary or teaser coil connected between the middle of that coil and a third terminal. If this be the case, then it seems to me that this motor is either a single-phase motor or a two-phase motor. The explanation given of the operation of this motor has not been very complete to-day. If I make a mistake in drawing on other sources of information in regard to it, I hope I will be corrected.

This motor I have taken to be a single-phase motor when running at speed, but essentially a two-phase motor, which is supplied by the three wires which are operated by two transformers which have E.M.Fs. at right angles, or the 90-degree relation of the two-phase motor. We are supplying, then, to this motor the output of two converters which are operated at a difference of 90 degrees. All the circuits of the motor are active while the motor is coming up to speed. One of the windings on the motor is somewhat different from that of the windings on the transformer; it is not exactly proportioned in both of its circuits to the E.M.F. supplied, so that when run at speed one of the circuits does all the work. It is very much as if two transformers are connected in parallel, one giving 100 volts and the other 99 volts. If we put a load on the two transformers connected in multiple until the E.M.F. drops to 99 volts, then one of the transformers would be carrying all the load and the other nothing. The motor described here is the same motor, if I understand it correctly, as is described in the patents granted to Mr. Steinmetz. Then it seems to me that this motor is very similar to a sort of lop-sided two-phase motor, stronger on one side than the other. The two circuits operate with fair effect to bring the machine up to speed and then one of the circuits takes all the load and the other has but little to do. The motor in running at full speed and doing its regular work operates as a single-phase motor. A single-phase induction motor will not carry the same load that the two-phase induction motor will. Any one who has operated two-phase induction motors knows that one circuit may be cut out and the machine will continue to run, but it will not carry the same load as before. If that be true and the information upon which I understand the connection of this motor be true, then this monocyclic motor seems to be a rather decrepit two-phase motor.

There is one point to which attention was called by my able friend Mr. Steinmetz to which I take exception. That is his definition of a polyphase system or a polyphase motor. He was pleased to say that difference of phase in E.M.F. with no difference in current does not constitute a polyphase system, and he pointed out that if a coil and a lamp be placed in series the E.M.F. measured directly across the lamp and the E. M. F. measured directly across the coil would not be in phase with one another, but would occur at different times. So also if a coil and a lamp be placed in multiple so that the same E.M.F. is on the terminals of both, then the currents are not of the same phase. But he held that neither of these would constitute a polyphase system, because the flow of energy was not constant. A constant flow of energy may be taken as a definition of a polyphase system, so might difference of E.M.F. or difference of currents. As I understand a polyphase system, I do not mean that the E.M.F. at one part of the circuit may be one thing and at another part somewhere else another thing, either at a great distance or connected with a different piece of apparatus; that would not necessarily constitute a multiphase system; but if the two different elements with difference of phase cause the operation of that apparatus, then we have the essence of a polyphase system. If we have a motor and wind its circuits in such a way that the circuits shall differ in capacity or self-induction, if the currents in the different circuits differ in phase, and owing to this the apparatus operates and the motor runs, then we have something which should be legitimately considered as polyphase apparatus. We have an apparatus which operates due to the difference of phases, or to too many phases, and in the polyphase motors that is the characteristic element. The element which causes rotation, the fundamental element, seems to be the shifting of the magnetic field in the apparatus. It is not fundamentally essential to the operation of such an apparatus that the currents give equal energy to the apparatus at all times, but that they may be supplied in such a way as to give the shifting field, which will cause the rotation and running of the apparatus. I would, therefore, call a multiphase machine one which has in it a shifting magnetic field of many phases, or currents producing these magnetic fields, rather than one having constant flow of energy to the apparatus.

The power wire operating in the monocyclic three-wire system is said to be a powerless wire. This wire is for the purpose of operating the motor while it is coming up to speed. The two great problems in an alternating current motor are: first, the bringing of the motor up to speed; and secondly, keeping it there. These are two different problems, and different methods are devised for effecting the two different results; and very often the elements which contribute to one detract from the effectiveness of the other. The power wire, if I am right in understanding this motor, does not necessarily supply power to the motor at the time when the motor is running at full speed, but it contributes to the power which is required for bringing the motor up to speed, and would continue to deliver power to the motor instead of lying idle and resulting in so much idle copper in our system if the motor were a complete and symmertical motor instead of one which has possibly been made defective to meet the requirements of this system.

Dr. Bell: The first question raised may be granted, that the monocyclic system is a modification of something. Is it now to be considered as a single-phase or two-phase system, or a polyphase system of some sort? I think that question was clearly answered by Mr. Steinmetz when he pointed out that you must consider as a polyphase system one in which the energy remains constant—the common characteristic of all polyphase systems, whether evenly balanced or unbalanced. In the monocyclic system we have three currents substantially in phase with each other and the total energy passes through zero. I fail to see how the widest possible extension of the definition of a polyphase machine could be made fairly to include it. The most that could be said would be that there might be a limiting case in which the unbalancing of a polyphase system might go on until the total energy would actually pass through zero. If that is so, it might serve equally well as a limiting case for either the single phase or the polyphase system. It is certain that the monocyclic in its operation suggests a polyphase system. In the character of the currents which flow through it, and in the distribution of the energy, it is peculiarly single-phase in its character. I was interested in Mr. Scott's remarks on the subject of the four-wire connection of the two-phase; and in the second place, the three-wire connection of the two-phase system. Now, with a four-wire connection, it is, of course, possible to use the Edison three-wire system on each branch, if one so desires; but in order to do so, and to run motors at the same time, one must unlink the two three-wire systems; in other words, you must have two three-wire systems, each system being approximately balanced as to itself, and each three-wire system balanced as respects the other three-wire system occupying the same territory. They must be interlinked for motor service, and that is the reason which, I maintain, bars out the two-phase four-wire system from employing the Edison three-wire connection, just as it must bar out in the same way, and even more effectively, the three-phase system from operating on each of its three phases an Edison three-wire system. It makes a complication of circuits for general distribution which would be perfectly intolerable, two three-wire circuits in the same territory, and each balanced with respect to the other—it would be something better imagined than described. In certain cases, for lights only, it may be applied, because you are at liberty to scatter your circuits, but even then it would require more or less balancing of the two systems, else you get into trouble with one side of the machine having a greater load than the other, which causes a difference in drop which cannot be compensated by compounding.

With the two-phase, three-wire system, Mr. Scott's point was well taken on the question of maximum voltage. However, if you are dealing with the maximum permissible on the transmission line, where the thing to be considered is not the maximum on the distributing system to translating devices, but the maximum permissible on the whole system, and if you confine yourself to that, you find that combining the two-phase into three wires requires excessive copper. If you confine yourself to the secondary system alone it will be possible to permit the same maximum voltage as on the straight Edison three-wire, and I should say that the same rule would apply to the reduction of copper in the three-phase three-wire system, or any other systems, in varying degree according to their character.

As regards the question of unbalancing I think I stated with a fair degree of distinctness that with any polyphase system, though unbalancing may occur, and occur in a serious degree, I do not believe it would be a common occurrence. I think I specifically included the polyphase systems in general.

With regard to the question of the reduced capacity of transformers operating on three-phase or monocyclic systems: as a matter of fact there are three plans of working, we will say, with a three-phase system as regards its transformers; in the first place, we may have a composite transformer including all three legs of the circuits, which has been used with very fair results. Next we may use three transformers, or, finally, only two transformers. Sometimes it is more convenient to use three, and sometimes two. We must remember that there are not to be had an infinite number of sizes of transformers, nor an infinite number of sizes of motors. Therefore it is sometimes difficult to find transformers which will exactly fit a given horse power of motor, and the loss of capacity which is thus met in furnishing transformers too large for the motors (because we must be sure to have them large enough) may easily amount to 10 or 15 per cent., either with two or three phases, and unless special transformers are made to fit the motors, we are liable thus to require an increased total capacity of transformers, as well on two-phase as on three-phase systems. With the three-transformer connection for the three-phase circuit we have one very material advantage, which, perhaps, makes it worth while to employ it in many cases, and that is if one of the transformers for any reason is crippled, we can operate at least two-thirds of the output with the remaining two; whereas, on the two-phase system, if one transformer gives out the motor is crippled, either by overloading and stopping absolutely, or able to run at half output as a single-phase motor, but in no case starting until the transformer is fixed. If two transformers are used, the statement has been made that the loss in output in connecting three-phase transformers is about 16 per cent. I would like to see experimental evidence brought up in this case. We have been informed in many well written technical articles that the output of the polyphase machine was thus and so in comparison with a single-phase machine, and we know that the facts do not fully bear out the theory. We are now given similar information in regard to the transformers. While I am not prepared to dispute the fact without having experimented on it, I would like to see some evidence that the difference in output rises to any practical magnitude.

As regards the teaser transformer, I think we may consider the secondary transformer on the monocyclic three-wire system as practically part of the power wire. It needs to be of small size and furnishes only a small amount of energy. With that connection that one transformer furnishes the power wire for the whole three-wire system. It is not a part of each motor, simply a part of a power wire, and as such it may be taken as a part of the installation belonging to the three-wire system. The single small transformer in the system furnishes the entire power wire for the whole system.

As regards the motor on the monocyclic two-wire system, it is correct, in a sense, to say that the motor does not know whether it is on a three-phase circuit or a monocyclic. As regards its operation, it does not know—that is, as regards the direction of the E. M. Fs. in it.

It is a matter of perfect indifference which system it is on; but as regards the character of the currents and their direction, if the motor possessed an ammeter to put in its own coils, it would find there was a very large difference in the distribution of currents. As regards its magnetic qualities it would not matter, although the actual distribution of the current is widely changed. We have in the monocyclic induction motor a motor which, in its operative qualities, is like a polyphase motor. Nevertheless, the distribution of currents in it, although resulting in a perfectly symmetrical production of motive power, is something that you cannot find in any polyphase motor. It depends on the particular action used in the monocyclic system. It has essentially a single-phase current, although its effect as regards magnetism is closely similar to that of the true polyphase motor.

As regards the motor on the monocyclic three-wire system, I was much pleased with the ingenuity with which Mr. Scott constructed a large, able-bodied and well-dressed man of straw for the purpose of knocking the gentleman down and jumping on him with both feet. The motor is not a two-phase motor of any kind. It is an ordinary induction motor such as is used indifferently on three-phase or monocyclic systems. Doubtless, from the experience of the speaker, he realized how bad a bad two-phase motor could be. The winding of the monocyclic motor is in every respect similar to that of the three-phase motor. There is a possibility, and sometimes a great convenience, in being able to work a monocyclic generator as a synchronous motor. Used in such a way it works during its operation like any other synchronous motor. It is a possibility which is sometimes very convenient; the motor starts itself, and the teaser coil, when the motor is up to speed, produces no effect on the rest of the system if the motor is properly designed with reference to suppressing the E. M. F. of the teaser circuit. In the monocyclic three-wire system we have in the first place a three-phase motor structure, but operating on a monocyclic three-wire and teaser circuit, with the properties and distribution of currents, or electrical character, of the single-phase system. The actual details of operation in a monocyclic motor are somewhat complicated. Substantially we have a structure which in all its characteristics is only proper to be operated on the monocyclic or three-phase circuits. The currents which flow through it, however, are not three-phase currents, the E. M. Fs. being, however, 120 degrees apart. The currents are substantially in phase, but the magnetism produced is so distributed as to give a perfectly symmetrical torque on the motor, just as though it were run upon a polyphase circuit; a point which I think justifies me in the remark I made at the beginning, that the monocyclic system is to be regarded, not altogether as a modified and glorified single-phase, nor again as a decrepit and disreputable polyphase system, but rather as in a class by itself.

Telephone Rates.

One of the members of the New York Board of Trade states that the counsel for the Metropolitan Telephone Company admitted at a former investigation that the average profits on each New York exchange subscriber for the six years ending with 1886 (deducting toll line service) was $72.73. In 1881, the profits per exchange subscriber were $39.84; 1882, $71.19; 1883, $91.05; 1884, $72.82; 1885, $81.15; and 1886, $80.33. It is claimed that the sworn testimony of the company's officers at that investigation also showed that the company's net profit in those six years on the cash capital invested amounted to 473.91 per cent., that the net profits in 1885 exceeded 116 per cent., that they exceeded 147 per cent. in 1886, and over 145 per cent. in 1887. While the telephone rate was $60 a year, and afterwards raised to $150, and again to $180 a year, the company realized $2,843,454.53 profits (net earnings) in six years on an original cash investment of $600,000. At present 9,500 regular subscribers pay an average rate of $175 per year. Half the total number of subscribers, however, pay $240 a year, 3,000 pay a rate based on the service rendered and 2,000 pay rates below $240 a year and down to $150. It is claimed by the telephone company that at present better instruments are used and a metallic circuit, the latter greatly increasing the fixed charges on the service.

A New Method of Measuring Illumination.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

In almost all cases the object of artificial lighting is to provide a sufficient intensity of illumination upon the illumined surfaces. In practice, the illumination is generally required in order to permit some kind of work to be carried on. In any case, the character and intensity of the illumination will necessarily vary with the nature of the work.

In a room in which reading only is to be done, it suffices if the proper illumination is obtained on the pages of the books, *i. e.*, on the reading tables, though the remainder of the room is comparatively dark. Where machinery is to be operated, the main light is generally required upon certain moving parts. In cases, however, where the character of the work requires the attendant to move about, or to observe some distant part of the machinery, a necessity exists for avoiding marked contrast in the illumination of the room. Here it is clear that the use of a single source, such as an arc lamp, is undesirable, since, apart from the fact that such use would produce a powerful illumination in the immediate neighborhood of the lamp, it would necessarily cause annoying shadows which could only be avoided by diffusing and scattering the light. It is evident, therefore, that in practice it is the illumination rather than the luminous intensity of the sources which is desired to be measured.

Although experience will enable the electrical engineer to determine the probable number and grouping of the separate sources of light, such as incandescent lamps, that will be required to produce any desired illumination in any given space, yet it is well-known that no rigid rule can be laid down as a safe guide in such cases, since the character and color of the surfaces of the walls and ceiling will largely influence the illumination produced by a given arrangement of light sources. The question, therefore, as to whether or not a certain area is properly lighted cannot be decided so accurately from a knowledge of the number and grouping of the luminous sources and their candle power as it can from a method of actually measuring the quantity of light received per unit of area by a particular surface or surfaces whose illumination it is desired to know. In other words, the question at issue is not so much the photometric intensity of the sources of light and their distribution, as it is the degree of illumination actually produced, and this question cannot be decided by the photometer, but requires the use of an illumination measurer or illuminometer.

Suppose, for example, it is desired to illumine a billiard room. Though experience must determine the number and position of the lamps; yet the commercial question as to whether or not the necessary illumination has been obtained upon the tables can best be determined, not so well from the number and grouping of separate lamps of a given candle power as by an actual measurement of the light received per unit of area on the table surfaces. In the same way, whether or not a certain grouping of lights over the tables is sufficient to illumine the rest of the room satisfactorily can be best determined by the measurement of the illumination produced in different parts of the room. Similarly, in a dining or reading room it is the illumination of the tables that has to be specially provided for, and the question of proper lighting is best determined from a determination of the illumination of the tables irrespective of the character or number of the lights present, except, of course, in so far as æsthetic requirements are concerned.

In street lighting, the requirements are that sufficient illumination be obtained on the surfaces of the streets, houses, vehicles and persons to be able to discern them clearly at reasonably sufficient distances. This primarily requires a certain intensity of illumination over a given area; and can best be determined by an actual measurement of the minimum illumination, rather than by calculations dependent upon a number of complex conditions, of which the photometrical intensity of the separate sources employed is but one.

Measuring the illumination rather than measuring the intensity of the separate luminous sources would remove a source of great annoyance both to electrical engineers and to municipalities, by rendering unnecessary discussions as to the candle power of the incandescent or arc lights employed; since, if the contract between the city and the lighting company be so drawn that it be agreed that the illumination in any part of a lighted street, for example, in the absence of moonlight, shall not be less than a certain minimum, all questions as to the candle power of the separate sources will fail to affect the contract, and it only remains for the electrical engineer to provide such lamps as will, at the spacing employed, give the illumination contracted for.

So far as we know there is no actual apparatus in existence, other than that we are about to describe, which will directly measure the intensity of the illumination at a given point, except the portable photometer of Prof. Weber, described by Mr. Heinrich on p. 422, Vol. XI., No. 7, July, 1894, of the "Proceedings of the American Institute of Electrical Engineers." In Weber's photometer the illumination received upon a screen from a small standard amyl acetate or benzine lamp is compared with the illumination to be measured. The difficulties of obtaining a reliable portable standard lamp, the rather cumbersome size of the apparatus, and the fact that it does not obviate the difficulty of comparing illuminations of different colors, have led us to devise a new instrument based on entirely different principles. We call our instrument an illuminometer, and have filed applications for a patent on the same.

A certain intensity of illumination is required to render a definite object, viewed at a definite distance, clearly delineated to the eye. It is well known that the illumination received upon the printed page of a book or newspaper must have a definite value in order to render the printed characters legible, and that the intensity of the illumination so required will, for a normal eye, depend upon the size and character of the print.

We employ this principle in the operation of our illuminometer as follows: a small test object of, say, printed characters, is placed in a darkened box, sufficiently small to be readily carried in the pocket. The test object is exposed to illumination received from a translucent plate of porcelain or opal glass, which receives, directly on its surface, illumination whose intensity is to be measured. Since the test object receives the light from this plate by transmission and subsequent diffusion, it is the area for the translucent plate exposed to the test object, in order to just render the latter legible to the eye, that determines the intensity of illumination upon the plate. A focusing eye-piece is placed opposite to the test object for purposes of annulling the effect of any focal abnormalities of vision. A sliding shutter, movable by a milled-headed screw, permits the effective area of the opal glass plate to be reduced until the amount of light received by the test object just permits of its legibility.

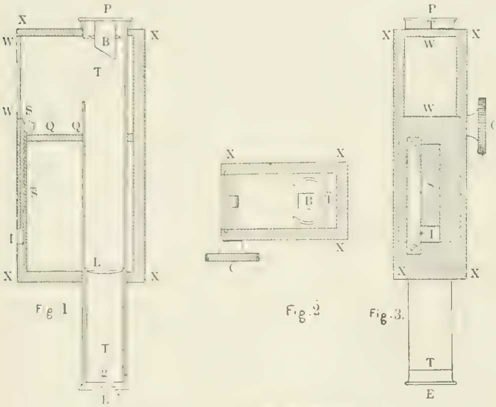


Fig 1 Fig 2 Fig 3.

DETAILS OF ILLUMINOMETER.

The detailed construction of our apparatus will be understood from an examination of Figs. 1, 2, and 3, which represent respectively a longitudinal cross section, a transverse cross section, and a plan view. A box, *XX*, blackened inside to prevent the reflection of light, is provided with a tube, *TT*, as shown. The test object is placed on a block at *B*, opposite the focusing eye-piece *E*. At the top of the box is a window, *WW*, closed by a translucent diaphragm of porcelain, opal glass, or similar material. This diaphragm is placed so as to act as a secondary illuminator of the test object at *B*.

In order to regulate the amount of light which passes from the window, *WW*, to the test object, a sliding shutter, *SS*, operated from beneath by a milled-headed screw, *C*, is placed in guides beneath the window so as to cover any desired fraction of its surface. In order to determine the effective area of the window, *i. e.*, the uncovered portion which admits light to the test object, *B*, the index, *I*, attached to the shutter, moves over a calibrated scale, *S*, from which the amount of illumination on the window, *WW*, may be immediately read off in suitable units.

Calibration of the instrument is effected by exposing the window, *WW*, to known intensities of illumination in a photometer, or darkened room, and marking off upon the scale, *S*, the points at which the indications of the instrument are obtained.

By the illumination on a surface is meant the quantity of light it receives per unit of area. Illumination may be expressed in terms of some unit illumination, obtained from a definite source at a definite distance. Thus, a standard candle produces a definite illumination at a distance of a foot, and this illumination is sometimes called a candle foot. A less objectionable, and more generally recognized unit, is the illumination produced by an International standard candle at a distance of one metre, and this unit is called the bougie-metre or the lux.

The International standard candle referred to is the *bougie decimal*, or the one-twentieth of the violle, or molten platinum standard of light, adopted by the Paris International Electrical Congress of 1889. Authorities, unfortunately, differ as to the relative value of this decimal standard candle in terms of the British candle or sugg, which burns 0.1296 gramme per minute, but Everett, in his C. G. S. system of units, 1891, gives data which make the international candle 0.988, or about 1.2 per cent. less than the standard British candle. Approximately, therefore, one lux is the illumination produced by a standard British candle at a distance of a metre.

In employing our instrument for such a purpose as measuring the illumination upon the surface of a table illumined by daylight, candle light, or incandescent light, we place the illuminometer upon the table with its window up, so that its window, being, say, only two inches above the table, practically coincides with the surface whose illumination is to be measured. The eye is then applied to the eye-piece and the test object focused under full illumination. The shutter is then gradually moved over the window until the test object just remains legible, when the number of luxes in the illumination of the table are shown by the index on the scale.

The degree of accuracy with which these measurements can be made, though small as compared with such determinations as length, mass and time, nevertheless does not compare unfavorably with photometric measurements in general. It is well known that two observers may vary in their determinations of the candle power of an incandescent lamp by 5 per cent., and, when the lights to be compared have different colors, the variation is often much greater.

The mean error of a single observation with our instrument is about 10 per cent., that is to say, if a number of measurements be successively made of an illumination within the range of the instrument, the average deviation of any single measurement from the mean of all the measurements is, with the instrument here exhibited, about 10 per cent., although we believe certain changes we have in view will notably reduce this percentage. Some tabulated observations are appended. In the instrument exhibited, the graduation of the scale extends from four luxes, by single luxes, to 15, then to 35 in divisions of five luxes, then to 70 in divisions of ten luxes, while the highest reading is 400. The total length of the scale is 1.5 inches. The total length of the instrument is 6½ inches, its breadth is 1.5 inches, and its height, excluding the milled-headed screw, is 2¼ inches, so that the apparatus can readily be carried in the pocket. Its weight is ten ounces.

It might be supposed that two different observers having different limits of distinct vision would obtain different results in determining a given illumination by the use of our instrument. In point of fact, however, we find that by the use of the focusing eye-piece, distinct vision of the test object being readily secured for each observer, the results of different observers do not appear to differ by more than the limits of probable error for the apparatus.

It is known that an illumination of five luxes is sufficient to permit the reading of ordinary print, although, on physiological grounds, the eyes should not be used for continuous reading at illuminations less than ten luxes. Fifteen to 25 luxes may be regarded as proper artificial illumination for reading. In the same way, the amount of light required to permit the performance of other kinds of work is readily determinable. It is evident, therefore, that our illuminometer is applicable to the determination of the question as to whether the illumination of a given area is or is not sufficient for the character of work to be done, and that the measurement of illuminations can be made with a reasonable percentage of error for all intensities within the range of the apparatus. This range can be varied by altering the character and dimensions of the window, as well as the character and dimensions of the test object.

It will be evident that the advantage of such an instrument consists in the fact that it entirely dispenses with the necessity for the use of a portable standard of light, thus removing a constant source of unknown error in apparatus previously employed for this purpose.

Moreover, the instrument does not require any great skill in its use, and with simple directions for use can readily be employed by an inexperienced observer.

It is evident that our illuminometer will permit a direct determination of the candle power of a source of light by measuring the illumination produced at a fixed distance by that source of light alone. Thus, for example, if an incandescent lamp has its illumination measured at a distance of one metre from the centre of the filament, the number of luxes indicated by the instrument, when its window is perpendicular to the rays from the lamp, and all other sources of light are well cut off, will give directly the number of international or decimal candles in the lamp. It is, therefore, possible to measure the candle power of a lamp in its socket, provided all other lamps in the neighborhood be extinguished, and that a black, non-reflecting cloth be placed so as to prevent any appreciable amount of light from entering the window, except that radiated directly from the lamp.

Our illuminometer, therefore, becomes, indirectly, a portable photometer.

In the use of the instrument, care must be taken to keep the glass of the eye-piece, and of the window, clean, as, otherwise, the observation may be vitiated. The use of the focusing eye-piece is intended to avoid the necessity that might arise for wearing glasses, by which the quantity of light entering the pupil of the eye from the test object would be necessarily reduced.

Since the indications of our instrument depend upon the physiological effect alone, and not on the contrast of an unknown with known illumination, all questions as to difference of color in the illumination to be measured are avoided, so that a measurement of the intensity, *e. g.*, the candle power of an arc lamp, can be made without employing a special arc standard.

Apart altogether from the use of our apparatus, the National Electric Light Association doubtless recognizes the fact that there exists to-day no generally accepted standard of illumination. We would respectfully recommend that the association consider the advisability of officially adopting as the unit of illumination the lux, or bougie-metre, *i. e.*, the illumination produced by a decimal candle at the distance of a metre. This unit has been under consideration for some years and has been provisionally adopted by several writers in this country and in Europe.

OBSERVER K. (INCANDESCENT LIGHT).

Observations.	No.	Sum.	Mean.	Residuals.		Sum of Residuals.	Mean Residual.
8 5	13	132.4	10 184	....	1.684	10 0.16	0.77
9.6	..	....	....	....	0 584	....	....
9.4	.	....	....	....	0 784	....	....
11.4	..	....	....	1.216	....	....	....
12.2	..	....	....	2.016	....	....	..
9.6	..	....	....	....	0 584	....	....
9.2	..	....	....	....	0.984	....	....
10 2	..	....	....	0.016	....	....	..
10.5	..	....	....	0.316	....	....	....
9 8	..	....	....	....	0 384	....	....
10.2	..	....	....	0.016	....	....	....
11 2	..	....	....	1.016	....	....	....
10 6	..	....	....	0.416	....	....	....

Result, 10.184; mean error, 0.77 (7.56%).

OBSERVER W. A. (DAYLIGHT).

Observations.	No.	Sum.	Mean.	Residuals.		Sum of Residuals.	Mean Residual.
47	13	604.5	46.5	0.5	....	65	5
37	..	....	....	....	9.5	....	....
50.5	..	....	....	4 0	....	....	....
57	..	....	....	10.5	....	....	....
43	..	....	...	....	3.5	....	....
45	..	....	....	....	1.5	....	....
38.5	..	....	....	....	8	....	....
40.5	..	..	....	....	6	....	....
46	..	....	....	....	0 5	....	....
55	..	....	....	8 5	....	....	....
55	..	....	....	8 5	....	....	....
43	..	....	....	....	3 5	....	....
47	..	....	....	0.5	....	....	....
				32 5	32 5		

Result, 46.5; mean error, 5 (10.75%).

DISCUSSION.

Mr. Caryl Haskins doubted if the permeability of the translucent screen would be the same for rays of light of different colors, and thought it would be greater or less, as the rays are more or less white or red. He said that the human eye certainly appreciates one more than another in different individuals, some appreciating the lower rays more quickly than others, while some people see better in the dark than others.

Prof. Elihu Thomson: The question of the measurement of illumination seems to me to be analogous to the measurement of temperature, largely by the feeling, though, perhaps, not liable to such great errors as might exist in that case. The object of the instrument is undoubtedly a good one, and it is undoubtedly meant to meet that condition which we, as members of the National Electric Light Association, often have to meet—a dispute as to whether a certain light is doing its duty, not whether the light up there or somewhere else was producing a certain illuminating effect, but whether it is actually delivering at the useful point on some surface, and of a quality which would enable us to read by it. Undoubtedly that is what we are driving at when we hang up a lamp. We do not care anything about the light up there; we want to have it here; and if we can arrange some means whereby, by placing an instrument here, we can get an exact idea of the illumination, measured by the degree of visibility, perhaps, then we have certainly accomplished a good object and a valuable one. It occurs to me, however, that the question resolves itself into a physiological question. We know perfectly well that visibility depends on contrasts. If we turn rapidly from a highly illumined surface and then down at some other object, we find that we have to wait a little while before the eyes will respond, and it depends altogether on the degree of brightness of the object toward which we looked how long we will have to wait. It is difficult to say how long we shall have to wait before the effect of that light in our eyes is removed absolutely. That is an uncertain question. I simply state this as bringing out one of the points in my mind. The object of our coming here is to get at the truth and know where we are on these questions; it is not to make captious criticisms, but to know where we are. There is a difference between visions—I think the rate at which an impression is made, and the legibility of an impression, are two different things; sometimes we get an impression quickly, and at other times we get an impression slowly. It would hardly be proper to measure everything by legibility, depending on time of impression, because the illumination as to rate may come in there. I think the eyes are different. I think it has been recognized that there is a different rate of impression—what we may call continuity of impression.

Another criticism I would make is that the printed slip that you would use in this instrument, after you have used it for a while you get to read it more easily than at first. If you are going to change that printed slip every time, you may change the character of the surface, you may have surface not so white or a little different, and you cannot be sure you are getting the standard surface. Every one knows if he has read a thing he can read it much more easily if he has to read it again and knows what is there. The effect of imagination comes in—that is another physiological action which has to be counted on. It is a question to my mind, in an instrument of this kind laid aside and not used for a time, whether the paper will maintain its integrity as a surface for receiving and diffusing light. We know that it is darkened by age. I think it would certainly be required that we should use some material like porcelain, like a watch face, absolutely permanent, if we employed the method at all.

There is another question. Is it true that with different individuals the iris opens or responds equally? do the eyes have the same aperture to receive light? I have my doubts so far as my observation goes. In the eye of a child the iris opens wide, but with an older person the eye is not so flexible; in fact, it may finally become partially fixed. It will not give the same aperture of illumination; the diaphragm is smaller and does not respond so easily. In certain forms of incipient disease the first indication is that the iris does not respond easily. What percentage of difference that would make in reading anything, or seeing anything with the eye, that was at all illuminated, I do not know; that is simply something which I put out as a suggestion. But it is a matter of my personal observation that if I am looking in a darkened room I see all the objects for a little while, they disappear, and then I see them again, as if the sensitive material of the eye was renewed in gushes. There is some peculiar connection of the sensoria which, as it were, brings on a wave of sensibility, then wipes it out, and then brings on another wave.

Then comes the question of color blindness in people. I have met a number of people subject to color blindness, not sensitive to the red rays, some more than others. It is well known that the power of vision to the higher rays is very different to that of the ultraviolet rays; some can see the lavender in the spectrum, others scarcely at all. It happens that at the extreme violet part of the spectrum there is not a great amount of useful illumination, but still there is some, and it might make a difference in some cases. I simply bring these points forward as indicating that we find it necessary, before adopting a method of this kind, to compare the results of a large number of observations to find out whether there was a difference to be noted, or whether we could rely upon a fair average result. Ten per cent. out would not bother us very much, and, perhaps, all these errors combined might, if we used due precautions, be included within the 10 per cent. Then the instrument undoubtedly would have my unqualified endorsement.

Mr. Jas. I. Ayer: The adoption of an instrument of this character would seem to me, as expressed by the other speakers, to be a thing which should receive a great deal of consideration. Aside from the different physiological results which might accrue from the difference in the eyes of different people, a standard instrument that was brought into use and put into the hands of people who are often endowed with power to determine matters in dispute, but frequently work very serious hardships, not the least of the points involved in a thing of that kind is the integrity of the persons using it. The point made by Prof. Thomson about the familiarity with the letters, where imagination comes into play, is a very important one. We had a case of this kind, where there were produced a number of sheets of paper with varying sizes of letters printed on the sheet. A committee was selected who remained with their backs toward the light so as to avoid affecting the vision by looking at the lamps, and each one would walk a definite distance away and then endeavor to read a certain number of lines aloud. We found variable results. One man would read line number two at 200 feet, and another, line number three the same distance, and so forth; but as we proceeded we found a change. We found that the man who first could only read line number two 200 feet away, could read line number three, the latter being a finer print. The men, I think, were naturally unbiased in the matter, but they gradually became familiar with the printing. To overcome this familiarity, at the suggestion of the chairman of the committee, we had printed a series of slips with a line of Volapük, a half dozen words on each line, and it was practically impossible to memorize it, and after an evening's work of several hours we found this relation continued to exist throughout the whole evening. The conditions did not change, the characters could not be so easily memorized; giving abundant evidence, to my mind, that it is very easy to have the imagination come in as an element to determine anything you have as a fixed standard to judge by.

Mr. Kennelly: The first point raised by Mr. Haskins is a question as to the relative sifting power of the translucent screen for various colors of light, but it seems to me—and I think it will seem to you on reflection—that that difficulty is entirely eliminated by the very method employed in calibration. If we have anything in light, if we have any basis in applying any value to it, it is a standard of intensity; that basis may be a standard candle, that basis may be a Hefner-Alteneck lamp—whatever these values may be, they are standard and recognized as such. If, with a definite standard to take the instrument at measuring distances from that standard, you have a definite known illumination, and if you calibrate and mark off the scale of the instrument to what that illumination must be, you have eliminated for that character of light all possible questions as to the degree of sifting of the translucent material. It is true that the argument does not hold so soon as you change the character of the light. The illumination measured on this table by incandescent light, if an incandescent lamp had served you as the standard, and a calibration was made by an incandescent lamp, it might cease to be the true illumination measured by oil or arc light; but by actual trial we have found that the error which may be induced by the variation which must exist, by the absorption of material for different colors, is too small to be noticed. A sixteen candle-power lamp measured for its intensity of candle power by the instrument in its use as an indirect photometer, agrees with the measurement obtained by reckoning it from calibration obtained by a standard candle, within the limits of probability of the instrument.

In regard to what Prof. Thomson has so eloquently explained with reference to the unfortunate power of our eyes, I grieve that our eyes should be open to such grave impeachment, and in fact I am only glad, after reading of the troubles to which we may be liable, that we have anything which we may call eyes at all. No two eyes see alike, and it is not possible to get an instrument, based on the agency of the eye, to be absolutely correct; but, on the other hand, I am pleased to remember that our eyes have some definite value, and just in so far as our eyes are perfect and normal, just in so far can we conduct the measurements relied upon.

In regard to the figure in the illuminometer, there is no doubt as to whether you know it or not. They are simple figures consisting of five characters, and after you once read it you can scarcely fail to recollect what you read. You know very well what the characters are. You simply endeavor to bring them down until you cannot read them. All these errors which are inherent in any apparatus involving the eye have, after all, a certain limit. I will ask any gentleman present if he can tell me what the illumination upon the surface of that table is, within 50 per cent. I will feel quite pleased if any gentleman can tell me within 50 per cent. what it is. We can measure it within 10 per cent. Surely you are glad to have something to tell you within 10 per cent., if you cannot estimate it within 50.

Prof. Houston: I do not think it necessary to carry out this discussion very much longer, though there are one or two points I would like to discuss in answer to the objections that have been raised here—happily by gentlemen who have preceded me. As to the permeability of the secondary illuminator, as questioned by Mr. Haskins: yes, there may be some question as to its being more permeable to a light of certain frequency than another. I think the explanation by Mr. Kennelly of the methods we adopt in calibrating the instrument obviates any objection that may have existed in that direction. As to the question ably raised by Prof. Thomson, it is unfortunately true that there are limitations to all our senses. These limitations are by no means restricted to the eye; they apply to all our senses; and, to a certain extent, the objections which the Professor has so pertinently brought, as limiting the use and applicability of our instrument, must necessarily apply to any instrument of physical research that can be employed. As to how long one should wait until the eye gets rested after reading the instrument, I think the answer is, fairly, he should wait until he can read the test object inside the instrument. He cannot get that in a moment. It may require a motion of the slide shutter, so that his eye will be exposed once or twice to an increasing and a decreasing illumination and by the time that he can read it I think his eye would be a fairly normal eye; and in the same way, that would answer, I think, the objections as to the time of legibility—as to whether we can see a thing rapidly or not. After all, the use of this instrument only requires that a person shall be able to do what his training has taught him to do since he first opened his eyes in this world—to be able to see an object with fair distinctness, that is all. There is very little judgment required, except that he must determine whether or not he can see well enough to do a certain thing, that is, to read. As to color blindness, that does exist; but I question very greatly whether the doctors, in their interest in physiological research or their willingness to-day that certain people on the railroads should not be in charge of locomotives, may have permitted their judgments to be warped. I do not believe that color blindness exists in anything like the extent it is stated to. If it does, this instrument is not limited to be used by five or six people, but it may be used by anybody, and in this way the actual facts can be known.

Electrical Carriage Traction in France.

A carriage has for some time been used in Paris whose motive power is supplied by Tommasi accumulators, the battery being contained in a box placed under a seat and connected with a small motor underneath the carriage. The outfit is completed by a controller and a brake, to which the circuit switch is connected. The plates of the accumulator consist of a celluloid envelope perforated with numerous small holes and filled with active material; in the centre is a lead core serving solely as a conductor and not as a support to the active matter, as in other systems of accumulators. The plates of the same sign are soldered to a connecting bar, and insulated from neighboring electrodes by vertical celluloid strips. The cells are of wood with a double lining of celluloid and closed at the top by a transparent cover tightly sealed.

No difficulty results from the motion of the carriage, and the battery can discharge without injury at extremely high rates.

The complete battery equipment of the carriage is composed of 21 cells, each weighing 28 lbs. and enclosed in seven boxes, three cells to the box. The cells are mounted in series and often discharge at a mean rate of 100 amperes and 40 volts at starting, and on high grades the discharge rate attains 200 amperes. Under these conditions the battery will supply power for one and one-half hours, which corresponds to a capacity of 16 ampere-hours per pound at light discharge, 23 ampere-hours at a mean rate of discharge, and 32 ampere-hours at a maximum rate. Under less severe conditions the capacity is much higher than this, say 47 ampere-hours at the rate of one ampere per hour, 38 ampere-hours at the rate of three amperes per hour and 32 ampere-hours at the rate of six amperes per hour. The total weight of the carriage with two passengers is about 2,000 pounds, and its speed about 12 miles an hour. The carriage starts freely and can be brought to a standstill almost instantaneously. It runs noiselessly, and its control is extremely simple. An interrupter permits the battery to be completely cut off from the motor during a long stop of the carriage.

Candle Power of Arc Lamps.

To the Editor of The Electrical World:

Sir:—I have read with interest the article in your issue of Feb. 23, by Dr. Stine, on the subject of candle power obtained with various carbons. From his premises his conclusions are logical, but I think he is in error in assuming that under normal conditions the light of the arc lamp, or any considerable portion of it, comes from the arc stream itself. He says: "The candle power of an arc (lamp) depends on the amount of carbon vapor which it contains." If his assumption were correct, the maximum candle power would be at the horizontal, since the depth of the crater, especially with solid carbons, is very small as compared with the length of the arc, and the crater wall interferes but slightly with horizontal radiation from the arc stream. The well-known candle power curves show the maximum at say 45 degrees below the horizontal, and in the case of the alternating arc with two cored carbons, there is a maximum both above and below the horizontal. In both cases at the horizontal, where we get the greatest illumination from the arc stream itself, the total candle power is small. It is at the surface of the crater that the greater portion of the energy of the arc is expended in volatilizing the carbon to furnish the vapor necessary to conduct the current across the gap; it is here that we find the highest temperature, and from the surface of the crater comes by far the greater portion of the light. That from the negative is largely reflected from the positive, and that from the arc stream is small. That from the crater, emitted by carbon at its temperature of volatilization, most nearly resembles sunlight in quality, while that from the arc stream is blue or violet; hence a long arc, in which a greater proportion of the light comes from the arc stream gives a violet tinge to the whole, though an opal globe shows the violet rays confined to a narrow band near the horizontal. The amount of carbon vapor present has very little influence on the candle power, for carbons made with a soft core for the express purpose of supplying carbon vapor to the arc, give a lower efficiency than solid carbons. (See Dr. Stine's published tests, if confirmation is required.)

The efficiency of any form of carbon as an illuminant rises with the temperature of the incandescing carbon. An incandescent lamp in which the filament is heated nearly to the point of destruction by vaporization shows an enormously increased efficiency. The arc is more efficient than the incandescent filament because of its higher temperature. In the arc the efficiency rises with the temperature of the crater. A highly refractory form of carbon, such as petroleum coke, gives a higher efficiency than a form which volatizes at a lower temperature, but carbons to burn at say 28 volts, as in alternating lamps, must be made of a less refractory material than those made to burn at 45 or 50 volts with the same currents. If a carbon adapted to a 28-volt lamp be burned at 45 volts, it will give less light at the same wattage than a carbon which would hiss at 40 volts but burns steadily at 45. Yet the former carbon is usually harder than the latter, but is made of a less refractory material, and at 45 volts gives off an excess of carbon vapor, with resultant flaming. I think Dr. Stine lays too much stress on softness. There is little danger of a molded carbon being too hard for a current of 9 or 10 amperes. He attributes excessive hardness to carbonization at too high a temperature. As a matter of fact, an over-carbonized carbon is soft. An underbaked carbon may be hard and to the eye appear very well, and yet hiss at 50 volts and flame at 55. I have seen such a carbon rebaked at a high temperature for an hour, and the hissing point thereby reduced to 42, and the flaming point raised to 60. In this case the hard carbon was objectionable, but the cause was the opposite of that indicated by Dr. Stine. If it were practicable to bake carbons at a temperature near that of the crater, we should thereby increase their efficiency. The introduction of hydrocarbons which Dr. Stine advocates as a correct principle, would be a return to the conditions of underbaking, as it is the presence of hydrocarbons which gives the objectionable results indicated above.

Finally, as to long-life carbons, passing over those in which life is lengthened by a heavy coating of copper, or still worse, of zinc or nickel, which forms a shell around the arc shutting the oxygen out and the light in, the perfectly baked carbon, whether hard or soft, disintegrates less, and therefore gives better life as well as better light. Dr. Stine's point on size and uniformity of grain is well taken and strikes at a very common error. But he might have carried the point further, for just such a grain as he adovcates gives the best life.

The prime consideration is that a carbon should be adapted to its particular work. For small currents a rather soft carbon is advantageous, and for low-tension sytems using 18 or 20 amperes, forced carbons are best adapted, both on account of hardness and of the peculiar arrangement of the grains. Dr. Stine mentions the influence of the crude material, and I regret that he has not gone more deeply into this, as it is of great importance, considering the variety of conditions which are now met with.

Washington, Pa. B. H. Blood.

Electrical Consonance.

To the Editor of The Electrical World:

Sir:—I feel very much flattered that Mr. Steinmetz has considered it worth his while to translate my article on "Electrical Consonance" into the language of electrographics. It gives me much satisfaction to know that Mr. Steinmetz has not detected a flaw in my reasoning and that the main features of this reasoning can be represented graphically by the extremely simple diagrams given by Mr. Steinmetz in the last issue of your esteemed journal. I wish, however, to warn your readers against a possible inference which they might draw from Mr. Steinmetz's extremely simple graphical discussion—the inference, namely, that the graphical method is superior to the analytical in studying alternating current phenomena. A closer examination of this particular case will reveal the nonpermissibility of such an inference; for although Mr. Steinmetz's diagram contains the main features of my article, viz:—(a) distinction between electrical resonance and neutralization of the apparent self induction of primary circuit by means of a condenser in the secondary, and (b) the existence of two distinct components in the secondary currents at which this neutralization takes place,—still, that is by no means all that I had to say in that article. In fact, the main point in my theoretical discussion was to bring out the complex manner in which the various physical constants of the two circuits enter into the quantitative relations which underly the phenomena of electrical consonance. I think that in this point I have succeeded very well, so well, indeed, that Mr. Steinmetz has considered it desirable to translate my article, minus the general complicated equations, into simple graphics. But I wish to assure your readers that if Mr. Steinmetz had seen fit to follow me to the bitter end, his graphical method would have resulted in extremely complex diagrams and would, therefore, have succeeded even better than my analytical method did in showing how complex are the relations underlying the phenomena of electrical consonance.

Without a knowledge of these very much involved equations it is impossible to find out the most effective conditions under which electrical consonance can be studied experimentally. I wish, however, to emphasize the fact that it is far from me to undervalue the strong points of the graphical method of which Mr. Steinmetz is an admirable advocate. There is room for all correct methods in the wide regions of the beautiful science of electricity.

New York, N. Y. M. I. Pupin.

Perhaps Not Sanguine Enough.

According to the Philadelphia *Ledger's* correspondent from Harrisburg, concerning the doings of the State legislature, it has been predicted that in the year 1899 the legislators will be taken from Philadelphia to Harrisburg by trains operated by electric energy. How this exact date has been determined we do not know, but we venture to predict that on those existing steam roads on which there is a very large passenger traffic between two large cities, not much over 100 miles apart, the substitution of electric traction will be made before that year. The change is so easily made, and the advantages and economy can doubtless be shown to be so great, that it will probably require only a few practical demonstrations, which are now beginning to be made, before the number of roads to take advantage of this improvement will increase in geometric ratio.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors, or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 922 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French, or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Alternators.—In a paper by Mr. v. Dobrowolsky reprinted in the "Elek. Zeit.," Feb. 7, he describes and illustrates a type of alternator and three-phase generator made by the General Electric Company of Berlin. He points out the advantages of using a single field coil for the multiple magnets, a system first used by Klimenko, and subsequently by Mordey and others; the machines are similar to those made by Stanley in this country; he believes this system will gradually be universally adopted; the advantages are, cheap excitation both in the copper required and in the energy consumed, and a very low fall in voltage, as the field may be made very strong and the armature windings few without increasing the dimensions of the machine abnormally; there is furthermore only a very small hysteresis loss and the efficiency even at small loads is very high; there is another advantage, that with a proper design the magnet coil may be stationary, while only the magnetic cores revolve. The general design of one of the machines is shown in the accompanying figures. The design is equally applicable to three-phase machines. He gives the data of a 400-hp three-phase machine. In conclusion he discusses the much vexed question of the best loss of voltage in an alternator; he ridicules the suggestion to make the self induction so great that on short circuit the current would not increase more than 50 per cent. and suggests that they had better be protected, like continuous current machines, by fuses or automatic disconnectors; although Mordey demonstrated practically that both the resistance and the self induction should be as small as possible, there seems to be still a discussion concerning it; he believes that constructors will soon agree that practical experience has shown that Mordey is correct. The loss in voltage is very objectionable when there are motors in circuit; if for the lighting current the loss in voltage is 4 to 5 per cent. it will, for a full load of motors, still be 15 to 20 per cent. In the above he combined the choking action and the armature reaction, which is not quite correct but the two actions are very closely related.

ALTERNATING CURRENT GENERATOR.

Alternators in Parallel.—According to the Lond. "Elec.," Feb. 15, the trial at the Coatbridge Station in which certain alternators (the particular type is not mentioned) were driven by gas engines and connected in parallel has proved that that system is untrustworthy and defective and it has been decided to run the station by steam.

Theory and Properties of Synchronous Motors.—An article by Mr. Blondel is begun in "L'Ind. Elec.," Feb. 10; he intends to give a sufficiently elementary discussion which will enable those who are familiar with graphical calculations to study the properties of these motors in detail; it does not admit of being abstracted.

Dynamo with a Single Bearing.—A well illustrated description of a machine of this kind made in France is given by Mr. Girault in "L'Ind. Elec.," Feb. 10; he also discusses the requirements for a cheap machine intended for moderately small outputs.

Small Dynamos.—The article on the construction of a small dynamo is continued in the Lond. "Elec. Rev.," Feb. 15, in which a number of illustrations with dimensions are given of a Manchester type dynamo.

Core Losses in Transformers.—The first part of a paper by Mr. Wilson is begun in the Lond. "Elec.," Feb. 15; the object of the paper is to ascertain whether the energy dissipated by magnetic hysteresis and induced or eddy currents combined is greater when the transformer is in action on open circuit than when loaded, or in other words to find the effect of the current in the secondary coil upon this dissipation of energy. The researches were made with a 2-kw Westinghouse transformer of an old pattern; the present portion contains the results of a test but no general conclusions.

Transformer Chambers.—Two types now in use in London are well illustrated and described in the Lond. "Elec.," Feb. 15.

LIGHTS AND LIGHTING.

The Electric Arc.—Mrs. Ayrton's article is continued in the Lond. "Elec.," Feb. 15. A number of interesting curves and deductions are given; the deductions do not admit of being abstracted; they will doubtless be found of great value to those working with arc lamps. Among other things she shows that a change in the constant value of the voltage from say 46 to 41 volts alters entirely the way in which the current varies with the length of the arc, increasing in the former case with the length of the arc and decreasing in the latter; additional experiments were made to confirm these conclusions. A set of curves are given connecting the apparent resistance of the arc with its length for various constant voltages and it is shown that as the arc gets nearer to the hissing point the apparent resistance approaches a constant, equal to from 1 to nearly 3 ohms; from this she deduces the important law "the apparent resistance of the arc when it is on the point of hissing is a constant for given carbons, and independent of the length of the arc;" this resistance is greater the smaller the carbons. A complete investigation was made of the variation of the voltage with the time that has elapsed after the arc was started or the current suddenly changed; the results show that the difference of potential becomes a constant for a given current and length of arc; the cause of the variation and the effect of a cored or uncored positive carbon are discussed; a true arc 3 mm in length can be maintained silently at least for a short time with a voltage of only 16 which is due by the positive carbon being cored.

Holophane Globes.—The Lond. "Elec. Rev.," Feb. 15, contains a well illustrated article by Mr. Blondel in which he describes the principle and construction of the holophane diffusing globes (see Digest, Nov. 10) invented by himself and Mr. Psaroudaki, gives their history and shows the difference between them and the Trotter system, which is chiefly in the fact that they are luminous over their entire surface and that the flutings are both refractory and reflecting, the latter predominating. Illustrations of forms adapted to incandescent lighting and Welsbach lamps are also given.

Globes.—Mr. Uppenborn in the "Zeit. Fuer. Beleucht.," Jan. 30, gives the results of some measurements recently made in Munich below an arc lamp containing an opal globe and below another containing a 12-sided reflecting and refracting globe recently introduced by Schuckert, showing a considerable increase in favor of the latter; the measurements were made on the street with a Weber photometer; the illumination below the lamp was considerably greater but at the expense of that some distance off.

Lighting.—In an article by Mr. Hanchett on electric construction in "El. Power" for February, he gives some practical hints regarding the distribution of lights in interiors giving a table which may be of some use, containing the number of square feet per 16 cp lamp, for different interiors; he discusses the inverted arc lamp, which he recommends very highly.

Church Illumination.—An illustrated article by Mr. Bernard in "El'ty," Feb. 20, describes some of the lighting effects in some New York churches.

Incandescent Lamp.—"Cassier's Mag." for February contains an illustrated article by Mr. Cuntz giving a history of the Edison lamp and an account of its manufacture. He states that to-day there are 11,000,000 lamps in use in the United States and nearly 25,000,000 in the whole world.

POWER AND HEAT.

Transmission Plant at Locle and La Chaux-de-Fonds.—A description of this plant is published in the "Elek. Zeit.," Feb. 7; it is of special interest because the continuous current is used. The dynamos, each of 1,800 volts and 150 amperes, are driven by turbines and are all connected in series, the maximum voltage for the full power being 14,400; the regulation is affected by altering the speed of the turbines; the length of the high tension circuit is 28.8 miles; the full voltage exists between the magnetic windings and the earth and the machines are therefore very carefully insulated, including an insulated coupling where they are connected with the turbines; no trouble has been experienced. The power is used partly in one of these towns and partly in the other.

Egypt.—A brief account is given in "L'Elec.," Feb. 16, of the plant proposed by Mr. Prompt for utilizing the hydraulic power of the Nile and distributing it electrically for irrigation purposes.

Arc Welding.—An abstract of a recent paper by Mr. Foster is published in the Lond. "Elec. Eng.," Feb. 15, with illustrations; the system used in two establishments in England is described, also a number of repairs which have been made very successfully by this method; one is that of a connecting rod, another that of a worn-out wobbler end of a roll for a rolling mill, and of a pinion, and another is the welding of two steel eccentrics to an old crank shaft. In one of the systems used a series of accumulators is permanently connected with the dynamo, the welding circuits, consisting each of the arc and a resistance, are connected in parallel; in this system the capacity of the dynamo is about doubled. In the other system there are no accumulators; the efficiency is not so high, but the first cost is less and the apparatus is more portable. When iron or steel are welded the carbon is usually made the negative pole, but for lead and some other metals the carbon is made positive. The system has been considerably improved the last few years.

Elastic Couplings for Gas Engines.—"L'Ind. Elec.," Feb. 10, contains a long article of a mathematical nature by Mr. Guillaume. The "Bul. Soc. Int. Elec." for January contains a mathematical discussion by Mr. Blondel; another by Mr. Arnoux on elastic coupling and the phenomenon of resonance; another of some length by Mr. Desroziers including a number of diagrams.

Electric Motor in the Machine Shop.—A paper by Mr. Richmond, read at a recent meeting of the American Society of Mechanical Engineers, is abstracted with the discussion, in the "Eng. News," Feb. 21 (see also Digest, Jan. 12). A very great advantage has been found in the substitution of motors for engines in rolling mills, dockyards, etc., as was to be expected; he refers to a recent paper by Selby-Bigge (see Digest, Jan. 5 and June 23), in which he instances a case where six steam engines aggregating 94 hp were replaced by motors aggregating 29.5 hp. He divides the applications of motors into the three well-known classes and refers to existing installations; in one case 9 motors aggregating 75 hp were installed, the dynamo being 40 hp, which was found by experience to be sufficient, although at times it is severely taxed; the average indicated power supplied during a six weeks test was 24 hp, or about 14 hp supplied to the dynamo. He refers to two papers which have been reprinted and published by the C. & C. Co., one by Castermans and the other by Melotte, referring to the government rifle factory at Herstal, Belgium, which he said ought to be in the hands of every one interested in this subject. He gives the statements from each of these regarding the advantages of using electric motors in such factories, all of which have been frequently given before and are already well recognized. In conclusion he states that the real question is, will electrical transmission enable one to turn out work at less cost? He believes that the cost of the motive power in a "factory" is not much more than 1 per cent. of the wages, etc. (but this varies greatly with the kind of factory), and if, therefore, it could be shown that the adoption of electrical transmission would increase the production of each man 1 per cent. only, it would compensate for the doubling up of the cost for motive power, but if it involves a loss of only 1 per cent. in the efficiency of the workman and machine, it is frivolous to insist upon the relative advantages of the difference between the transmission efficiency, since there is an absolute loss equal to the total cost of the motive power. In the discussion Prof. Crocker said that existing figures cannot be looked for now as they will be quite different in different cases; he claims, however, that the success or failure will be decided by the question of whether it is satisfactory in the long run and whether the superintendent and workmen like it; the greatest advantage is that the shop is clear of belts and shafting; he believes that the average load in shops is not over 30 per cent. of the total capacity; there are also many times when the shop is running every light. Mr. Oberlin Smith believes that the advantages, other than in the transmission loss, are such that even now it will pay to equip machines with motors as fast as it can properly be done; the clear space obtained by avoiding belts enables one to use cranes and enables the shop to be better lighted; the speed is also under control; a sudden excessive overload will do no more harm than blowing the fuse, whereas with a belt driven machine serious injury may arise. Mr. Fay states that after serious consideration he concludes that it is not always proper to put a motor on every machine, the efficiency of very small motors is not high enough; for small machines, several are connected to one motor; he refers to a motor built by his company which will give a difference of speed of 100 per cent. without any sparking whatever, which is accomplished by "field commutation." Mr. Platt called attention to the advantages of the modern slow speed motors. Mr. Davis referred to a very satisfactory system at the Southwark Foundry in Philadelphia. Mr. Henderson stated that the arrangement of the windows and trusses of a roof could be made much more satisfactory if no account need be taken of shafting. Prof. Crocker favored 250 volts on the ground that carbon commutator brushes have not sufficient conductivity for 110 volt circuits. Mr. Towne called attention to the fact that there are many factories in which much larger amounts of power are used than in machine shops and in those cases an economy of power would be of greater importance.

Direct Driven Machines.—"Cassier's Mag." for February contains an article by Mr. Hall including some illustrations of a large direct driven lathe and drill. He calls attention to the well known advantages of direct driving and gives the results of some measurements made with some lathes.

Efficiencies of Mechanical and Electrical Machines.—Mr. Willis in "Cassier's Mag." for February discusses the efficiencies of boilers, engines, dynamos, motors and lights, making some interesting deductions. An ordinary engine and boiler waste 96 per cent. of the energy of the coal, and the best waste 92 per cent.; the light efficiency of the incandescent lamp he gives as 9 per cent. (is this not much too high, except possibly for a much overworked lamp?) making the total efficiency between coal and light six-tenths of 1 per cent; the efficiency of the arc light he gives as 35 per cent. (this also seems much too high), making a total efficiency of 2.1 per cent; with steam generated electric energy used for heating the waste would be 94 per cent., the amount of coal required would therefore be 94 per cent., while in an ordinary stove it is probably about 45 per cent.; the amount of coal would therefore be nine times as little.

Transmission Plant at Pordenone.—"El. Power" for February abstracts an illustrated description of this plant from an Italian journal; two continuous current generators of 140 hp each are connected in series, as also the 2 motors, 2.5 miles distant, a third or neutral wire being used in order that the motors may be run independently; the total efficiency is given as 80 per cent; the voltage of each machine is 3,000, and it is believed to be safe to increase it to 4,000.

Niagara Power Plant.—A descriptive article by Mr. Perkins, with some illustrations, is published in the "West. El.," Feb. 23.

Heating Apparatus.—In the "Elec. Eng.," Feb. 27, Mr. Leonard describes and illustrates his apparatus for various purposes in which a small amount of heat is required. He shows the advantages of encouraging the use of such apparatus to level the load line of a station; the reasons why so little of this kind of apparatus has heretofore been used, are that much of it did not work economically, that its first cost was too great, that the current was too great to allow it to be attached to a lamp socket, and that the cost of the energy was too great; he believes that all these objections have been overcome by his apparatus; the resistance material which he uses has a very high fusing point, is surrounded by a thin coating of almost infusible material and is embedded in a closely applied mass of metal; the wire cannot combine chemically with the surrounding medium and is hermetically sealed, it can therefore be operated at a red heat. A storage capacity for heat is not only unnecessary but extremely detrimental and the radiation loss becomes great; in his apparatus the working surface is as small as possible and has the least possible amount of material with the lowest specific heat. A small soldering iron requires 50 watts, while as heretofore made they required 400 and more; other small heating apparatus is shown, requiring but 150 watts. He gives a very useful table of a large number of equivalents of power, work, and heat units.

TRACTION.

Conduit and Overhead Systems.—A long illustrated paper by Mr. Gerard is contained in the "Bul. Soc. Belge. d'Elec.," June-September; the greater part of it is devoted to descriptions of conduit roads; an illustration is given to the side trolley system used in South Staffordshire, Eng.

Accumulator Traction.—According to a note in the "Elek. Zeit.," Feb. 14, a number of serious difficulties were encountered in the Waddell-Entz system recently started in Hagen, Germany, necessitating a number of changes, but it is claimed that they have now been overcome.

Traction.—In a continuation of his serial in Lond. "Engineering," Feb. 15, Mr. Dawsen discusses the return circuit.

Trolley System Applied to Steam Roads.—The "Elec. Eng.," Feb. 20, contains several further communications regarding this subject (see also Digest Feb. 23). Prof. Anthony believes that 1,000 and even 1,500 volts can be safely used; series wound motors can be built for 1,000 volts; 4 to 5 cars drawn by an electric locomotive will best fill the requirements for long express run services; he calls attention to the great want of maintaining a high efficiency of the motor at varying speeds; he men-

[illegible] correct method which has been proposed, but whether it would be successful in practice is uncertain; in this the motor acts through a liquid gearing in the form of a pump driving liquid [illegible] axles; by using one or several motors the speed would be varied but the efficiency would remain the same; the Leonard system is economical, but a 500-hp locomotive must be equipped with 1,500-hp electrical machinery. At present alternating current motors are not suitable, they do not lend themselves readily to varying speeds and cannot be handled with the same facility. A 1,000 volt three-wire system using the rail as the balancing conductor he considers would be best; for traffic requiring frequent stops motor cars should be used and for trains of 5 or 6 cars either a locomotive should be used or else car motors all handled from one point; trolley wires should be overhead as they would be in the way of the section men if placed on low posts. He believes there is no doubt that electric traction is more economical than steam locomotive traction; one great advantage in the change is that single cars run at frequent intervals accommodate the public far better than long trains at long intervals. Mr. Arnold approves of electric locomotives rather than motor cars; the direct current constant potential system is the only one that has proved itself practical; the voltage may be at least 1,000 and will probably be increased later on; the three-wire system is best when there is a frequent service but is not practical for the long lines with few trains. Mr. Short believes the time has now come when steam roads will be changed to electric roads and that it will be more economical as far as operation is concerned; his company is at present filling several orders for such roads; they use long double truck cars for speeds of 35 to 40 miles an hour with two 50-hp motors, or, when trailers are used, two 100 hp motors on the combined baggage and smoking car; for long trains it may be advisable to use a locomotive; for a moderate amount of power he believes the overhead system best; the three-wire system can be used to advantage where there is sufficient traffic; with heavy locomotives and trains it will be a serious problem to place the conductors where they will do little harm and still be heavy enough mechanically; he does not believe it will be safe to place them near the surface of the ground unless they are inclosed.

Electric Traction on Steam Roads.—According to the "St. Ry. Gaz.," Feb. 23, the cars on the railway connecting Burlington and Mt. Holly, N. J., on which electric traction is to be substituted for the present steam traction, will be almost as large as the standard passenger coach and they will be equipped with two motors of 75 hp each, designed for a speed of 50 miles an hour; trailers may be used; the intention is to give a frequent service at high speed; steam locomotives will probably be used for hauling freight.

[illegible]—A summary of some length is published in the "St. Ry. Gaz.," Feb. 23; it deals almost entirely with the civil engineering features; the total length of single track in the proposed subway will be about 5 miles.

City and South London Railways.—An abstract of the semi-annual report of the company is reprinted in the "West. El.," Feb. 23.

Light Railways.—The "Eng. News." Feb. 21, gives a brief summary of the recent English Board of Trade Report.

Railway Motors.—Mr. Henry in the "Elec. Eng.," Feb. 20, calls attention to some of his patents for improvements in railway motors. In reference to the magnetic brush holder (described in the Digest Feb. 16), he calls attention to the energy lost at the brush contact by friction and finds it to be 20,000 foot-pounds per minute with ordinary motors run at 20 miles per hour with a brush pressure of 12 pounds. To overcome the loss in the short circuited armature coils he connects the commutator segments with the armature windings by means of superficial spring contacts, instead of solder, which will increase the resistance of the local circuits, but the resistance is said to be insignificant for the whole energy. An improvement in the motor fields consists in winding them with a large number of parallel conductors all connected together at one end, the other ends being joined together at the will of the motorman; (this does away with the external resistances but amounts practically to making them of copper and placing them on a field, the advantages of this would therefore seem questionable).

Overhead Trolley Wires in Philadelphia.—From the report of Chief Walker of the Electrical Bureau of Philadelphia the city ducts are occupied to the extent of 5,113 978 feet (or very nearly 1,000 miles) by the four leading trolley companies of that city. He is still of the opinion that the successful working of the underground trolley system is assured; he calls attention to the dangerous features of the overhead trolley, citing the forcible illustration during a recent storm in which the guard wires themselves, which under ordinary circumstances may be useful, became not only utterly useless but were themselves a danger in coming in contact with the trolley wires; they are even a danger when they remain in position, when foreign wires form crosses between them and the trolley wire (would this not be avoided if the guard wires and poles were thoroughly grounded?). The trolley companies in this city now have 16,868 poles.

Conduit vs. Trolley.—Mr. Sach's article is continued in "El. Power" for February. He gives a large number of illustrations of proposed systems including a few that are in use.

Electric Carriage.—A brief description of one operated with the Tommasi accumulators is given in the "Elec. Rev.," Feb. 20.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Calculation of Multiphase Plants.—An article by Dr. Fischer is published in the "Elek. Zeit.," Feb. 7 and 14. He develops the formulas and gives some diagrams to aid in the exact calculation of all problems that arise, with the aid of a very simple formula in which there are no trigonometric quantities. This method has been used for a number of years by the firm of Siemens & Halske.

Central Station Statistics.—Some deductions from the table recently published in "L'Ind. Elec." (see Digest, Feb. 23) are given in that journal Feb. 10; they refer to France, not including Paris. On Jan. 1, 1895, there were 328 stations, an increase of 9 per cent. over the previous year; the total power was 40,000 hp of which about 25 per cent. is hydraulic power, 56 per cent. steam power, 15 per cent. both, and the rest gas power; the number of stations using hydraulic power is 151 and the number using steam power 119; 260 stations use the continuous current, 73 use the alternating current and three use polyphase currents, corresponding to 70.75 per cent., 27 per cent. and 2.25 per cent. respectively of the total power; the stations using alternating currents have a mean of 145 hp as against 110 for the continuous current stations; 29 are operated by the municipalities, but mostly small, using hydraulic power; 26 are run by gas companies.

Operating Central Stations.—In a paper by Mr. McLean in the Lond. "Elec. Rev.," Feb. 15, on "Some Points on the Working of Central Stations," he reviews the chief reason why electrical energy is somewhat expensive and discusses the means by which a better result may be arrived at.

Rules and Regulations.—The "Elek. Zeit.," Feb. 14, reprints a lengthy discussion which took place at a recent meeting in the German Electrical Society of the proposed set of rules and regulations (see Digest, Feb. 16 and Jan. 12) to guard against fire risks.

Fire at a Central Station.—A recent fire at the Kensington, station, in which accumulators are used, is described in the Lond. "Elec.," Feb. 15.

Electricity in Mining.—A paper by Mr. Corlett is reprinted in full in the Lond. "Elec. Rev.," Feb. 15; he reviews what has been done and considers certain important points; he discusses signaling, telephones, blasting, lighting and transmission of power.

Bremen.—A long well illustrated description is published in the "Elek. Zeit.," Feb. 7; the continuous current three-wire system is used, there being one main station and three sub-stations each with a battery of accumulators, and auxiliary machine and the regulating apparatus; there are only two wires from the main station to the sub-stations, the three-wire system beginning at the latter.

Blackburn.—A well illustrated description of this station is published in the Lond. "Elec. Eng.," Feb. 15; there is little novel in the system used which is of the direct current, low-pressure, three-wire type; accumulators are used.

Chemnitz Three-Phase Lighting Station.—The Lond. "Elec.," Feb. 15, reprints with illustrations a translation of the article mentioned in the Digest, Feb. 9.

Protection Against Lightning.—Some interesting notes by Mr. Wurtz collected during the last summer are published in "El. Power" for February. On account of the existence of nodes and anti-nodes on circuits, many outlets are needed; the question arises, how many arresters will give reasonable protection? To determine this, experiments under actual working conditions were resorted to; a very much exposed trolley line was provided with a large number of arresters, each in series, with a recording device consisting of a piece of tissue paper separating a brass plug from its socket, each discharge perforating it and preferably in a new point each time; after each storm the papers were removed and the records noted; the results have so far been very satisfactory but not yet sufficient to warrant the drawing of conclusions; it may have to be continued two or three years longer; of 22 arresters struck only three have received more than one discharge, which is very significant, showing that the discharges were selective, choosing arresters according to location rather than size of gap; each discharge selects a gap best suited to itself; had any one of the arresters been missing the charge would have been forced to select a more difficult path; the perforations showed a subdivision of the charge; when discharges are heavy they are liable to divide, and if there is only one arrester, the chances of damage to an armature are much greater; it is not unfrequent that the motor armature is damaged by a portion of the very discharge which passes through the arrester; none of the discharges seem to have entered the station. He confidently expects that a continuation of this experiment will substantiate his conclusions and demonstrate the number of arresters required per mile of wire. For 100 miles of feeder and trolley wire, the cost of his lightning arresters at the rate of 4 per mile would be about $2,000, the interest on which is $120 per year, and yet there are plants having no arresters whose direct losses from lightning amount to from 40 to 10 times this sum. He gives some observations made at Bodie, Cal., and a number of curious notes reaching him from time to time, which are instructive.

Lightning Arresters.—A lecture by Mr. Wurtz is briefly abstracted in the "Sibley Jour." for February. It appears to contain little that was not already published in his previous well known papers. He divides the possible ways in which overhead wires may become charged into four groups, by direct stroke, by conduction, by static induction, and by dynamic induction; the first is so very rare that it can be disregarded; experiments and observations lead to the conclusion that it is by static induction that excessive charges are most commonly produced. Lightning discharges vibrate from 10 to 12 times per stroke, the whole time being about 0.001 second; the atmosphere in the neighborhood of such a discharge has its voltage enormously increased.

Philadelphia.—According to Chief Walker's report there are 5,295 electric lamps (probably arc lights only) for public lighting, of which 498 are run by underground wires laid by the city; the city owns the lamps and the contractors furnish the current for 3c. per night less than for lamps erected by themselves, which represents a saving to the city of $5,453, which, together with $4,600, derived from leasing their ducts and conductors, makes a total of 3 per cent. on the amount expended by the city; he recommends that the city should own all the electric substructures; 9,936 lights were deducted from the companies' bills during the year for failure to live up to the contracts, 96 poles and about 70 miles of the wire have been removed during the year; three men and eight horses were killed by the wires during the year. From the figures it appears that Philadelphia has more electric street lamps than New York and Chicago combined and 600 less than those cities together with Brooklyn; it can therefore claim to be the most brilliantly lighted city in the country (but this does not necessarily follow, because the area is very great).

Municipal Plant Statistics.—In "El. Power" for February Mr. Foster gives some deductions for the South Norwalk plant, which supplies 89 arc lamps at an average cost per lamp per night, including interest and depreciation, of 19.2c., which is a surprisingly good figure.

Central Station Economy.—An editorial in "El'ty," Feb. 20, discusses the relative costs of electric and gas lighting and in conclusion recommends a judicious storage of energy in order to level the load line.

Windmill Lighting Plant.—A description of the plant for lighting the residence of Mr. Brush is published in "El'ty," Feb. 20, including a good illustration of the windmill.

Monocyclic System.—The system is discussed unfavorably in an editorial in "El'ty," Feb. 27; it is claimed that it is even more complicated than present systems.

WIRES, WIRING AND CONDUITS.

Telephoning with Uninsulated Wires.—The "Elek. Zeit.," Feb. 7, describes at some length a series of tests made by the German Government with bare wires of different kinds laid directly on the ground. It has been claimed by the makers of bimetallic wires that they require less insulation than those of copper and other materials and the present tests were made to investigate this; the results are given in detail and show that this claim cannot be substantiated in practice.

Cannon Street Explosion.—The first part of the report of Major Cardew is published in the Lond. "Elec. Eng.," Feb. 15.

Wiring.—In an article by Mr. Hanchett on electric construction, in "El. Power" for February, he gives some practical hints and rules for calculating the size of wires, including a table of constants which simplifies the calculations; for lamps taking 0.55 ampere each he gives the rule: Divide the line loss by the lamp feet and the result is the resistance in ohms per foot of the proper wire (by the distance in feet he means the distance to the lamp and not the length of wire).

Subway Cables.—The "Eng. News," Feb. 21, reprints in full the specifications for the electrical equipment of the telegraph cables for the Baltimore subways, including an illustration of the arrangement of the pole terminals.

Telephone Cables with Dry Air Circulation.—The "Elec. Rev.," Feb. 20, reprints from the "Journal of the Institution of Electrical Engineers" for January the abstract of the paper by Mr. Barbarat which was abstracted in the Digest Feb. 23.

ELECTRO-PHYSICS AND MAGNETISM.

Cathode Rays.—In a Physical Society paper briefly abstracted in "L'Ind. Elec.," Feb. 10, Mr. Curie states that he found that luminous rays were not deflected, like cathode rays, by the action of a magnetic field, the rays being perpendicular to the lines of force; when a convergent beam was used, focussed in the middle of the field, a slight lateral displacement of the focus was noticed; he does not think that these negative results show that cathode rays are radiations of a different nature than those of light although they are not favorable.

Action of a Current on Fused Sulphides.—An Academy paper by Mr. Garnier is abstracted in "L'Ind. Elec.," Feb. 10, and "L'Elec.," Feb. 16. In a previous paper he showed that carbon under the influence of a low voltage current is transported from the positive to the negative pole; similar experiments with fused metallic sulphides, in the open air with electrodes of carbon, showed that the sulphur disappeared, forming probably sulphide of carbon, while the conductivity increases.

Electromotive Phenomena of [illegible]—The Lond. "Elec. Rev.," Feb. 15, contains a communication by Mr. Lawrence in which he quotes largely from a paper by Dr. Morton of New York.

Magnetic Pull.—A paper by Mr. Weber from the "Weid. Ann.," Vol. 54, page 30, is abstracted briefly in the "Elek. Zeit.," Feb. 7; it is chiefly of theoretical interest.

Electric Oscillations.—Under the heading of "A Critical Resume" Dr. Pupin in "El. Power" for February gives at some length a review of the recent French book on this subject by Poincaré.

Experiments with Tesla Currents.—An abstract of Mr. Himstedt's paper, published more fully in the ELECTRICAL WORLD Sept. 15, 1894, is published in the "Elec. Rev.," Feb. 20.

Large Gun Magnet.—Some illustrations of Col. King's large magnet (described in the Digest Jan. 19) are published, together with some data, in the "Elec. Rev.," Feb. 27.

Hysteresis.—In his serial on dynamo design Mr. Harrison in the "Elec. Age," Feb. 23, discusses the subject of hysteresis.

ELECTRO-CHEMISTRY AND BATTERIES.

Tin Chromic Chloride Cell.—A Physical Society paper by Mr. Skinner on this cell, based on an account published by Mr. Case of New York, is abstracted in the Lond. "Elec." and "Elec. Eng.," Feb. 15. It consists of a tin plate and a platinum plate immersed in chromic chloride; when the cell is heated to nearly the boiling point of water, chloride of tin is formed at the expense of the chromic chloride and when cooled again on open circuit the reverse change takes place; the voltage at 15 degrees C. was 0.44 and at 97 degrees C. 0.40 as measured by Poggendorff's method, but when connected directly to a galvanometer there was no current at ordinary temperatures but "some current at 100 degrees C." The author prefers to use amalgam of tin and mercury instead of a tin plate; there is no reversed E. M. F. on cooling; he thinks the heat acts by removing an obstacle. Mr. Appleyard thought Prof. Minchin had used tin chloride cells with two tin plates, the cell working only when one plate was illuminated.

Chlorine Cell.—An illustrated description from the Italian, of the Ettore cell, is given in "L'Eclairage Elec.," Feb. 2; it is a modification of an existing type of cell; the electrodes are carbon and amalgamated zinc; the exciting liquid is a nearly saturated solution of chlorhydrate of ammonia, the depolarizer being chlorine in a gaseous form produced by hydrochloric acid falling drop by drop on hypochlorite of calcium (the chloride of calcium of commerce) in a closed vessel connected to the battery box by means of a tube; that which is not used is absorbed by passing through a vessel containing chalk; the box containing a number of the cells is hermetically sealed; the carbons appear to be made in the form of a porous cup containing the liquid and the zinc, the chlorine being in contact with the outside; the advantages claimed are, small dimensions, ease of construction, economy and cheapness of the chemicals, the ammonia solution being continually regenerated; a battery of 20 cells has an E. M. F. of 50 volts and the internal resistance is low; it has been used to light several rooms with 16-cp lamp.

Local Action in Accumulators.—Mr. Fitzgerald states that the local action would increase if the cell is discharged slightly before being allowed to rest for a long time; contact between the electrolyte and the grid should be avoided, which is done by an unbroken layer of the peroxide on the surface, which, however, is destroyed or broken by a slight discharge; attention should also be paid to purity of material, strength of the acid and avoidance of conditions favorable to the production of persulphuric acid.

Theory of Electrometallurgy.—Prof. Crocker's article is concluded in "El. Power" for February. An abstract of the whole article was given in the Digest Feb. 9.

Shafer-Heinemann Accumulator.—The article abstracted in the Digest last week is reprinted in full in "El'ty," Feb. 27.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Alternating Current Curves.—A paper by Dr. Fleming is begun in the Lond. "Elec.," Feb. 15. He calls attention to the importance of finding the curves at the consumer's end of the line as distinguished from those at the alternator end. He describes a simple apparatus devised by himself after considerable experimenting "which enables these curves to be taken with utmost facility at any place and on any circuit;" the success of the apparatus depends entirely on the details of construction, those interested should therefore consult the original article. The apparatus consists of a simple synchronous alternating current and motor having 8 poles and an armature 6 inches in diameter, the fields requiring about 4 amperes; its shaft contains a contact arrangement with insulating springs set by the aid of a graduated disc; a good illustration is given. To start the motor the fields are supplied with current from a small secondary battery and it is started to rotate by hand with the aid of a thin leather strap running over a pulley. A Kelvin multicellular voltmeter is preferred and is used in connection with a constant E. M. F. in series, obtained from 50 small accumulators, with which arrangement it can be used to measure the voltages over a whole range. He gives the results of a test with a Kapp, a Mordey and a Thomson-Houston alternator, also with a Ganz transformer; a selection of the curves is promised in the continuation of the article. As the investigations are not yet completed he does not discuss the results, one question, however, has received a solution, it was found that the iron-core loss of a transformer is least when taken on that alternator the E. M. F. curve of which is farthest removed from being a simple sine curve, a result in contradiction to some statements made not long since.

Electrochemical Curve Tracer.—An illustrated description of his well-known system is given by Dr. Janet in the "Bul. Soc. Int. Elec." for January. It is stated to be a simple method offering no difficulties in its application and requiring but simple and cheap apparatus.

[illegible]—The "Elek. Zeit.," Feb. 7, contains a long communication from Mr. Lenz in which he criticises very unfavorably the method of Mr. Grau, which was described in the Digest Dec. 1. He discusses the formula for the calculation of the magnetization energy and shows that the value received will be quite incorrect, and as most of the other quantities are deduced from it, they will also be wrong; he claims that in measuring the field by means of a coil around the armature connected to a ballistic galvanometer the excitation should be reversed in order to get correct results. He concludes that the method has neither practical nor scientific value, for, besides containing a number of errors it is new.

Influence of Magnetization and Temperature on the Conductivity of Bismuth.—A paper by Mr. Henderson from the "Weid. Ann.," Vol. 53, page 912, is abstracted with a table of values in the "Elek. Zeit.," Feb. 7. He shows that the resistance increases in general with the temperature for magnetization below 10,000 units, while the reverse is true for higher field densities; without a knowledge of the temperature, therefore, not even approximate determinations of the field density can be made with the resistance of bismuth wire; such an instrument may, however, be used if combined with a thermometer or a spiral of other wire having a known temperature coefficient. From the table of values the resistance increases more than threefold for fields from 0 to 38,900 units.

Spectrum Photometry.—The description of a new photometer by Mr. Koenig from the "Weid. Ann.," Vol. 53, page 785, is published in the "Zeit. Fuer. Beleucht.," Jan. 30.

Galvanometer.—A four-coil galvanometer made by Nalder is described and illustrated in the Lond. "Elec.," Feb. 15; its design is simple and compact and it is capable of standing rough handling although a high-class, sensitive instrument.

Testing Primary Batteries.—The paper abstracted in the Digest Feb. 16 is given in abstract with some of the illustrations in the "Elec. Rev.," Feb. 20.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone Switchboard.—An improvement is described and illustrated by Mr. Engelmann in the "Elek. Zeit.," Feb. 14; he does away with the controlling battery in the common return circuit of a number of lines and thereby overcomes an important objection in the Braun system.

Paying for Telephone Service.—In the "Elek. Zeit.," Feb. 14, Mr. Barth replies to some objections which were made in that journal regarding his system, mentioned in the Digest Feb. 16.

Telegraph Cables in the World.—The "Elek. Zeit.," Feb. 7, publishes a table of the lengths of all the cables.

Lightning and Telegraph Insulators.—The article referred to in the Digest last week is reprinted with the illustration in the "Elec. Rev.," Feb. 20.

Gilgit Telegraph Line.—The article referred to in the Digest Jan. 19 is reprinted in the "West. El.," Feb. 23.

Carbonelle Microphone.—A translation of the article abstracted in the Digest Jan. 12 is published in the "Elec.," Feb. 20.

Pictorial Telegraphy.—In "El'ty," Feb. 20, Mr. Perry describes the well known system of Mr. Amstutz, including some specimens of the work.

MISCELLANEOUS.

Calcic Carbide.—The production of this material (see Digest, Feb. 16) and its use are discussed in the Lond. "Elec. Rev.," Feb. 15, in which, however, but little more is given than was contained in our abstract. The material itself is not new, as it was produced long ago by Wohler and later by Travers, though not by this process; carbides of barium and potassium and other elements also produce acetylene. It is calculated that the cost of the electric power from central stations would be over 10 times the figure on which the previous estimate was based and that the success of this compound therefore depends entirely on cheap water power; only 5 per cent. of the heat produced by coal is recoverable in the electric furnace. Belief is expressed that there is no immediate cause for apprehension, as the original estimate of the cost was probably much too high. Prof. Lewes states that 1 hp of electrical energy consumed in incandescent lamps gave light equal to 28 compared with 44 given by 1 hp consumed in producing acetylene light through the aid of the carbide; this difference is not sufficient to make steam-generated carbide and acetylene light compete with electric incandescent ligh the cost of handling, packing, storing and selling would never be made up by this difference; at 3.25 watts per candle the two lights are equal, power for power, and with arc lamps the tables are turned completely, the figures being 80 as against 50 for the acetylene light.

Boride of Iron.—An Academy paper by Mr. Moissan is abstracted briefly in "L'Ind. Elec.," Feb. 10.

Training of Electrical Engineers.—Mr. Cahoon's article is concluded in "El. Power" for February (see Digest Feb. 2). The object of the course at the works of the General Electric Company is to give a thorough knowledge of the various processes through which a piece of electric apparatus is carried from its inception to its completion and to familiarize the student with the principles involved; he believes the tendencies of colleges is to go too much into abstruse technicalities; for one who intends to become a designing engineer such a course is excellent and necessary; he believes there shoud be a broader English and business education; few, if any, of the colleges impart a knowledge of engineering as outlined by him. He discusses the future prospects of a student and calls attention to the fact that the supply is greater than the demand and that the remuneration is therefore less in this field than in any other engineering profession, with a tendency to decrease still further; electrical engineering is becoming a settled profession and the men who compose it are compelled to work much harder and under greater tension than in any other of the engineering professions. "If a young man is willing to work in an exceedingly interesting field for a very small salary, with but little prospects of ever getting a large one, and is content to receive as his reward the honor and glory belonging to the electrical profession, then let him enter the electrical field; but if he is looking after money and will not be satisfied unless he does get it, then it would be better for him to enter some other field."

Cleveland.—The greater part of the issue of the "Elec. Eng.," Feb. 20, is devoted to a long, illustrated description of Cleveland and its electrical industries. The "West. El." and "Elec. Age.," Feb. 23, publish descriptions of some of the electrical industries of that city.

Stanley Works.—The "Elec. Eng.," Feb. 27, gives a well illustrated description of the works of this company and of some of its apparatus.

First Aid in Electric Accidents.—The "Elec. Rev.," Feb. 20, reprints the article of Dr. Hedley from the Lond. "Lancet" mentioned in the Digest Oct. 13.

Biographical.—A large number of brief biographies with portraits of "early electrical salesmen" are published in "El'ty.," Feb. 20.

New Books.

Electrical Engineering. For Electric Light Artisans and Students. By W. Slingo and A. Brooker. New and revised edition. London: Longmans, Green & Co. 753 pages, 346 illustrations. Price, $3.50.

This works treats of the various subjects pertaining to electrical engineering in a manner to be easily followed by students who have never had the advantage of a mathematical training. The exposition of theories and laws and the descriptions of instruments and machinery are, in general, clear and accurate, and well calculated to give a good understanding of the principles that underlie the construction and use of electrical apparatus. Students not familiar with the fundamental principles of electrical science will find this work to lead up by easy steps from the foundations of electrical science to the explanations of the operation of electrical generators and motors, the methods of measurement of electrical quantities, and the principles underlying the design and construction of electrical engineering works. In the description of apparatus and machinery, however, the student will find little that pertains to electrical engineering practice in the United States, and to the American student, therefore, the great value of the work will consist in its clear and simple elucidation of the principles that pertain to all electrical engineering practice. The work begins with a statement of the fundamental phenomenon of bodies electrified by friction. From these the ideas of potential, current and resistance are developed and the units in which they are measured (?) defined. At the end of the second chapter is a very clear explanation of the derivation of the C. G. S. units. The third chapter relates to primary batteries.

Chapters IV. to VII. relate to instruments and methods of measurements. Several English and Continental instruments are described, but no mention whatever is made of the Weston instruments manufactured in this country. This seems inexcusable, even in an English work revised after the World's Fair at Chicago, where, upon motion of Prof. Ayrton, the Weston instruments were adopted as the standard in the tests by the jury of award.

In the five following chapters the theory of dynamo-electric generators is quite fully discussed, and several typical forms of machines are described. The characteristics of the magnetic field are well explained, and the relation between strength of field and magnetizating force developed from the analogy of the magnetic to the electric current is well treated, and the author very properly describes as one of the simplest forms of dynamos a machine in which there is no moving wire, but where the magnetic field is varied by the movement of a mass of soft iron.

The following chapters treat of storage batteries, arc and incandescent lamps, system of distribution, and electric meters. More space might well have been given to the subject of distribution, and it would have been well if the methods of proportioning conductors, the advantages of the three-wire system, etc., had been more fully treated. As already stated, the authors' descriptions and explanations are generally clear and accurate, and the work will prove a valuable one to the class of readers for whom it was intended. But there are some errors and misapprehensions, which are the more to be regretted since those for whom the book was written would not be likely to discover them. The authors give several pages to a proof that an electric current does not flow from one ground plate to another, and state that "anything more unreasonable than such a hypothesis (that such currents exists) it is really impossible to conceive," and then admit at the end that, in the case of electric railways using large currents, there may be such a flow, apparently entirely obvious of the fact that the difference betweeen that and a telegraph line is only one of degree.

They are not clear as to the meaning of difference of potential, and the distinction between difference of potential and electromotive force. They tell us that "Where there is no difference of potential there can be no flow of electricity," and "that electricity always flows from the body possessing the higher to that possessing the lower potential." It is a well-known fact that in every dynamo electricity flows through the armature winding and against the potential difference from the low to the high potential brush. They are careful in several references to the simple voltaic cell to say that the difference does not exist below the liquid surface, while it is well known that precisely the same effect will be produced by a contact of the plates below as above the liquid. In this connection the reviewer wishes to protest against the perpetuation of the old nomenclature based upon a mistaken theory which calls the zinc the positive and the copper the negative plate. The zinc of a cell is never under any condition in any part positive in respect to the copper.

In the discussion of magnetic leakage the authors state that in a case where the leakage was 24¼ per cent. "almost a quarter of the power spent for the purpose of developing the field in this particular case was wasted." This seems to be based on the idea that if there were no leakage so many additional lines would pass through the armature, which is very far from the truth.

In several instances the authors, in their desire to magnify the importance of a special subject, have used meaningless and exaggerated expressions that are out of place in a book of this character. Referring to Ohm's law, they say, "It is doubtful whether in the whole range of history of electrical science a law has ever been enunciated so full of truth;" one is tempted to ask for a table of laws with the percentage of truth in each. Again, speaking of the discovery of current induction by Faraday in 1831, they say, "The principles which he then discovered of the remarkable action of the varying current upon an adjacent circuit are of almost incalculable importance; while the method of constructing his original transformer, which we shall briefly describe, *was well abreast of the then existing practice.* The italics are the reviewer's.

An elementary electro-technical series is in preparation by Messrs. Houston and Kennelly, modeled somewhat after the lines of the several German and French electro-technical series which have been so well received abroad. The titles of the various volumes will be as follows: "Alternating Electric Currents," "Electric Heating," "Electromagnetism," "Electricity in Electro-Therapeutics," "Electric Arc Lighting," "Electric Incandescent Lighting," "Electrical Measurements," "Electric Street Railroads," "Electric Telephony," "Electric Telegraphy."

Improvement in Incandescent Lamps.

The following table of determinations of the efficiency of the present Packard Lamp is the result of measurements made by Mr. Jas. P. Gilbert, electrician and chemist of the New York & Ohio Company, Warren, O., and shows the rather remarkable fact that the candle power and efficiency of the lamps tested increased during 200 or 300 hours of burning. The tests were made on fifty lamps, and corroborated by several other tests; of these fifty lamps none had burned out at the end of 300 hours nor had any shown signs of deterioration at any point; at the end of three hundred hours they showed such a constant increase in efficiency that it was deemed advisable to publish the result so far obtained at once rather than wait for the complete life test. The lamp are of 16-cp and are being tested on a 98-volt direct current circuit.

AVERAGE MEASUREMENTS.

	Volts.	Current.	Total Watts.	Watts per cp.
Initial	98 2	.583 Amp.	57.25	3.59
End of 100 hours	97.4	.577 "	56.23	3 51
End of 200 hours	96 9	.571 "	55.33	3.46
End of 300 hours	96.8	.578 "	55.93	3.49

INCREASE IN CANDLE POWER AT 98 VOLTS.

Initial	16 cp
End of 100 hours	17.9 "
End of 200 hours	18.7 "
End of 300 hours	18.7 "

Ordering Railway Supplies.

BY A. W. ABELL.

Electric railway managers, like other mortals, are known to have their trials; indeed, few men are more beset than they with difficulties continually springing up, some old, others new and surprising, most of them costly. Not the least of these is the annoying delay in getting orders for supplies filled, and it is this that the writer would discuss.

The manufacturing companies are undoubtedly considerably to blame for delay in shipments, perhaps unavoidable in many cases. Are the railway companies faultless in the matter?

A most troublesome side of a supply company's business is the incompleteness of orders. Attempting to fill many of them is as puzzling as trying to direct a lost child who cries through the street, "I want mamma!"

A few examples from actual practice will illustrate. The following telegram is received: "Ship by express immediately 500 nigger heads." Anxious to accommodate his customer the manufacturer hastens about trying to learn from his associates what is meant, but none knows. How can a supply company keep posted on all local terms throughout the country? Another telegram: "Express 800 motor brushes at once." There are various makes of even street car motors, and many roads are using two or three more types of the same company's make. Hence the indefiniteness of the above order. A letter is received, calling, among other things, for "eight field coils." One naturally supposes that they are to be for railway motors until it is learned that they are wanted for circuit breakers. Whoever made out the order originally (probably the electrician or the steam engineer), no doubt had clearly in mind what he wanted, but failed to convey all his knowledge to the supply house. Another order includes "one dozen motor bolts," "two dozen controller wipers," etc. There are three or four sizes of bolts on a motor, and "wiper" may be as good as the catalogue name for the part meant, but the order cannot be filled on such indefinite information.

The above instances are but samples of orders daily received, orders so destitute of specific description that it is impossible to fill them without additional information. The delay annoys the officials of the road, for they do not order until the last minute, when they are in pressing need of the material.

While manufacturers are kept constantly in hot water by these indefinite but urgent orders, their desire to please customers causes them to refrain from expressing their inner thoughts, or doing more than politely requesting that further information be sent, and the same old story continues—indefinite orders, costly delays, irritated customers. Is there no remedy for all this?

Any new business springing up so suddenly as has electric traction is apt to be imperfectly understood at first by its financial backers. "Will it pay?" is the great question, and acting on their knowledge of the old horse car business, the promoters start out to keep down expenses at every turn. It is seldom thought necessary to pay the salary necessary to keep an electrical engineer. An electrician (?) is employed, to whom everything technical is intrusted. He makes out a memorandum order which is copied verbatim on the regular order blank by the office clerk, and is then signed by the superintendent and mailed. So the indefiniteness of orders originates with the electrician, or some workman who hasn't education enough to express in specific, unmistakable terms what he has in mind. To do that is not easy even for a trained man.

As is well known, manufacturers of railway apparatus furnish illustrated catalogues, in which each part has its catalogue number, and were these catalogues intelligently *used*, vaguely defined orders would cease. These catalogues are sent to all customers. They reach the office of the railway company, but so far as can be judged by subsequent orders, there they remain under a stack of papers, often never consulted at all (as the writer well knows), or their usefulness little appreciated.

What should be done is this: The superintendent or general manager should see that those have catalogues who make out the orders originally. In the case of large railway companies, the purchasing agent, who places all orders, should send for a sufficient number of catalogues and distribute them among those who send him their memorandum orders, *i. e.*, the superintendent of the power station, line superintendents, superintendent of repair shops, etc., and should insist on the use of *catalogue numbers.* Usually he puts the order through just as it comes to him.

Were he to examine it critically and from it attempt to find in his catalogue the parts called for, he would discover how indefinite the order had been made out, and remedy the deficiencies therein before it left the office of the railway company, thus avoiding annoying correspondence, waste of valuable time, and, in many cases, days of costly delay. It is sometimes true that after careful search the catalogue number of a part desired cannot be decided upon with absolute certainty. In such cases information should be furnished as to what the part is for, where used, etc., and what is especially helpful, let a little *sketch* be made. Supply companies never dread too lengthy descriptions of parts ordered. It appears to them, however, that those who make out orders often try to be as brief and indefinite as possible. Undoubtedly these men are very busy, and make out the orders hurriedly, but they should remember that "haste makes waste" of time as well as other things. Five minutes of concentrated thought at the start in properly making out and carefully looking over the order would often save them days of impatient waiting.

Controlling a Motor from a Distance.

BY C. F. JENKINS

Now that electricity is coming to supersede compressed air to a greater or less extent in mining operations, many new problems will confront the practical engineer. One of the most interesting will be the handling of the small ore cars. The writer some five years ago was employed in keeping in repair engines, compressors, hoisters, etc., of a large silver mine, one hoister of which worked 2,300 feet of cable incline hoist. This shaft was well adapted for operation by means of an electric motor car, from the fact that the incline at no point was so steep that it could not be easily mounted. From the mouth of the shaft a line of track of about 800 yards led to the reduction plant. This shaft was one of those peculiar ones which follow a lead a long way and was dry throughout. As the drift was narrow and low for most of its length, the men were never permitted to ride upon the cars—in fact, it would have been almost impossible.

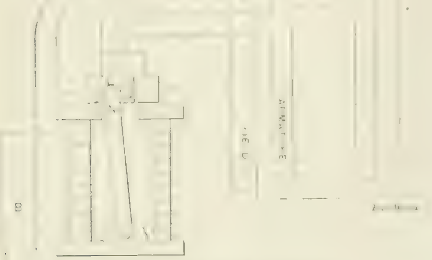


Fig. 1.—Car Pole Changer.

As there are many places where these conditions exist, a solution of the problem of the substitution of a motor for the cable car in this particular case is given herewith.

The cars, both on the shaft track and on the track leading to the mill, must travel unattended the whole distance and be under the absolute control of the engineer at the head of the shaft, to move forward and backward at will over any portion of the entire track.

This is accomplished in the following manner: Upon an ordinary motor car bed an automatic pole-changer is mounted and inserted in series with the source of supply, as in Fig. 1. Now, the operation of this piece of mechanism is such that when the current in the leads *B*, which, in the case under consideration, may, owing to the extremely dry condition prevailing, be the two rails of the track, flows in the direction of the arrow, then will *a* of the electromagnet of the pole-changer become a south pole and attract the north pole of the permanent magnet *N*, upon the upper extremity of which a block of insulating material, supporting two brass contact pieces, is secured. As these pieces make contact with the terminals of the armature, a circuit is completed through the motor and the rotation of the armature is such that it moves the truck forward, let us say. Upon a reversal of the direction of the current in the leads *B*, the *a* pole of the electromagnet becomes a north pole and the *c* a south pole. Of a consequence, the vibrating tongue or permanent magnet *N* instantly responds to this new condition and swings over until its *N* pole comes against the *c* pole, which is a south. This reverses the terminals of the armature, and, necessarily, as the current in the leads has been changed, the direction of the current in the armature remains the same as before. As the current through the fields has been reversed, and that through the armature has not been changed, the rotation of the latter is reversed and the car moves backward. As this action can be produced at any time, no matter upon what part of the track the car may be, we have accomplished the desired end.

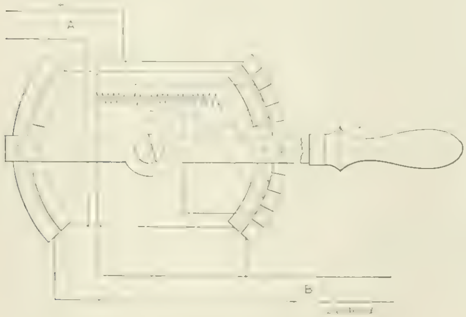


Fig. 2.—Station Pole Changer.

Fig. 2 illustrates a convenient form of station pole-changer for reversing the current in the leads *B*, which, in the case under consideration, are the rails, *A* being the mains or source of supply. The speed of the car is increased as the switch is thrown more from the centre. If the lever is thrown over to the left the car, according to the discussion above, travels forward with increasing speed as the lever is moved from block to block. The reverse is likewise true, except as to direction of rotation, using the same resistance, however, as will be seen.

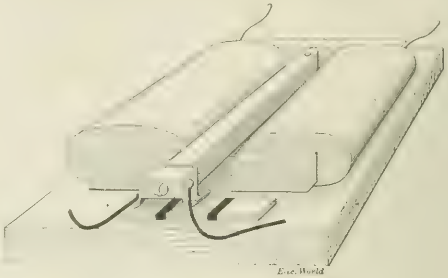


Fig. 3.—Pole Changer Contacts.

In order to prevent short circuiting, the automatic pole-changer contact blocks should be rather wide apart and filled in, as shown in Fig. 3, with some non-conducting material.

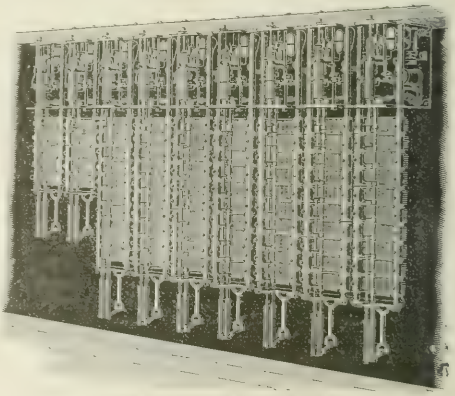
It is scarcely necessary, however, to say that where a motor is employed in hauling a train of trailers, a trolley strip or wire conductor should be used for one lead. This is not so expensive in first cost, however, as the cable, and is subject to practically no wear.

This system would seem to possess considerable merit for several reasons. It is flexible, adapting itself readily to many and varying conditions for both stationary and car motors. It is economical, needing no motorman other than the controlling station attendant, who can be so situated as to operate quite a number of motors on as many different tracks. The weight of a driver on each car is obviated, and where cars are small ones this is a feature worthy of consideration.

It is equally well adapted to series or shunt machines, and so far as tested, has developed no weak points.

New Automatic Telephone Switchboard.

The accompanying illustration represents the new switchboard of the Strowger Automatic Telephone Exchange, Chicago. As will be noticed,



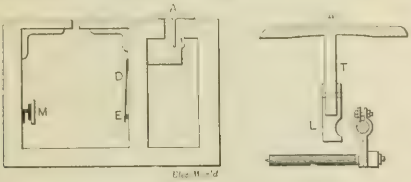
New Strowger Switchboard.

the new board is mounted vertically whereas the old one was set up in a horizontal position. This simple change permits the elimination of all springs from the re-setting mechanism, the drops being reset by gravity, obviating, it is said, tendency to stick or work sluggishly, and the uncertainty which was occasionally manifested in the operation of the old style switchboard. The new board possesses the additional advantages of occupying very much less floor space than did the old one and being more convenient of access in making adjustments, etc.

Conduit Electric Railway System.

A patent has recently been granted Mr. W. L. Hedenberg for a conduit railway system, the principal features of which are that the use of the rails as a return is abolished, the circuit is not grounded, and the permanently live conductor is enclosed in a sealed conduit. While none of these principles is new, the detail method of applying them may be found interesting.

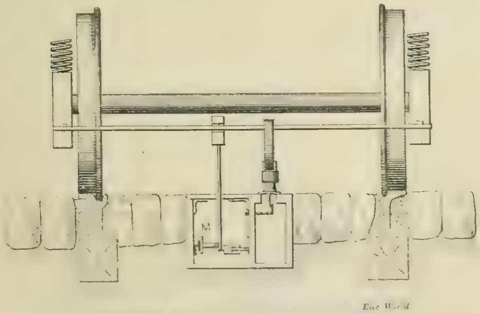
The conduit, as shown in cross section by Fig. 1, may be constructed of creosoted timber, but concrete is preferable. As shown in the drawing there are two entirely separate compartments, one having a slot and the other being hermetically sealed. The main trolley wire, with the necessary feeders, are in the sealed compartment, the former being held in place by a pair of metal clamps. These clamps are attached to a piece of hard rubber or vulcanized fibre. To the latter a small arm is bolted which passes through the wall into the adjoining compartment, and which is connected to a metal plate by means of a pivot. This plate, shown at *D* in Fig. 1, is also pivoted to the partition between the compartments, and held away from the partition at the lower extremity by means of a spring, *E*. So long as this spring is not pressed down the conductor is held away from the projection on the aluminium bronze plate, *A*, in the sealed compartment.



CONDUIT RAILWAY SYSTEM.—FIGS. 1 AND 2.

The modus operandi is as follows: The car carries an arm to which a pair of insulated rollers are attached, running horizontally. One of these rollers presses down the plate shown in Fig. 1 at *D*. By pressing this plate it throws the conductor in the closed compartment in contact with a heavy piece of carbon, *L*, Fig. 2, the latter being firmly attached to the aluminium bronze projection, *T*, Figs. 1 and 2. The current immediately passes to the surface of the aluminium bronze plate and is taken off, by means of either a brush or wheel on the car, as shown in Fig. 3. These plates are about six feet in length and insulated one from the other, so that at no time will more than two plates be in circuit and these will be directly under the car.

The current passes from the brush through the motor, but instead of returning as usual through the rails, passes down the arm carrying the insulated wheels, and by means of a brush held in place by a spring, as shown in Fig. 3, it is transferred to an insulated plate, *M*, fastened to the side of the slot conduit. This arrangement obviates the use of the rails as a return, and eliminates the objectionable practice of grounding one side of the circuit. The conduit should be drained at the lowest points, and when no car is passing the surface plates of the unsealed compartment may be removed and any accumulation of dirt flushed out. The compartment containing the main conductor is watertight, the only openings being one every 25 inches where the quarter-inch arm passes through the dividing wall, and this is so arranged that no water can work through. The contact plate carried by the arm, *D*, to which the conductor is attached, as shown in Figs. 1 and 3, is 14 inches in length. One of these is placed every 25 inches, centre to centre, so that one plate is depressed by one of the horizontal wheels in the slot conduit before the other plate is released, thus assuring a constant flow of current, and no sparking when contact is broken.

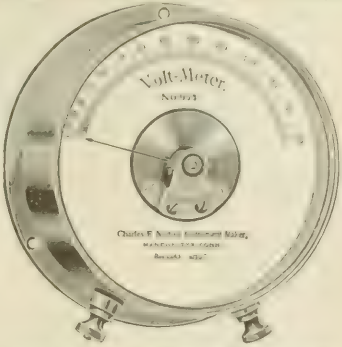


CONDUIT RAILWAY SYSTEM.—FIG. 3.

The advantages claimed are as follows: First, simplicity of construction; second, doing away with the necessity of using the rails as a return, and third, cheapness of construction, the estimated cost with concrete conduit, conductors, labor, etc., being $20,000 per mile.

Magnetic Vane Voltmeters and Ammeters.

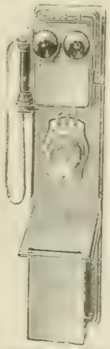
We illustrate below a magnetic vane voltmeter, manufactured by Charles E. Norton, Manchester, Conn. Mr. Norton was for a number of years connected with the Mather Electric Company as superintendent of their instrument department when that company was making the M. V. instruments sold by Queen & Company, of Philadelphia, and since the Mather re-organization he has built these instruments for them, so that magnetic vane voltmeters and ammeters have been known to the trade for the past five years. Mr. Norton has, however, greatly improved the instruments, in appearance as well as construction, and guarantees them to be accurate within two per cent.



IMPROVED MAGNETIC VANE VOLTMETER.

Combined Long and Short Distance Telephone.

We illustrate herewith the combined long and short distance telephone manufactured by the Gerson Electrical Manufacturing Company, of Philadelphia, which is claimed to be exceptionally efficient. It is said that a recent governmental test in competition with a number of other instruments demonstrated an efficiency of 99 per cent. for the Gerson instrument, while the next highest efficiency reached by any of the other makes was 90 per cent. and the average efficiency of the lot, exclusive of the Gerson instrument, was 81 per cent., 100 being taken as perfect. The instrument works equally well on long or short lines without any adjustment.



NEW TELEPHONE.

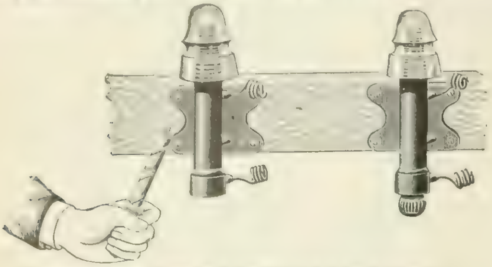
GASOLINE TORCH.

Hot Blast Blow Pipe.

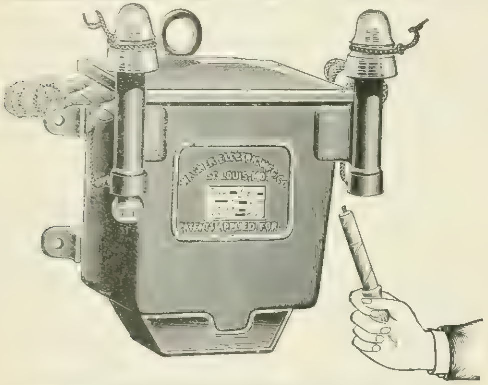
The gasoline blow pipe we illustrate is manufactured by the White Manufacturing Company, 40 State street, Chicago, under the name of the Imperial hot blast blow pipe, and is claimed to give a much hotter blast than the usual forms of gasoline torches in use. It burns four hours with one charge, and has a renewable seat for the needle valve which when worn can be replaced at a small cost, the torch then being practically as good as when new. The reservoir is made of one piece of rolled brass of special quality, rendering it leak proof, and is a third lighter than usual forms. The air valve is at the bottom of the pump, conveniently placed, thus dispensing with the various outside tubes and trappings usually present, and rendering it handier and less liable to get out of order. The pump is extremely simple, supplies a strong blast and drains every drop of gasoline.

Some Novel Specialties.

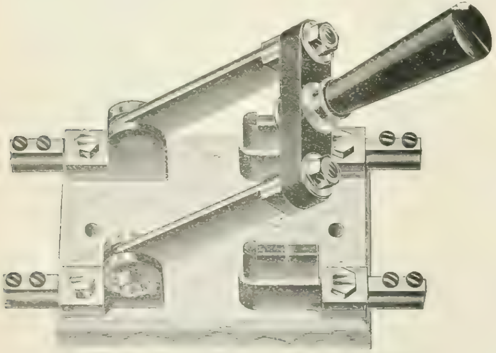
The development and manufacture of electrical devices has reached such a stage that anything genuinely new and at the same time practical is seldom brought out nowadays. The Wagner Electric Manufacturing Company, of St. Louis, has, however, demonstrated the fallibility of the old axiom concerning new things under the sun by the production of the combination fuse box and insulator bracket which we illustrate herewith. The cut is almost self explanatory. Fig. 1 shows the arrangement bolted to a cross-arm or a similar support for independent use, and Fig. 2 shows the same arrangement but attached to a transformer for use in connection therewith. The iron pin on which the insulator is screwed is hollow, and a lava plug carrying the fuse and contact pieces is screwed into this hollow pin from below. The shell of the insulator pin is lined with a lava bushing, and the device is said to break a 5,000-volt circuit carrying fifty amperes without producing an arc or damaging the lava plug. No tools whatever are required to remove the fuse plug or re-fuse it, and it is impossible to obtain a shock while removing or replacing the plug. The use of the device as shown in Fig. 1 obviates the use of separate brackets or pins in leading the primary wires to the transformer, and saves the trouble and cost of drilling holes in walls for the attachment of such brackets, while in cases where the transformer is placed inside the building or a separate fuse box is insisted upon, the arrangement shown in Fig. 2 may be used to advantage.



Combined Fuse Box and Insulator Bracket. Fig. 1.


WAGNER ELECTRIC MFG. CO.
ST. LOUIS, MO.
PATENTS APPLIED FOR.

Combined Fuse Box and Insulator Bracket.—Fig. 2.

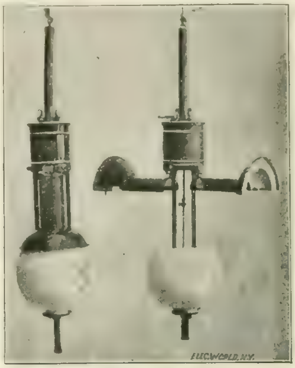


Knife Blade Switch with Carbon Brake.

Another meritorious device recently brought out by the Wagner Company is the knife switch with carbon break also illustrated herewith. The carbon break is secured by placing in front of each contact jaw a socket electrically connected with the jaw and containing a carbon pencil which is pressed outward by a spring. When the switch is opened the pencil follows the blade until the latter is clear of the jaw, thus relieving the jaw of the arc. It is claimed that it is impossible to burn or damage the contact jaws by any amount of use, and when the carbon pencils wear away they can be replaced at trifling cost.

Arc Lamp Spark Arrester.

The accompanying engraving illustrates a simple spark arrester for arc lamps which is being put on the market by the S. K. C. Specialty Company, of Pittsfield, Mass., and which is claimed to possess several features of merit. The arrester is divided vertically in half, as shown, and when open is entirely out of the way of the trimmer. The globe may be removed for cleaning, etc., and fresh carbons put in without removing the spark arrester or experiencing any inconvenience from its presence. The device is substantially constructed of stout material, reinforced around the edges, and is calculated to stand a considerable amount of service.



Spark Arrester.

A New Alternating Current Motor.

We illustrate below an alternating current motor manufactured by the Phillips Electric Motor Company, of 120 Liberty street, New York, which is claimed to be self-starting under load on a simple alternating circuit. It is further claimed that this motor runs at uniform speed with an efficiency equal to that of the best direct current machines, and that it has been evolved from an extended practical experience in the construction of numerous types of alternating current machines, with the result that all the defects and drawbacks present in former motors have been eliminated in the design of this one. The new motor is now manufactured in all sizes from 1 to 10 horse-power inclusive.

New Alternating Current Motor.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, March 2, 1895.

ELECTRICAL STOCKS have had to suffer along with all the rest of the list as a result of the depression into which Wall street was plunged this week. Not being quite so active as a good many of the steam railroad and so called industrial issues, the effect on quotations has been less serious, but the fact that they are sadly neglected would result in any attempt to market electrical stocks at the present time proving a matter attended with very disagreeable and unsatisfactory consequences. Electrical stocks should not be in the dumps; all trade advices agree in reports of activity and revival, but Wall street refuses to be encouraged by even a highly successful bond sale, and sells stocks with a perversity hard to understand. But one can now hope for better things. After to-day the "Ivy Handle" Congress is a welcome thing of the past; a big business revival is confidently counted on, and, what with the whole stock list tremendously oversold, any buying should result in a vigorous bull movement.

WESTINGHOUSE ELECTRIC issues have for the moment dropped completely out of sight, so far as any transactions in them are concerned, though very little change can be noted in quotations. Exception must be made to the scrip; that rules very strong, 96 ex-interest having been bid for it at one time during the week, though 94 ex-interest is now the ruling quotation. The scrip carries 6 per cent. with it.

AMERICAN BELL TELEPHONE stock still suffers from lassitude. The most gratifying circumstance to record in connection with this security is the record of instrument output just published, which is a very valuable straw as indicating the direction of currents in the commercial atmosphere, for the more telephones used the better business in general must be. For the month ending February the gross output increased 5,918 instruments; the net output increased 4,944. From Dec. 20 to Feb. 20 the net output was 5,350, an increase of 8,865 over a similar period in 1894, showing a much improved state of affairs in general. Some attempt was made this week to create fictitious bull enthusiasm in the stock by publishing a statement to the effect that the "Bell Telephone Company now has a surplus of between $35,000,000 and $40,000 000, mostly in stocks of its sub-companies, which is equal to from 175 to 200 per cent. on the present capital." It was very properly pointed out that the company's own report contradicts any such absurd calculations. The main item of asset in the ledger balances on Dec. 31, 1893, was "stocks $37,065,131," and, so far from these stocks being a surplus in themselves, the whole ledger balance does not foot up more than $45 712,340.

ELECTRIC STORAGE COMPANY stock of Philadelphia promises greater activity by the organization of a sub-company—the Manhattan Storage Battery Company of New York. This concern, already duly incorporated with a capital of $600 000, is to control the entire sale of the Electric Storage Company's accumulators in New York and Brooklyn, which means the practical monopoly of the business in these cities. The object in forming a New York branch is to bring the company on the selling ground and also to financier the sale of accumulators in more satisfactory manner than heretofore. One of the impediments to a wider market of storage batteries has been the first cost, and the Manhattan Company intends to alleviate this by making easier terms to the buyers. The accumulators will be sold on sort of an installment plan. In this way the first cost will be reduced and the time payments will make it possible for many to purchase batteries, who would not under old terms. The ample capital of the concern allows of this arrangement. The officers and incorporators of the Manhattan Storage Battery Company are: James H. Hoffman, president; Louis Stern, vice-president; August Belmont, treasurer; Lewis May, secretary, and Ignatz Boskowitz.

ELECTRIC TRACTION STOCKS.

	Bid.	Asked.
Union Ry. Co. (Huckleberry)	112	115
Brooklyn Traction, com	9½	10⅛
" " pref	52½	54½
Long Island Traction	6½	7
Rochester St. Ry	36	40
Columbus St. Ry	46	48
Louisville St. Ry. com	37	39
" " " pref	87	88
Cleveland Electric Ry	59	60
Cleveland City Ry	68	70
North Shore Traction	23	25
New Orleans Traction	15	16
New Orleans Traction pref	58	60
Worcester Traction com	10	11½
" " pref	77½	79
Metropolitan Traction, Philadelphia	96⅛	97
Philadelphia Traction	88	88⅛
People's Traction	49	50
Binghamton R. R. common	100	—

BONDS.

	Bid.	Asked
*Union Ry. 1st. mtge 6s	105	108
*Westchester Electric 1st. mtge. 5s	98	101
Rochester St. Ry. 1st. 5s	95	97
*Columbus St. Ry. 1st 5s	95	97
Columbus Crosstown 1st. 5s	95	97
*Binghamton Railroad Co. 5s	99	100

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* With accrued interest.

GENERAL ELECTRIC has sadly disappointed believers in the stock's inherent strength. It has developed a tendency to sag even in those rare intervals when other stocks were disposed to brace [illegible]ness hardly encouraging to the people who for weeks have been endeavoring to bolster up the price. Company reports furnish no warrant for the continued heaviness of the stock. A semi-official statement published this week both in New York and Boston conveys the reassuring information that the General Electric Company is now earning above $2,500,000 net per annum, and, if orders continue into the present fiscal year beginning February last at the rate noted for the past two months, there will be no need to bother any further about the capital impairment question, as the company will earn itself into a sound position. The statement goes on to recite that the company is earning five times the amount of the preferred stock dividends now accumulating, and there will be no difficulty paying them when the capital question is once fully settled. The statement adds: "The General Electric Company is doing the largest business in its history as respects the volume of the output measured in tonnage or pieces of machinery, and were the prices equal to those of three years ago, it would be earning about 30 per cent. per annum on its capital instead of having its capital selling at 30 per cent of what it has cost most of its owners. Prices are low, but the cost sheets have also been liberally reduced by the introduction of new machinery and labor saving devices. The company has earned during the past fiscal year above $1,500,000, but it has continued—here is the important part of the inspired statement—to charge off with a liberal hand and will shrink its assets still further in the final accounting, so that probably very little margin of earnings above what may be necessary will be shown and the capital account, which is now all a matter of bookkeeping, may be still further written down, [illegible]." This is what Wall street is [illegible] of, and this statement is taken as a first announcement of what the annual statement now near at hand may really have to show.

UNITED ELECTRIC SECURITIES holders have had the following profit and loss account for the six months ending Feb. 1 furnished them: Underlying bond interest and dividends received, $157,581; collateral trust bond interest and expenses $116,833; net $40,753. Profits from the sale of underlying bonds and purchases of collateral trust 5s were $63 655, making the total net for the six months $104,408. The surplus on Aug. 1, 1894, was $180,556. Since then there has been charged off $97,220 and $35,000 for preferred dividends, leaving a surplus on Feb 1, 1895, of $48,336. The $500,000 common stock, $1,000,000 preferred stock and $4,188,000 collateral trust 5 per cent. bonds now have behind them $5,736,336. The collateral 5s were redeemed at about 1¾ per cent. over subscription price. The price of the underlying first mortgage bonds sold—there are $5,846,000 of these deposited to secure the collateral trust 5 per cent. bonds—averages 89. If the remaining bonds were sold at 73 2, the proceeds would retire the collateral 5s at 103.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	128	130
Edison Electric Ill., New York	100	96	99
" " " Brooklyn	100	107	110
" " " Boston	100	124	125
" " " Philadelphia	100	120	124
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	31	32
General Electric	100	28	29
General Electric, pref	100	61	65
Westinghouse Consolidated, com	50	30½	31
" " pref	50	50	51
BONDS			
Edison Electric Ill., New York	1,000	105	106
Edison Electric Light of Europe	190	75	85
General Electric Co. deb. 5s	1 000	89	90
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	192	193
American District Telegraph	100	40	45
American Telegraph & Cable	100	90	92
Central & South American Telegraph	100	117	120
Commercial Cables	100	130	140
Erie Telephone	100	49	50
Gold & Stock Telegraph	100	105	110
Mexican Telegraph	100	180	190
Mexican Telephone	100	70	80
New England Telephone	100	67	69
New York & New Jersey Telephone	100	102	105
Postal Telegraph-Cable	100	55	58
Western Union Telegraph	100	87½	88

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 BROADWAY, NEW YORK, March 4 1895.

MR. W. B. ALLEN, chief sales agent of the Brownell Car Company, St. Louis, is likely to earn a reputation with his customers for ubiquity, so indefatigably and frequently does he get around among them.

MR. [illegible] electrical [illegible] of the [illegible] Elec- [illegible] company [illegible] New York [illegible] week.

MR. [illegible] ALLEN, [illegible] com- pany [illegible] New York [illegible] New Hampshire [illegible] com- pany and its customers.

THE [illegible] ELECTRIC MANUFACTURING COMPANY has removed from 80 Pine street to 25 Whitehall street, New York.

THE [illegible] TELEPHONE BILL [illegible] provides that a [illegible] sub- [illegible] profit on its invested capital and bonded indebtedness. The Metropolitan Telegraph & Telephone [illegible] the New York Board of Trade and Transportation is as vigorously pushing it, on the ground that the Metropolitan Company has "fattened upon the people" under a $150 rate, and yet insists upon an increase of rental to $240.

THE FIRST ANNUAL BALL of the employes of Zimdars & Hunt, electrical contractors, took place at Lyric Hall on the evening of Washington's birthday. The hall was handsomely decorated. The chief feature was the electrical display, which consisted of an entire electric illumination of the stage end of the hall, and included some very novel and surprising effects. Two columns supported an arch, upon which was mounted about seventy-five incandescent lamps The shaft of each column was entwined with smilax, interspersed with roses, and round each column there was also disposed about fifty incandescent lights. On the caps of the columns were two American shields with flags draped each side, the colors in shields being illuminated by numerous small electric lamps. Above the arch were numerous novel devices displayed, one reading "employes of Zimdars & Hunt," also the familar formula C E, all being illuminated by electric lights, making a pleasing and handsome effect. The decorations were designed by Mr. J. P. Smith and executed by the employes of Zimdars & Hunt under the superintendence of Mr. J. F. Vielberth, assisted by Messrs. Geo. Ruckle, J. I. C. King and Geo. McGibney, foremen. Mr. Geo. T. Butler presided. There were doubts among the many friends of the employes of Zimdars & Hunt as to whether the strike in the electrical trade would not seriously interfere with the success of the undertaking. Notwithstanding this, owing to the able management, to whom great credit is due, it far exceeded the expectations of the most sanguine. At 9 o'clock Prof. Douthwaite, with full orchestra, discoursed sweet music for the promenade concert, which lasted till 10 o'clock, after which the grand march took place, followed by dancing, which was continued till the small hours of the morning. At the supper table cheer after cheer was given for the firm of Zimdars & Hunt, the firm being represented by Mr. Hunt, who was also accompanied by his wife and family. After their healths were proposed quiet would not prevail till Mr. Hunt, who is always equal to the occasion, addressed the assemblage, and in a short speech congratulated the employes and gave them much praise for achieving such success in their first annual ball, stating that a jollier lot of strikers he had never met.

General News.

NEW INCORPORATIONS.

THE MAGNOLIA AVENUE RAILWAY COMPANY, Jefferson City, Mo., capital stock $50.000, has been incorporated by Thos. J. Prosser, W. W Penny and others.

THE FREEPORT ELECTRIC LIGHT & FUEL COMPANY, Freeport, Ill. has been incorporated by Chas. D. Knowlton, Louis Stoskopf and others. The capital stock is $100,000.

THE SOUTHWESTERN ILLINOIS TELEPHONE COMPANY, East St Louis, Ill., capital stock $100.000, has been incorporated by Anthony Isch, Daniel Sullivan and A. Rodenburg.

THE CAMBRIDGE CITY ELECTRIC LIGHT COMPANY, Cambridge, Ind., capital stock $20.000, has been incorporated by Edward W. Boden, Chas. H. Kerlin, and Thos. B. Stephens.

THE NANTASKET ELECTRIC STREET RAILWAY COMPANY, Hull, Mass, capital stock $12.500, has been incorporated. The parties interested are B. T. Harrington, G. F. McKay and J. L. Mitchell.

THE TROY TELEPHONE COMPANY, Troy, O., capital stock $10.000, has been incorporated by J. M. Campbell, J. O. Dabis, K. Harter and others for the purpose of operating a telephone exchange in Troy.

THE MONTGOMERY ELECTRIC COMPANY, Ambler, Pa., capital stock $1,000 has been incorporated to supply light, heat and power. Henry Parker, E. A. Murphy and R. L Parkinson, Philadelphia, Pa., are interested.

THE ST. LOUIS BELT RAILWAY COMPANY, St. Louis, Mo., capital stock $2,000,000, has been incorporated to construct a belt line in that city to tap all the street railways and giving every line and system connection with others.

THE VERMILLION WATER, LIGHT AND POWER COMPANY, Vermillion, So. Dak., capital stock $25 000, has been formed to furnish water and light to that city. G. T. Salmer, S. E. Brookman and E Brookman, all of Vermillion, are interested.

THE HARRISON ELECTRIC COMPANY, Chicago, Ill., capital stock $500.000, has been formed to manufacture all kinds of electrical machinery, appliances and devices. The promoters are Edward M. Harrison, Lewis H. Painter and Lewis Rinaker.

THE MURPHYSBORO GAS LIGHT COMPANY, Murphysboro, Ills., capital stock $30.000, has been formed to manufacture gas and to maintain and operate water works and electric light plants. J D. Peters, P M. Post, W.C. Norman and E. Kirchner are interested.

THE JAEGER ELECTRIC LAMP COMPANY, Newark, N. J., capital stock $10,000, has been formed to manufacture and sell electric lamps, etc. Herman G. Jaeger, Norman D. Webster, Brooklyn, N. Y., and Louis J. Auerbacher, Newark, N. J., are interested.

THE VIRGINIA TELEPHONE COMPANY, Norfolk, Va., has been incorporated, with D. Lowenberg, president; R. W. Arnold, vice-president, and Charles Pickett, secretary and treasurer, to operate lines in Virginia. The capital stock is $5,000 with the privilege of increasing it to $100,000.

THE COSMOPOLITAN ELECTRIC COMPANY, Chicago, Ill., capital stock $2 000,000, has been incorporated to generate and supply electricity and manufacture and sell appliances for light, heat and power; construct plants, etc. Albert H. Tyrrell, Wm. H. Pope, and Walter H. Marble.

THE MANHATTAN ELECTRIC STORAGE BATTERY COMPANY, New York capital stock $600 000, has been formed to manufacture electric storage batteries and any apliances connected therewith. August Belmont, J. H. Hoffman, Louis Stern and Lewis May, of New York, are interested.

THE COMMERCIAL HEAT AND POWER COMPANY, Chicago, Ill., capital stock $2,000,000, has been formed to construct, maintain and operate a plant for furnishing heat and power, to construct and maintain pipes, mains, etc. The promoters are Daniel V. Harkin, Harry C. Colson and M. W. Cagney.

THE FRANKLIN ELECTRIC ILLUMINATING COMPANY, Oyster Bay, N.Y., capital stock $25.000, has been formed to generate and use electricity for heat, light and power in Sea Cliff, Glen Cove, etc., L. I., N.Y. The promoters are Samuel Stenson, John Graham, and W. A. Porter, Sea Cliff L. I., N. Y.

THE FULLER ELECTRIC ENGINEERING COMPANY, East St. Louis, Ill., capital stock $30.000, has been formed to manufacture and deal in electrical appliances of all kinds, build and operate electric plants and carry on a general electrical business. W. A. Fuller, Chas. T. Dana and C. H. Dudley are the interested parties.

THE THIRD STREET & SUBURBAN RAILWAY COMPANY, Seattle, Wash., capital stock $100,000, has been incorporated to build, own and operate a street railway, electric light and power plant, saw mills, etc. Angus Mackintosh, A. B. Brocker, Fred. Baueman, W. C. Crambs, Thos. Boyd, David T. Denny and Thos. Denny are interested.

THE UNITED STATES & HAYTI CABLE COMPANY, New York, maximum capital stock $500,000, has been formed to construct and maintain a line of electric telegraphs, cable (submarine, etc.,) between the United States and the West Indies, etc. John W. Mackay, Virginia City, Nev.; George C. Ward, Brooklyn, N. Y., and J. W. Mackay, Jr., New York, are the organizers.

THE NORTHWESTERN TELEPHONE AND CONSTRUCTION COMPANY, Osage, Ia., capital stock $50 000, has been incorporated. H. J. Fitzgerald president; C. H. McNieder, vice-president and H. C. Baldwin, treasurer. This company proposes to construct and operate telephone systems in Osage, Charles City, Mason City and New Hampton and to connect these towns by their lines.

THE GENERAL ELECTRIC RAILWAY COMPANY, Chicago, Ill., capital stock $5,000,000, has been incorporated to manufacture, acquire, own and use and sell, etc., etc., inventions, improvements, patents on railway appliances and devices and model patterns and samples for same, and to acquire and operate street railways. Daniel M. Simmons, Wm. A. Youmans and Geo. Pfleger are interested.

TELEGRAPH AND TELEPHONE.

LEBANON, KY.—A new telephone exchange is to be established.

AUGUSTA, GA.—Hardy Jackson is forming a telephone company.

TROY, ALA.—A. J. Robinson will establish a telephone exchange.

BRISTOL, TENN.—A. D. Reynolds and others are organizing a telephone company.

SPARTANSBURG, S. C.—A company is being formed to establish a telephone system.

PENSACOLA, FLA.—A meeting has been held to organize a new telephone company.

SPRINGFIELD, O.—Talbott & Van Horn have been granted a franchise for a new telephone system.

CARTERSVILLE, GA.—J W Dodds and G. G. Leake, of Cedartown, are organizing a new telephone company.

BIRMINGHAM, ALA—E. B. Bowles and others have petitioned the City Council for a telephone franchise.

OCONTO, WIS.—W. L. Porter, of Ontonagon, has asked for a francise for 10 years to operate a telephone system.

BOGUE CHITTO, MISS.—C. H. Trotter will construct telephone lines, and wishes prices on telephone equipment.

PRINCETON, ILL.—A telephone company with 100 members has been organized and an independent system wil be put in at once.

NEW ORLEANS, LA.—S. P Walmsley, Chas H. Schenck and others have applied for a franchise to construct a telephone system.

WEBSTER, N. C.—Jos. J Hooker will establish a private telephone line. He desires prices of telephone equipments, including wire.

ELMIRA, N. Y.—The Northern Allegheny Telephone Company is preparing to extend its line. Long distance telephones are soon to be attached.

WESTMINSTER, MD.—R. B. Hazlett and others are forming a company to establish a telephone system to connect with a number of surrounding towns.

OSHKOSH, WIS.—Oshkosh City Council has granted Mr. Humes a telephone franchise. He will expend $30,000 on the plant and begin the work of construction at once.

PETERSBURG, VA.—The Petersburg Telephone Company, recently incorporated, is in the market for telephone poles, lines, insulators, pins, brackets, cross arms, switchboards, etc., etc.

NASHVILLE, TENN.—The Cumberland Telephone and Telegraph Company has perfected arrangements by which Nashville will have telephone connection with Chicago, and also with Eastern cities.

DENVER, COL.—The Rocky Mountain & Colorado Telephone companies will establish a telephone line between Cheyenne and Denver. Construction work will commence as soon as the weather permits.

FARGO, N. D.—Hillsboro, Grand Forks and Fargo are to be connected by telephone. Supt. Wainman, of the Northwestern Telephone Exchange, has announced the intention of that company to build such a line in the spring.

ALTON, ILL.—The Alton Telephone Company has presented an ordinance to the City Council, asking for a franchise to do business in this city. This is an inauguration of a fight against the Bell Telephone people to bring about a reduced rate of rentals.

ELECTRIC LIGHT AND POWER.

PENN YAN, N. Y.—A municipal plant is being discussed.

SABINA, O.—Steps are being taken to establish electric light plant.

WONEWOC, WIS.—Wonewoc is agitating the question of electric lights.

RANDOLPH, WIS.—There is talk of supplying Randolph with electric lights.

TORONTO, CAN.—Municipal lighting is assuming something of a tangible shape.

CHICAGO, ILL.—A dynamo will be put in the new jail to be erected by the city of Chicago.

WINCHESTER, IND.—Fire destroyed the electric light plant. Loss $10,000; insurance $3.500.

MAUSTON, WIS.—Plans and specifications are being perfected for an electric light plant at Mauston.

SISTERSVILLE, W. VA.—W. C. Titus, of Ovid, Mich., is contemplating the establishment of an electric light plant.

CLEVELAND TENN.—E. T. Hall will give information concerning the establishment of an electric light plant.

POPLAR BLUFFS, Mo.—The Fort Wayne Electric Light Company has been awarded the contract for lighting the city.

ALBANY, N. Y.—The Senate has appropriated $16.000 for electric lighting and other improvements in the Albany armory.

WARRENSBURGH, N. Y.—The Warrensburgh electric light works will extend its lines to Lake George in the early spring.

CHICAGO, ILL.—A dynamo will be put in to light the new factory of the Chicago Sash, Door and Blind Manufacturing Co.

REDCLIFF, COL.—The electric motor and machinery at the Tip Top mine in Eagle River canyon was badly wrecked recently.

PALMYRA, N.Y.—H. M Howard has secured a franchise for electric lighting and will organize a stock company to erect the plant.

AITKIN, MINN.—At the March election a proposition to issue $10.000 worth of bonds for an electric light plant will be laid before the voters.

ALTOONA, PA.—The question of making a loan of $70,000 for an electric light plant will be submitted to a vote of the people of Altoona.

GRAND RAPIDS, MICH.—The mayor has vetoed the action of the council authorizing a bond issue to build a municipal electric light plant.

PASADENA, CAL.—President J. S. Torrence, of the Pasadena Electric Light Company, says his company will make a large addition to the plant.

PATERSON, N. J.—The new Boston store of the Meyer Brothers will be equipped with all modern improvements, including electric elevators.

FLORENCE, S. C.—The Florence Improvement and Manufacturing Company is in the market for an arc dynamo of 30 to 50 lights capacity, and a 1.000 or 1,500 light alternator, new or second hand.

SALAMANCA, N. Y.—It is reported that the local electric light plant has been confiscated by the Western Electric Company as a result of some difficulties beween that company and the former owner.

WILLETS POINT, L. I., N. Y.—Col. W. R. King, commandant of the United States Engineers Corps, contemplates the construction of an electrict light system at Willets Point, to cost about $300 or $400.

EAST ORANGE, N. J.—A committee composed of Dr. Waite and Israel L. Dodd and Wm. Caldwell has been appointed by the First Ward Republican Club, East Orange, for the converting of the old disposal works in East Orange into an electric light plant as soon as the outlet sewer is finished.

CUTHBERT, GA.—The city has decided to defer putting in an electric plant pending a showing from some electric light companies, who desire to put in a plant on the franchise plan. If the city can make it to its advantage to do this, it will adopt this plan, otherwise, later on, it will put in its own plant and operate and control it.

THE ELECTRIC RAILWAY.

SANDY SPRING, MD., is to have an electric railway.

FAIRVIEW, MASS.—An electric railway will probably be established.

CARTHAGE, MO.—The Jasper County Electric Railway Company is to build a power house.

UTICA, N. Y.—Beckwith & Quackenbush are now in possession of the Frankfort and Herkimer electric road.

CHICAGO, ILL.—The South Chicago City Railway Company has been authorized to construct an electric railway.

NORTH TONAWANDA, N. Y.—An electric street railway is to be constructed and an application for a franchise is pending.

SKOWHEGAN, ME.—Business men of Skowhegan are subscribing liberally for stock in the proposed Madison & Athens electric railroad.

SHEBOYGAN, WIS.—The Sheboygan City Railway Company has asked for a permit to put in a trolley system. John M. Seaman is president.

WEST SPRINGFIELD, MASS.—The Street Railway Company has asked permission of the Selectmen to extend its tracks to the Holyoke line.

HORNELLSVILLE, N. Y.—A project is on foot to build an electric railway from Hornellsville to Canisteo and other towns early in the spring.

PITTSBURGH, PA.—John B. [illegible] and others are contemplating the construction of an electric street railway to run from Troy Hill to Reserve township.

LONG ISLAND CITY, N. Y.—The Long Island City & Newtown Railway Company and the Steinway Railway Company are desirous of extending their lines.

HAMBURG, N.Y.—A trolley line to connect Hamburg with Buffalo is expected shortly. Hon. Thos. L. Bunting, J. Peifer, Geo. M. Pierce and H S. Spencer are interested.

LOWELL, MASS.—It is stated that work on a power house in this city, to supply the Lowell, Lawrence and Haverhill road, will be commenced in the near future.

ORLANDO, FLA.—An ordinance is now before the City Council to be reported upon at the next meeting asking for a franchise to operate a street railway and electric light plant.

SYRACUSE, N. Y.—Both the Syracuse Street Railway Company and the East Side Railway Company have petitioned the Common Council for franchises for extension of their lines.

NEW BRITAIN, CONN.—The Central Railway & Electric Company of New Britain has asked permission to extend its lines from New Britain through Newington to the city of Hartford.

SALAMANCA, N. Y.—A company has been formed and a charter obtained for the purpose of constructing an electric road between Little Valley and this place and extending on to Great Valley.

OCEAN CITY, MD.—The Sinepuxent Beach Company is considering the scheme of building an electric line along the beach, about six miles long. Chas. Goldsborough, of Baltimore, is president

AUGUSTA, ME.—Petition has been made by V. R. Tuttle and 62 others for an act to authorize the Waldo and Somerset Railway Company to extend and build their road from Burnham to Sandy Bay.

FALL RIVER, MASS.—At a regular meeting of Board of Aldermen, the petition of the Fall River Railway Company asking for rights on certain streets of the city for the operation of their line was granted.

MERIDIAN, MISS.—J. T. Donovan, P. A. Bradley and others have been granted a franchise by the city council to construct an electric railway, and a new company has been formed with a capital stock of $250,000.

NEW YORK, N. Y.—The People's Traction Company, recently incorporated, will apply for a franchise in Westchester county to operate a trolley road through the Hudson River towns from New York to Peekskill.

OCALA, FLA.—Work is to begin at once on the Ocala & Silver Springs Railway, according to the statement of Secretary Anderson of the company. It will be operated first with steam dummies and later with electric motors.

ATLANTA, GA.—The Atlanta Electric Railway Company, which was incorporated to build a line in the suburbs of the city, has elected Dayton Hale, president, and D. H. Livermore, secretary. Surveys are now being made.

QUEBEC, CAN.—Mr. Beemer will begin the construction as soon as the weather will permit, of an electric railway in and around the city of Quebec. He will also construct a line to the famous line of La Bonne Ste. Anne.

HANOVER, MASS.—Franchises have been granted to the Hanover Street Railway Company to extend its lines from the corner of Webster street to Norwell, and through High and Washington streets in Norwell to the Higham line.

SYRACUSE, N. Y.—The Business Men's Association committee, which has the proposed extension of the electric railway in charge, reports that the prospects for the speedy extension of the road through West Genesee street are good.

SAN FRANCISCO, CAL.—M. J. Shiels has applied for a franchise to build a double track railway on certain streets terminating near the proposed Union depot, the line to be operated by cable, storage batteries, or smokeless petroleum engines.

NANTICOKE, PA.—The People's Railway Company, of Nanticoke, is perfecting arrangements to begin the construction of a road to pass through Alden, Wanamie, etc. Work to commence as soon as possible. The main power plant will be located near Alden.

HULL, ONT.—Peter Ryan, of Toronto, states he has secured from Mr. Viau, of Hull, the franchises for the proposed electric railway from Hull to Aylmer, and for the electric lighting of the city of Hull. Work on the electric road to commence early next summer.

DETROIT, MICH.—Right of way has been secured for an electric railway from Detroit to Mt. Clemens, Mich., a distance of 20 miles, and work will be commenced in the spring. Chas. J. Reilly, 19 Buhl Block, and C. M. Swift, 3 Bank Chambers, may be addressed for information.

MADISON, ME.—At a recent meeting held at said place a unanimous vote was given to grant the right of way to the Electric Railway Company running from Skowhegan to Madison passing through the centre of town. Work will be commenced in the spring and completed in the fall.

BUFFALO, N. Y.—If a satisfactory arrangement can be concluded between the directors of the Buffalo & Williamsville electric road and the property owners between that suburb and Clarence, the latter place will shortly have a direct trolley connection with this city by an extension of the Williamsville line. It is to cost about $75.000.

MARINETTE, WIS.—It is probable that two additional miles of street railway will be constructed in this city in a short time. The capital stock of the gas, electric light and railway company is $100.000, which may be raised to $200.000, which figure is said to repesent the actual investments of the company. The new line will run along the bay shore.

GREEN BAY, WIS.—The Green Bay Electric Street Railway Company is canvassing for electric light subscribers with a view to putting in a plant. This has aroused the Green Bay & Fort Howard Electric Light & Gas Company, which is already in the field, and there is promise of a rate war, which will make gas and electric lighting much cheaper than at present.

EAST STROUDSBURG, PA.—It is said a charter will be applied for for a [illegible] connecting with the Bangor, Pen Argyl & Wind Gap Electric Railway [illegible] and run over to Lake Poponoming. Henry Fulmer, [illegible] principal promoters and says that the road will be in running order by [illegible] the summer tourists begin to move toward the mountains.

BATAVIA, N. Y.—Business men of this place are considering the matter of [illegible] stock in the proposed railway from Batavia to Oak Orchard, by way of Albion. Gen. Avery of New York is president of the new company. Mr. Beckwith, of Albion, says that Albion people are very much interested in the project, having subscribed nearly $30,000 worth of stock. The company asks that [illegible] subscribe [illegible]

BOSTON, MASS.—The Western New Hampshire Street Railway Company has applied for incorporation to build an electric railway from Williamsburg to Goshen, five miles; to Cummington, seven miles further, and to Worthington, eight miles more. The capital stock is to be $200,000, and Lyman D. James, Williamsburg; Alvah Barrus, Goshen; J. C. Hammond, Northampton; John Olmstead, of Springfield, Mass., and others are interested.

JOLIET, ILL.—The Joliet Street Railway Company is petitioning the Council for permission to extend its street car lines. J. A. Henry, president, states that considerable improvements, repairs and alterations should be made at once both in the plant, the track and the rolling stock of its railway; that such improvements, etc., will require the expenditure of a large sum of money, which can only be raised by the sale of bonds of said road.

FLUSHING, L. I., N. Y.—The plant of the Flushing & College Point Electric Railway will be sold. A new company has been formed consisting of Daniel Odell, E. Bayard Halstead, Paul D. Cravath, S. Kellogg and others of New York. The capital stock of the new organization is $125,000. It is inferred that the new company will purchase the plant. The new company expects to spend at least $25,000 in enlarging and improving the plant.

GOSHEN, MASS.—Promoters of the reorganized Northampton Street Railway have asked the Legislature for a charter to build a line through Williamsburg, Goshen, Chesterfield, Worthington and Cummington. The name will be the Western Hampshire Street Railway Company, and permission is asked to issue $150,000 in stock and $50,000 in bonds. The incorporators named are: Lyman D. James, of Williamsburg; Alvan Barrus, of Goshen, and J. C. Hammond, of Northampton.

MISCELLANEOUS NOTES.

MUNICIPAL LIGHTING IN DECATUR, ILL., is claimed by the *Daily* [illegible] of that city to be a snare and delusion. The paper states that while the system of bookkeeping in the clerk's office shows an annual expense account of $[illegible] for 103 lights, the actual cost of these lights is about $12,458. The discrepancy is explained by the fact that nothing is charged to interest and depreciation accounts, and all the money paid attendants is charged up to the water works, which is operated in connection with the light plant, notwithstanding several of these attendants would not be required but for the electric light plant. The lights in Decatur are run on the moonlight schedule.

ROYAL E. HOUSE, the inventor of the House printing telegraph system and many other meritorious devices, died at Bridgeport, Conn., on Feb. 25, aged 81 years. Mr House constructed in 1840 a waterwheel embodying all the salient principles of the modern turbine, and in 1844, prior to the construction of the first telegraph line of Prof. Morse (but subsequent to the issue of the earlier Morse patents) a House printing telegraph machine was exhibited in New York. This machine printed the messages in Roman characters at the rate of about 40 to 50 words a minute. The great expense of installing and maintaining the instruments, however, was prohibitive.

Trade and Industrial Notes.

THE CLEVELAND MACHINE SCREW COMPANY, Cleveland, Ohio, is sending out a very handsome calendar.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY, 50 Broadway, New York has issued a very tasteful illustrated pamphlet, describing the Manhattan arc lamp.

THE F. E. BELDEN MICA MINING COMPANY, of Boston, has established a branch house at 182 Franklin street, New York, in charge of Mr. Union Adams, Jr., where all of its widely known products may be obtained.

THE ELECTRICAL ENGINEERING COMPANY, of Minneapolis, Minn., has published its third catalogue of electrical supplies and apparatus. The new catalogue is exceedingly comprehensive and well arranged as to contents.

THE CUTLER-HAMMER MANUFACTURING COMPANY were burned out at 8 o'clock on the morning of February 27 and before night of the same day they were ready for business at 16 South Canal street. This is lively moving around.

THE METROPOLITAN ELECTRIC COMPANY, of Chicago, is introducing to the trade a new carbon battery of high efficiency test for open circuit work. The battery is guaranteed and offered to the trade seeking a high-class article of this description.

THE ELSON & BREWSTER ENGINEERING COMPANY, New York, reports business as being very good. Orders have recently been received for electrical moulding for the Stokes building on Pine street and the Ward's Island insane asylum, and other orders are flowing in continuously. Brisk sales on woven-wire brushes are reported.

THE CHICAGO CROSS ARM COMPANY is now in its new and more spacious office at 1440-1441 Monadnock Block, Chicago, where it reports a very brisk and promising business. Having several large orders for future delivery, it was necessary also to increase the company's mill capacity to meet the increasing demand for its well-known Yellow Pine Cross Arms.

THE STROWGER AUTOMATIC TELEPHONE SYSTEM is reported as being in successful operation in La Porte, Ind.; La Grange, Ill.; Ypsilanti, Mich.; Perry, N. Y.; Albert Lea, Minn., and Chariton, Ia. Applications have been made and franchises granted for the automatic system in Philadelphia, Pa.; Brooklyn, N. Y.; Bloomington, Ill.; Rockford, Ill.; Michigan City, Ind.; Frankfort, Ind., Canton, O.; Akron, O.; Tacoma, Wash.; Bakersfield, Cal.; Sterling, Ill.; Hannibal, Mo., and other places.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, have purchased of H. P. Lucas, receiver, the catalogue, good will and a large part of the stock of the Knapp Electrical Works (insolvent) and is consequently prepared to fill all orders for "Knapp" specialties promptly from Chicago stock. The Knapp catalogue is one of the largest, most complete and expensive electrical supply catalogues ever published. The Electric Appliance Company is making some revisions and additions to the original volume, making it even more complete and desirable than before.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., reports a continuation of the unprecedented amount of new business secured. The following sales have recently been made through its isolated lighting department: The Berlin Iron Bridge Company, East Berlin, Conn., second order, 250-light ring type dynamo; Perkins Electric Switch Mfg. Company, Hartford Conn., 350-light ring type dynamo; Haverhill Paper Company, Bradford, Mass., 150-light ring type dynamo; Inter-Mountain Electric Company, Pocatello, Idaho, 450-light ring type dynamo; Hub Gore Makers, Brockton, Mass., 450-light ring type dynamo; Coffee Exchange, New York City, 600-light ring type dynamo; Iroquois Furnace Company, 150-light ring type dynamo; Cranston Worsted Mills, Bristol, R. I., 250-light ring type dynamo; New Opera House, Holyoke, Mass., 250-light ring type dynamo; Hub Gore Makers, Camden, N. J., 150-light ring type dynamo; Waverly Woolen Company, Pittsfield, Maine, 350-light ring type dynamo, second order; Thatcher Bros., New Bedford, Mass., 100-light ring type dynamo; James F. Grant, Youngstown, Ohio, 450-light ring type dynamo; Rockwell Mfg. Company, Milwaukee, Wis., 100-light ring type dynamo, second order; Burtis Howard, Minneapolis, Minn., 100-light ring type dynamo, third order; S. N. Blake, Elmira, N. Y., two 250-light ring type dynamos; B. Lowenstein & Bros., Memphis, Tenn., 100-light ring type dynamo; Straight Line Engine Company, Straight Line, New York, 20-kw Manchester type generator; Cook Locomotive Works, Paterson, N. J., 45-kw, 220-volt, multipolar generator; J. Holt Gates, Chicago, Ill., two 60-kw 500 volt, multipolar generators; Denison (Tex.) Light and Power Company, 45-kw multipolar generator, 220 volts.

THE ELECTRICAL MAINTENANCE COMPANY, 50 Broadway, New York, a corporation backed by some of New York's best financial and business men, reports that its start in the electric field has been most encouraging. The objects of this company are to inspect and maintain electric plants at a fixed rate per annum. The question of guaranteeing an installation by manufacturers, which is invariably asked for, has been a most objectionable feature in the selling of electrical plants, owing to the fact that while a plant may have been installed perfectly, some mistake by incompetent people handling the plant often develops very unpleasant questions of responsibility which the manufacturer refuses to meet. This undesirable feature is disposed of by this company's contract, which may be figured with an installation, in which case it assumes all responsibility for the period covered. The company's examiners visit plants under its care at regular intervals, and thereby not only acquaint themselves with all details, and educate the persons in charge, but are liable under the contract for any and all damage resulting from any instruction given. The company also claims that its facilities are such that in the event of a plant needing repairs they can be accomplished in the least possible time, and it is obvious that its own interests demand extraordinary exertions under such conditions. Another important advantage this company claims for its customers is that in the event of sudden absence, by reason of sickness or from other causes, of an engineer, one of the examiners, who would be thoroughly acquainted in detail with any and all plants under their charge, could be obtained in an hour or so, thus exempting the plant from damage due to the natural errors of a man unacquainted therewith. The company is becoming well established in New York, Brooklyn and vicinity, and is preparing to establish branches in all of the largest cities in this country. The officers and board of directors are: J. J. McKenna, general manager; R. L. Johnson, secretary; Geo. H. Cook, Henry M. Denton, Edward R. Jones, James S. Kendall, Freeman D. Bewley, William Duryea and C. F. Travis, directors.

THE WALKER MANUFACTURING COMPANY, of Cleveland, O., reports among some of the larger orders taken already this year the following: The Complete Electric Construction Company, New York City, two 50-kw belted lighting generators; The Rahway Electric Railway Company, Rahway, N. J., one 100-kw belted generator and double car equipments, 25-hp steel motors; the Schuylkill Electric Railway Company, Pottsville, Pa., three 400-kw belted generators with switchboard apparatus and two double car equipments, 25-hp steel motors; Saginaw Consolidated Street Railway Company, Saginaw, Mich., one 200-kw belted generator and six complete car equipments, 25-hp steel motors; Hartford & West Hartford Street Railway Company, Hartford, Conn., two double car equipments, 50-hp steel motors, and two double car equipments, 25-hp steel motors; Waukesha Street Railway Company, Waukesha, Wis., one 150-kw belted generator, and three double car equipments, 50-hp steel motors; the Detroit Railway, Detroit, Mich., two 400-kw direct coupled generators, and one 750-kw direct coupled generator; Gloucester, Essex & Beverly Street Railway Company, Gloucester, Mass., two 225-kw direct coupled generators and 16 double car equipments, 25-hp steel motors; The Jasper County Electric Railway Company, Carthage, Mo., two 200-kw belted generators and five double car equipments, 30-hp steel motors. Besides the foregoing the company has taken orders for its spring-mounted steel motors for the Louisville Railway Company, Louisville; Atlantic Avenue Railway Company, Brooklyn; Steinway Railway Company, Brooklyn; Ottumwa Electric Railway Company, Ottumwa, Iowa; Aurora Street Railway Company, Aurora, Ill.; Bloomington City Railway Company, Bloomington, Ill.; Kansas City Railway Company Kansas City, Mo.; Atlanta Electric Railway Company, Atlanta, and many others. Large orders have also been booked for general work, among which might be mentioned a contract for four 2,000-ton steam and hydraulic cotton compressors for Mr. W. W. Bierce, Montgomery, Ala.

Business Notices.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention, Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

THE SYRACUSE STORAGE BATTERY COMPANY desires to test, in fair competition, a street car of their equipment with a similar car,or cars, equipped by other storage systems, for 60, 80, or 120 mile trips, the number of trips and the street railway on which the test is made to be mutually agreed upon by the storage companies interested. The award of merit to be made by a committee who have no interest in any of the storage batteries to be tested. The committee to be made up as follows: One member to be chosen by each of the following named papers: ELECTRICAL WORLD, *Electrical Engineer*, and one member by the street railway company represented. Address all communications, C. L. Pack, Secretary, Syracuse Storage Battery Co., 38 and 39 Herald Building, Syracuse, N. Y.

DEFECTIVE MACHINERY.

To the Editor of The Electrical World:

Sir:—In a recent issue of the *Iron Age*, under the head of "Machinery," there appeared an article concerning the settlement of suits between Fielding & Platt, of England, and the Morgan Engineering Company, wherein they say that the Morgans agreed to forego a verdict of $10,600 and pay $4,500 besides.

It is true that we obtained such a verdict on the ground of defective machinery turnished by Fielding & Platt, but the $4,500, which was an undisputed balance of account due from us was deducted therefrom, leaving a net verdict in our favor of $6,100. It is not true that after the argument in New York there was any prospect of the court disturbing our verdict. It was very evident that Judge Hammond, who tried the case, would support the verdict in our favor, and knowing this to be so, the representatives of Fielding & Platt proposed a settlement which, with modifications, we accepted. In this suit, after a long trial, the jury had found as above stated.

At the same time another suit was pending by Fielding & Platt against us, wherein they claimed many thousands of dollars as royalties, on what was called "Tweddell's System." The settlement was this: First, Fielding & Platt had paid substantially all the costs (a large sum) in both suits to date of settlement, and this they released; second, Fielding & Platt released us from all alleged claims for royalties, and dismissed both their suits; third, each party paid one-half the remaining costs, being a small sum; fourth, we paid the balance of account due from us.

We should not feel at liberty to state the terms of settlement but for the evident fact that the article in question emanated from the other side. It will at once be seen that the terms of the settlement were entirely satisfactory to us.

Very truly yours, MORGAN ENGINEERING COMPANY,
per T. R. MORGAN, SR., President.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEBRUARY 26 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

534,631. AUTOMATIC ALARM CHECK AND GUARD; A. F. Carpenter, St. Louis, Mo. App. filed May 31, 1894. A closed casing adapted to contain a cushion of air at the top provided with a lateral water discharge opening near its lower end, and an outlet opening having a pipe extension upward beyond said discharge opening a shoulder projecting inward to form an opening of nearly the same area as the mouth of the said extension, and providing an annular passage to the lower portion and discharge opening of the casing, and an alarm check and suitable operative connections therefor, a supply pipe, an interposed air chamber and a break check between alarm check and supply pipe.

534,639. PRINTING TELEGRAPH; S. V. Essick, Brooklyn, N. Y. App. filed Sept. 18, 1890. In a transmitter for a printing telegraphic system, a power impelled shaft provided with spirally arranged stop pins, a series of pivoted key levers one for each pin; a series of sliding keys; a locking bar for locking any one or all of said keys in a depressed position; an escapement carried by the rotary shaft, a pole changer operatively connected with the shaft; a polar magnet having an armature carrying an escapement pallet and electrical connections.

534,642. RAILWAY SUPPLY SYSTEM; H. F. Gray, Passaic, N. J. App. filed Aug. 8, 1893. The combination of two sets of conductors or contact points on the road bed arranged in two distinct lines, one set constituting the working contact or conductor and the other a supplemental conductor, both normally insulated or disconnected from the line and from the ground, an operating switch coil in a connection from one conductor or contact in one set to one in the other, a connection from one of said conductors to the contact of the switch that is operated by a magnet to connect said contact with the line, and means for transmitting the power current from one supplemental contact to another.

534,650. ELECTRICALLY ACTUATED COMBINATION LOCK.; S. L. G. Knox, Camden, N. J. App. filed April 13, 1894. An electric lock motor having a rotatable shaft provided with a scapewheel, a combination lock-gearing connective of said motor and said lock, electrically actuated escapement mechanism for controlling the speed of the lock motor, bolt operating mechanism a series of circuits leading from the outside to the inside of the said safe or compartment and including sources of electricity and the mechanisms.

534,662. ELECTRIC RAILWAY SYSTEM; H. A. F. Petersen, Milwaukee, Wis. App. filed Nov. 8, 1893. An underground conduit for electric railway conductors comprising a suitable casing divided into a plurality of longitudinal passages or compartments,one of which is arranged to communicate at intervals with a sewer, and provided in its upper wall with a longitudinal slot and another of said passages being arranged to contain the conductors and provided with a longitudinal opening, a suitable cover arranged to normally close said opening, blower mechanism arranged to discharge into the passage, containing the conductors, an electric motor for actuating said blower, a switch for controlling the motor, and a suitable device, sensitive to moisture and adapted to operate the switch to stop or start the motor automatically.

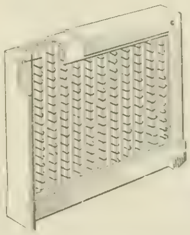
534,663. UNDERGROUND CONDUIT FOR ELECTRIC RAILWAYS; H. A. F. Petersen, Milwaukee, Wis. App. filed March 26, 1894. A conduit arranged to extend longitudinally adjacent to one of the track rails and located wholly beneath the surface of the ground and wholly outside of the line of track, said conduit being divided into two longitudinal compartments, one of which is provided in its upper wall with a longitudinal slot for the admission of a carrier, and the other compartment being arranged to contain the electric conductors and communicating with the first mentioned compartment by means of a longitudinal opening and a vertical and lateral adjustable contact carrier adapted to normally extend outside of the line of the car, and through the longitudinal slot in the upper wall of the first compartment containing the conductors and provided with contact devices for engagement with said conductors.

534,670. TELEGRAPH AND TELEPHONE SYSTEM; C. A. Rolfe, Chicago, Ill. App. filed Sept. 16, 1893. The combination of a main line, a neutral line, means for connecting the two lines at one or more substations and telephones or the like at the main station arranged for connection respectively with the right and left of the lines.

534,671. FIRE ALARM TELEGRAPH SYSTEM; C. A. Rolfe, Chicago, Ill. App. filed April 10, 1894. In a signal-transmitting system, a signal mechanism having a suitable releasing device, a local battery and a normally closed auxiliary circuit including said battery and releasing device, and a local house alarm and a magneto-generator, both likewise included in said normally closed circuit, and a make and break device operated by the signal transmitting mechanism and arranged for making and breaking the auxiliary circuit when the signal transmitting mechanism is operated, the said releasing device being operated, the signal transmitting mechanism by an impulse from the magneto-generator sent over the circuit and supplemental to the local battery current, and the said local or house alarm being sounded by reason of the operation of the signal mechanism, and also by reason of a break in the local circuit from any other cause.

534,677. ELECTRIC ARC LAMP; H. O. Swoboda, New York, N. Y. App. filed April 6, 1894. In an arc lamp, the combination of a magnet for controlling the carbon support of the said lamp, windings or coils for energizing the magnet and a movable piece consisting of an armature independent from and actuated by the pole piece or pieces of the carbon support controlling magnet to make or break the circuits of said one of said windings or coils.

534,678. ELECTRIC CURRENT TRANSFORMER.; J. A. G. Trudeau, Ottawa Can. App. filed April 6, 1894. A combination of a cylinder or drum provided with bars having their ends extending past each other, two groups of contact brushes, and a conductor connecting brushes, the two groups being arranged in such relation to the two drums and to each other that two of the brushes of one group shall bear upon one bar and two of the brushes of the other group shall bear upon another bar all at the same time.



NO. 534,699. ELECTRIC RESISTANCE CARD.

534,699. ELECTRIC RESISTANCE CARD; Alton J. Shaw, Muskegon, Mich. App filed Dec. 1, 1894. A resistance card, block, or section, comprising an open frame a separate cap or bar applied to said frame and forming one wall thereof, and a conductor mounted within said frame and held in place by the detachable cap or bar.

534,729. COMMUTATOR; D. P. Thomson, Schenectady, N. Y. App. filed Dec 17, 1894. A commutator segment for a dynamo-electric machine having a cut in its upper surface not extending to the end of the segment, and adapted to receive the lead or conductor.

534,731. METHOD OF AND MEANS FOR PREVENTING MAGNETIC LEAKAGE; E. Thomson, Swampscott, Mass. App. filed Feb. 6, 1893. A device for preventing magnetic leakage between the coils of an alternating electric current apparatus, consisting of an endless conductor placed out of the normal primary field but adapted to be cut by the lines of force when deflected from their normal position.

534,752. CONNECTOR FOR ELECTRIC CONDUCTORS; R. D. Titcomb, Schenectady, N. Y. App. filed [illegible] 23, 189[illegible]. A connector or coupling for electric [illegible] composed of two interchangeable parts, each having a tubular body [illegible] registering with a recess upon the other part, a [illegible] upon one part being cut away to permit the insertion of the corresponding pin upon the other part.

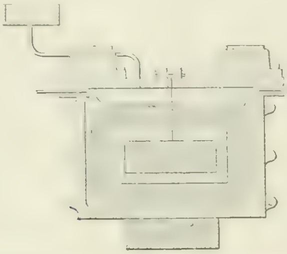
[illegible] CONCENTRATOR AND AMALGAMATOR FOR PRECIOUS METALS; H. Baudouin and J. Southern, of Grass Valley, Cal. App. filed June 14, 1894. An apparatus for working [illegible] containing valuable precious metals, consisting of a pan having an inclined bottom with annular overflow quicksilver channels and copper plates disposed with relation thereto, so that the pulp flows over and against them, and means for producing an electric current through said plates, a discharge gate at the lower periphery of the pan, a sieve or screen extending over the top of the pan, a central hopper from which material is delivered to pass over said screen, and a discharge opening and gate in line with the surface of the screen whereby the finer material is separated by the oscillations of the pan to pass through the screen and the coarser material is discharged through the gate above the screen.

534,779. SIGNALING SYSTEM; C. H. Brace, Union City, Mich. App. filed Nov. 27, 1894. A system having a series of movable signal characters for conveying intelligence and a series of stops respectively registering with such characters and a detent, operated by an electro-magnet adapted to engage any one of the stops at the receiving station, of means at the sending station in the circuit of the said electromagnet, comprising a circuit closer consisting of a triangular movable electrical conductor, the movement thereof practically isochronal with the movement of the signal characters in combination with a stationary contact point adapted to contact the moving conductor and close the circuit and then open the same.

534,785. METHOD AND APPARATUS FOR INSULATING ELECTRICAL CONDUCTORS; L. W. Downes, Providence, R. I. App. filed Aug. 22, 1894. The process of manufacturing insulated electrical conductors, which process consists in coating a wire with adhesive substance, wrapping it with fibrous asbestos, brushing the fibrous coating to raise the nap, compressing it between pressure rolls, coating with waterproof material, and subjecting it to a final rolling to produce a smooth finished surface.

534,786. APPARATUS FOR MANUFACTURE OF INSULATED ELECTRICAL CONDUCTORS; L. W. Downes, Providence, R. I. App. filed Dec. 11, 1894. The combination with a rotating disc mounted upon a hollow shaft through which the covered wire is fed, of a carding-wheel for operating upon the covered wire, mounted upon and rotating with said disc a short shaft passing through the disc carrying at one side of the latter a pinion on the carding wheel, whereby the latter is revolved as it is rotated about and in contact with the circumference of the covered wire.

534,802. ELECTRIC METAL WORKING APPARATUS; Hermann Lemp, Lynn, Mass. App. filed Dec. 3, 1892. The combination in a converter of a primary having a number of turns and a secondary consisting of a sealed metal tube enveloping the primary coil and containing oil.



No. 534,802.—Electric Metal Working Apparatus.

534,815. ELECTRIC SLOT FOR SIGNALS; J. P. Coleman, Swissvale, Penn. App. filed Sept. 27, 1893. In an electric slot or signals, the combination of a movable slide connected to the signal, a pivotally mounted arm adapted to engage the slide, a pivotally mounted block provided with an extension adapted to push the arm toward the slide, a signal operating lever connected to the block and an electro-magnet for holding the arm in engagement with the slide.

534,826. SIGNAL; E. H. Goodman, Pittsburgh, Pa. App. filed Oct. 25, 1894. The combination of a movable signal blade, two series of electric lamps mounted on the movable blade and having different colored globes, said series being arranged in independent circuits, and means operative on a change in position of the signal for closing one circuit and opening the other circuit.

534,834. BATTERY SYSTEM FOR ELECTRIC RAILWAYS; E. Julien, Brussels, Belg. App. filed Dec. 9, 1886. In combination with a charging table and a number of drawers or boxes of accumulators thereon, terminals on the said drawers or boxes connected with the accumulators and contact plates on the table having each independent connection with a charging circuit, under control of a suitable interrupter or switch, whereby any battery can be withdrawn from the charging circuit without affecting the others.

534,851. DRIVING MECHANISM FOR DYNAMOS LOCATED ON RAILWAY CARS; W. L. Bliss, Brooklyn, N. Y. App. filed Aug. 17, 1894. In combination a car truck, a friction wheel thereon, a dynamo mounted on the car truck, a dynamo shaft mounted to rotate in suitable bearings, spur wheels on the dynamo shaft, a yoke having a swinging movement on the bearings, as a pivot, said yoke carrying a countershaft having spur wheels engaging with the spur wheels on the dynamo shaft, a friction wheel on said countershaft engaging the friction wheel on the car axle and springs engaging the yoke for holding the friction wheels snugly together as the truck and car approach and recede from each other.

534,852. ELECTRIC ARC LAMP; J. Brockie, Forest Hill, Eng. App. filed Nov. 13, 1894. An electric lamp with a carbon rod provided with a rack of a feed wheel for actuating the same, said feed wheel being provided with a spiral rim and operating to rotate a pinion gearing with said rack, a lever provided with a projection adapted to engage said spiral rim and an armature connected to said lever and operating to throw said projection into and out of engagement with said rim.

534,908. ELECTRIC SIGNALING APPARATUS; B. J. Noyes, Boston, Mass. App. filed July 5, 1892. The combination with a message-recording instrument located at a main station and one or more signal transmitters located at substations adapted to transmit two different classes of signals one of which includes a prolonged change in the condition of the circuit and an electric signaling circuit connecting them, of a bell or other indicating device also located at said main station having a striking lever, a toothed wheel to actuate it, driven by a normally wound train and an electric magnet affected by said prolonged change in the condition of the circuit which controls the operative connection of the circuit between said toothed wheel and striking lever.

534,953. DYNAMO-ELECTRIC MACHINE; R. Eickemeyer, Yonkers, N. Y. App filed June 7, 1888. A combination of a set of counterpart coils annularly arranged, electrically connected together, and directly connected to a limited number of commutator bars, and other commutator bars which are electrically connected in groups to those bars, with which said coils are directly connected.

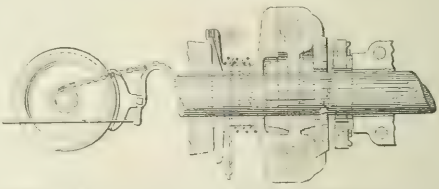
534,956. ELECTRIC TROLLEY RAILWAY; J. M. Hammill, Aldan, Pa. App. filed Jan. 23, 1894. A combination of a slotted conduit and a conductor located therein, a shield interposed between slot and the conductor, a trolley wheel having flanges and trolley arm bent around shield, and having throughout an external insulating coating or covering and an outer casing surrounding that portion of the insulated trolley arm which passes through the slot of the conduit.

534,970. TELEGRAPH AND TELEPHONE SYSTEM; C. A. Rolfe, Chicago, Ill. App. filed Feb. 15, 1893. The combination of the main signal line having branches, the neutral line, the main or central office telephone and a switch comprising contact points arranged in pairs and connected up with said telephone, a couple of contact points connected with the right of the neutral line and one branch of the main line, and the other branch of the main line with a series of levers to establish connection between points.

534,971. INCANDESCENT LIGHT; Henry F. Rooney, Randolph, Mass. App. filed Nov. 17, 1894. A combination of a central reflector, pear-shaped, provided with longitudinal parallel grooves made V-shaped and extending throughout the length of the main portion and each line of the filaments is set opposite the groove and follows it longitudinally for its entire length, said lines of filament being set at a suitable distance from the corner of centre of the grooves to provide two reflectors.

534,974. ELECTRIC BRAKE; Elmer A. Sperry, Cleveland, O. App. filed Jan. 30, 1894. In a brake for a car, a rotating axle, a portion upon such axle presenting a surface organized to be gripped, a stationary gripping mechanism for such rotating portion having a co operating surface, a groove in one of the surfaces, and a solid lubricant in said groove.

534,975. APPARATUS FOR ARRESTING MOTION OF ELECTRICALLY PROPELLED MECHANISM; E. A. Sperry, Cleveland, Ohio. App. filed Feb. 5, 1894. A combination with an electric motor, of a rheostat or variable resistance, means for cutting off all communication between the motor and the source of electric supply and suitable means other than the motor or its parts for maintaining the direction of the current through the field magnets the same when the motor is used as a generator as when used as a motor, and for directing the current so generated through the said rheostat, a local circuit and a brake magnet coil for said local circuit.



No. 534,975.—Apparatus for Arresting Motion of Electrically Propelled Mechanism.

534,977. ELECTRIC BRAKE; E. A. Sperry, Cleveland, O. App. filed June 8, 1894. A brake for revolving machinery presenting a wearing face upon one side, means for the support of the brake magnet independent of the revolving element, abutments from the other side of the magnet approaching the revolving part, means mounted upon the revolving part for guiding the magnet and a wearing plate or portion between the guide and the abutments.

534,986. CONDUIT ELECTRIC RAILWAY; M. F. Flynn, Stamford, Conn. App. filed May 24, 1894. In an electric railway, the combination with the closed conduit and the line wire therein of the trolley rail on the conduit having contact surfaces above the line wire, tilting levers arranged below the line wire and adapted to carry the wire upward against the contact screws, and an operating mechanism extending from the levers up through the conduit in the path of the trolley for actuating the levers by the movement of a passing trolley.

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DAY LOAD IN CENTRAL STATIONS.

The paper recently read by Mr. H. Ward Leonard before the American Institute of Electrical Engineers, and abstracted in our last issue, brings out very strongly the great importance of the load factor in central station, and offers some very striking comparisons as to its effect. It is pointed out that the very small load factor in European stations is what has rendered the employment of the storage battery so profitable there, and while the conclusion of Mr. Leonard that in our large cities the load factor is much larger than abroad is correct, yet it should be remembered that not many of our 2,400 central stations come in this category, the conditions in all but a very few being such as to promise a large gain in economy from the use of storage batteries. That central stations can make a rate of 4 cents per kilowatt for a day load with a resulting profit, as asserted by Mr. Leonard, seems to us problematical under present conditions as to investment and cost of operation. It is already the custom in this country to make a much smaller charge for day motor loads, but the lowest price charged that we know of is more than 10 cents per kilowatt hour, and it is a long distance from this to 4 cents. Should, however, it be possible to furnish power at the rate named, there would seem to be little difficulty in attaining the necessary load, as the price would be equivalent to less than $100 per yearly horse power, which is cheaper than steam power can be generated in a city in quantities of less than 15 or 20 horse power, exclusive of the value of the space occupied by the plant. It may be added that such a case would represent the anomaly of a quarter or less of the output paying almost the entire fixed charges of the remainder, or, in other words, making up for the loss at which the latter is sold.

ACETYLENE GAS.

The newspapers have taken up the subject of acetylene gas, and, as was to be expected, are making it a subject of sensationalism, the public being informed that it can be produced so cheaply that ordinary gas and electricity will probably be displaced. Much stress is laid upon the advantages possessed by reason of the portability of the carbide from which it is formed, and it is stated that houses can consequently be supplied with the gas in cylinders, and that the carbide will be sold in sticks for use in lamps. It is well to understand, however, that the claim for cheapness has not yet by any means been satisfactorily demonstrated. The price of $12 per ton for the carbide, which is that usually quoted, rests upon a cost of electrical energy of only $5 per yearly horse power, and in estimating the price of the gas to the consumer, no proper allowance is made for the cost of distribution and fixed charges. If we were to estimate, for example, the cost of the electric light on the same basis, a figure would be arrived at that would place gas at $1 per thousand totally out of competition. The price named for electrical energy at Niagara is $18 per yearly horse power at the generator terminals, which would probably bring the cost not far from $25 at a reducing furnace, this figure taking account of losses in transmission and transformation, charges on investment, etc. On the basis of $25 per annual horse power for electrical energy, a writer in the *Journal* of the Franklin Institute estimates that the cost of acetylene gas would be $3.70 per thousand, and assuming that its illuminating power is ten times greater than that of ordinary gas, as claimed, this would be equivalent to 37 cents per thousand as compared with the latter. This, however, would be merely the cost of manufacture, which is quite different from the final cost as delivered to the consumer. We are informed that in Philadelphia the city purchases gas from private works for 35 cents per thousand, and therefore the new gas would seem to be more expensive than ordinary gas even on the basis of an estimate which apparently neglects several factors in the total cost of production.

ELECTRICITY DIRECT FROM FUEL.

We print elsewhere the reply of Dr. Borchers to criticisms on his gas battery, with rejoinders by two of his former critics. From these latest contributions to the subject it will be seen that the matter of generating electricity direct from fuel with the absence of heat is yet far from being demonstrated a practical possibility, and we trust that the further results which Dr. Borchers has promised to communicate will have a more certain basis. As pointed out by the London *Electrician* and by Mr. C. J. Reed, it is idle in a matter like the one at issue, where there is a possibility of the existence of many complicated actions, to rely upon qualitative observations or to neglect investigation of any of the factors that may possibly affect the result. Nor will a demonstration be sufficient in which any of the necessary points depend for their proof merely upon the indications of chemical equations, for Mr. Barnes shows how unsafe this method has been in the present instance. While such equations are valuable for representing known relations, and may give useful indications as to possible reactions, the discussion of the Borchers battery shows what was already known, that they cannot be applied with any degree of certainty when entering a new field of investigation. We commend to our readers the statement by Mr. Reed of the problem implied in the production of electricity direct from fuel, as we believe it to be not generally understood. It consists in the conversion of the energy of fuel into electrical energy without heat and without the destruction of chemical reagents or the formation of waste products. This, it will be recognized, is something entirely different from deriving electrical energy direct from heat, though the two cases are sometimes confused. In the former case the theoretical efficiency of conversion may be 100 per cent., but in the latter it is limited in the same manner as in the steam engine, and in fact the process would be classed under that of heat engines; that is to say, the theoretical efficiency of conversion would be the ratio of the difference of temperature involved in the process to the extreme absolute temperature. Under this latter head, for instance, come regenerative batteries like the Case battery, thermo-magnetic generators like that of Edison, and thermo electric piles.

THE DEMAND FOR ELECTRICAL ENGINEERS.

A writer in another column takes a somewhat pessimistic view of the profession of electrical engineering, which at least serves to show that it bears a likeness to all other professions in admitting of argument to prove that it is a field to be avoided. The overcrowding of professions has, we presume, been a theme for lamentation by members thereof ever since professions have existed. From the days of Athens to the present the overcrowding of the legal profession has disturbed its members, and about commencement time we yearly read the darkest forebodings as to the prospects of newly graduated doctors; yet law and medicine have always contained fair opportunities for the young man. While we agree that the popular fallacy as to the future of electricity has caused an abnormal flux of young men into the profession of electrical engineering, and that entirely too much stress has been placed upon the teaching of designing, yet we cannot believe that the present opportunities in the profession are as narrow as asserted. Moreover, the proportion of central stations and electric railways that will offer profitable employment to educated engineers will grow yearly as it becomes recognized that the present hap-hazard manner in which the majority of these are run does not pay—and there are over 2,400 of the former and 600 of the latter in this country. If any serious mistake has been made with respect to educating electrical engineers it has been rather as to the manner of education, which we think has been, as a rule, too narrow, thereby circumscribing the opportunities of graduates. A graduate of a technical course, which aims primarily to train the mind and teach broad principles, practical instruction being subordinated to these objects, may not so readily find minor positions immediately upon the completion of his studies, but the future is more certain for him than it is to one whose training has been industrial rather than educational. The more special the training of the latter, the more limited are his opportunities in the future, not only on account of the narrower range of employment available, but also from the lack of versatility incident to a system of education in which the mind is either not developed at all in its higher faculties or merely trained in one direction. The survey which Mr. Ford takes of the electrical field is an extremely limited one, for it does not include among other positions those in the executive department or business branches. While it may be true that most technical graduates at the present time would be handicapped in their aspirations for these positions by graduates of high schools or of college classical courses, we see no reason why a technical education should have this tendency. If the principle were recognized that breadth of view and flexibility of intellect are not incompatible with technical skill, the opportunities of graduates would be vastly extended, and with no sacrifice except in detail knowledge, which can be much better acquired in actual work than in college kindergartens.

London Electric Lighting Companies.

The London *Electrician* gives a flattering account of the leading low tension electric lighting companies in London. Taking the companies in the order of their capital expenditures, it finds the Westminster Electric Supply Corporation at the head of the list, with a capital expenditure of some £411,000 and an output of some 2,173,000 units, this well-managed concern actually decreasing its expenses in face of a 27 per cent. increase in its output. The St. James and Pall Mall Electric Light Company has now a capital expenditure of some £227,000 and an output of 1,570,000 units. The legal expenses of this company gave rise to some grumbling at the annual general meeting, and it is not perhaps altogether cheering to learn that more "nuisance" litigation is pending; such misfortunes can, however, be accepted with some equanimity in face of a 6½ per cent. dividend, and may be considered as disagreeable incidents in a not altogether unpleasant campaign. The Charing Cross and Strand Electricity Supply Corporation comes next, with a capital expenditure of some £212,000 and an estimated output of some 950,000 units. The Kensington & Knightsbridge Electric Lighting Company, which has not, by the way, overcome its early coyness in the matter of presenting accounts to the shareholders in Board of Trade form, follows next with a capital expenditure of something like £187,000 and an output of about 978,000 units. This concern has succeeded in augmenting its income by 33 per cent., with an increased expenditure of only 20 per cent. Lastly, we come to the Chelsea Electricity Supply Company, with its capital expenditure of £120,000 and its output of 469,000 units, and which has managed to bring down its sheer cost of production by one-third of a penny. All these companies, therefore, tell the same tale of increased output and decrease in the ratio of working expenses to revenue. All of them are paying satisfactory dividends, the same as last year in some cases, more than last year in others.

A Brilliant Discovery.

An electrical contemporary informs its readers that according to the recent Bate Refrigerating decision, the Edison lamp patent expired on May 10, 1894, and, therefore, "This decision will also have the effect of throwing out of court those cases for infringement of the lamp patent brought by the General Electric Company since the date of May 10, 1894, and doubtless affect other litigation of the same character!"

Rudolf Eickemeyer.

BY CHAS. PROTEUS STEINMETZ.

Since I had the honor to be very well acquainted with the late Mr. Rudolf Eickemeyer, who died in Washington, Jan. 28, on his way to the South, and was associated with him for many years, a few notes on his long and useful life may be of interest.

Mr. Eickemeyer was the most intelligent of all the men I ever met. He was well versed not only in his particular lines of work, but in all branches of exact science and art, and was able to discuss intelligently problems of electric and mechanical engineering, as well as political economy or literature, music and art, biological or physiological problems, and had also done original work in many directions.

Mr. Rudolf Eickemeyer was born Oct. 18, 1831, in Bavaria, where his father was governmental forestry officer. He attended the Realschule of Kaiserslautern and afterward the Polytechnic Institute at Darmstadt. At the outbreak of the revolution of 1848 he, with his friend, and later partner, George Osterheld, joined the insurgents, as all the boys of his generation did. Thus he participated in the campaign in South Germany and was present at the siege of the Bavarian fortresses of Landau and Kaiserslautern. Of this period of his life he often told the most interesting and amusing incidents in later years. The arrival of the Prussian army scattered the heretofore victorious rebels, and although a large majority of them were amnestied, it very soon became evident to them that Germany of that time, as later and before, had no use for talents which did not renounce their political opinions in blind obedience to their rulers. Thus sooner or later most of the participants in the rebellion came to America, and in 1850 Rudolf Eickemeyer, with his friend, George Osterheld, left Germany and embarked for this country, arriving in New York in November.

RUDOLF EICKEMEYER.

However, America at that time was not the industrial country that it is now, but was still very largely dependent in this respect upon Europe, especially England, and, therefore, offered small opportunities to technically educated men. Mr. Eickemeyer worked on the building of the Erie Railway, and later found employment in the Buffalo Steam Engine Works, but a strike there caused him to leave and return to New York, and in 1854 he established a small repair shop in Yonkers.

Since the hat manufacture was Yonkers' foremost industry at that time, he frequently had occasion to repair hat machinery, and thus came to see the defects of the machinery. He was thus led to make improvements, and invented new and better machinery for which he took out patents. In this way a new industry, the building of hat machinery, originated in Yonkers, and for a long time the Eickemeyer Company practically monopolized the hat machine industry, and is still the leading concern, its export trade, especially with England, being very large. Besides hat machinery different agricultural machines, including an improved mowing machine, were invented and manufactured by Mr. Eickemeyer, and companies licensed by him. Upon the outbreak of the war of secession Mr. Eickemeyer turned his works into an arms factory and manufactured revolvers in large quantities.

As soon as Mr. Eickemeyer had settled down in Yonkers he renewed his interest in the progress of scientific thought, and closely followed all publications and investigations in the sundry branches of exact science. Thus, when in the seventies the science of electricity came in the foreground, he did considerable experimental work, took out patents on telephones, etc. He was, however, entirely original in his work, and never followed in the beaten track of other investigators, but first found for himself by reasoning or experiment the solution of the problem which interested him, and then compared it with what others had done.

His first experiments in electrical machinery were on unipolar machines. They brought no direct return, but offered a splendid occasion to fully grasp the problems of the electromagnetic circuit, very little understood at that time. The first commercial application he made in the invention of the iron-clad dynamo now generally known from its use as a motor in all first-class electric elevators.

Since 1884 the old factory had been largely turned into an electric laboratory and work shop, and numerous electrical machines built, such as train-lighting dynamos—where the iron-clad form offered special protection against the carbon and iron dust always present with running railway trains, railway motors, elevator motors, lighting and railway generators, etc. The first two railway motors were operated in 1888, on a branch of the Steinway road in Long Island City. In 1889 the first direct coupled railway motor was finished. Later the electric railways of Lynchburg, Toledo, Yonkers and the Steinway road in Long Island City were fitted out with Eickemeyer motors directly coupled to both axles by parallel rods. However, the limited facilities of the old factory and the rapidly increasing demand for elevator motors made it impossible to follow the demand of any other kind of machinery sufficiently to gain an appropriate share of the market. Thus transactions with the General Electric Company led, in 1892, to a consolidation of the interests. A large factory exclusively for the production of elevator motors had in the meantime been built by Eickemeyer and Otis Brothers, the well-known elevator manufacturers in Yonkers, and put in operation, and the demand for hat machinery, in which the orders were many years behind, induced Mr. Eiickemeyer in the last years to use the old factory again mostly for the production of this class of work, without, however, entirely giving up experimental electrical work.

A number of scientific investigations on hysteresis, high potential phenomena, etc., have been made in the Eickemeyer laboratory with Mr. Eickemeyer's personal co-operation, and are recorded in the Transactions of the American Institute of Electrical Engineers. Mr. Eickemeyer was probably the first to understand the importance of testing the iron used in electrical machinery for permeability as well as hysteresis, and special instruments were invented by him for this purpose. Considerable experimental work on alternating current machinery, especially with single-phase motors, was carried out in the Eickemeyer laboratory, but had not left the experimental stage when the consolidation with the General Electric Company's interests was made; the results, however, were utilized in connection with work done contemporaneously at Lynn, and since that time have led to what is now the modern alternating current practice.

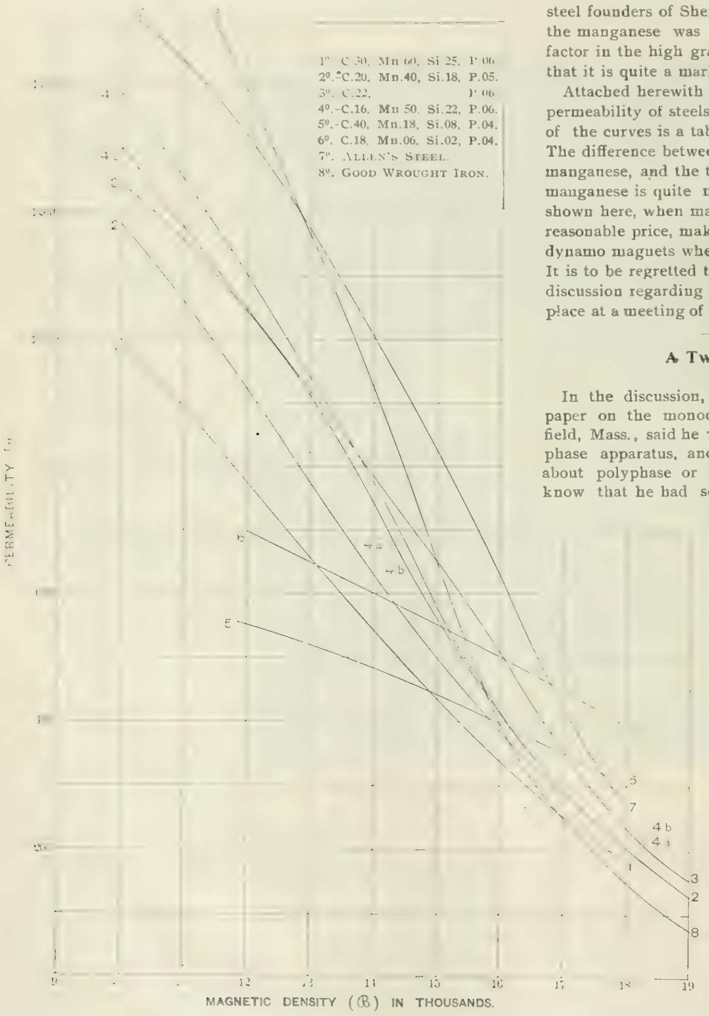
Several years ago Mr. Eickemeyer suffered from a severe attack of the grippe and never completely recovered, being obliged to spend the winter in the South. As the result of his sojourn in the South two years ago he published "Letters from the Southwest," as a manuscript for his friends, sketching in the most interesting and entertaining manner the habits and customs of the people of the Southwest States.

It was while on the way to the South that business delayed Mr. Eickemeyer in Washington until it was too late. America thereby lost one of its foremost inventors and engineers.

The Permeability of Mild Steel.

BY DUGALD C. JACKSON.

I note in your issue of Feb. 2 that Mr. Wiener includes in his very complete series of articles on the design of dynamos some data relating to steel castings. I wish to call your attention to certain facts in relation to steel castings which apparently Mr. Wiener does not bring out. On page 54 of my "Text Book on the Construction of Dynamos" will be found the following statement in regard to the effect of impurities upon the magnetic quality of mild steels.



Permeability Curves.

"1. The permeability depends inversely upon the amount of carbon present.

"2. The permeability depends inversely upon the amount of manganese present when it much exceeds .15 per cent."

These statements in regard to the effect of carbon and manganese and those in regard to other impurities which follow on the page were enunciated after a careful study had been made of various test pieces tested by myself, and of the reports on magnetic testing made by Hopkinson, Ewing, Henrard and others. Since early in 1893, when the paragraphs which I have just quoted were written, I have made various additional tests of mild steels, and have added to my collection of data the results of many tests made by others.

Taking the results as they come, there seems to be quite conclusive proof that manganese in as large a percentage as .60 per cent. has a marked injurious effect upon the magnetic quality of steel castings. The highest magnetic tests of mild steel castings of which I have any record are given by Henrard in "La Lumière Electrique," Vol. 33, and by Ewing in a circular issued by Edgar Allen & Co., steel founders of Sheffield, England. In the latter sample especially the manganese was exceedingly low, and while that is only one factor in the high grade of this particular steel, I have little doubt that it is quite a marked factor.

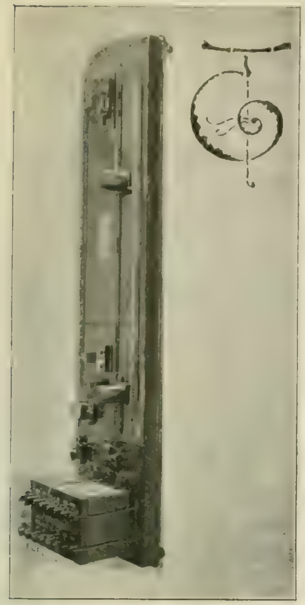
Attached herewith is a series of half a dozen curves showing the permeability of steels made by different manufacturers. Alongside of the curves is a table showing the composition of the samples. The difference between the steels carrying .40 per cent. or more of manganese, and the three samples carrying a very small amount of manganese is quite marked. Any of the steels whose curves are shown here, when made into solid castings of uniform quality and of reasonable price, make much the best material for ordinary forms of dynamo magnets when it is desirable to use large magnetic densities. It is to be regretted that the steel founders were not drawn into the discussion regarding materials for dynamo frames which lately took place at a meeting of the American Institute of Electrical Engineers.

A Two-Phased Alternating Plant.

In the discussion, at the Cleveland Convention, of Dr. Bell's paper on the monocyclic system, Mr. W. R. Gardener, of Pittsfield, Mass., said he was much interested in the question of multiphase apparatus, and while he did not pretend to know anything about polyphase or multiphase systems, or of teasers, he did know that he had something in his station that gave perfect satisfaction, and fulfilled his requirements as a central station man—a two-phase machine which had been in operation for over a year and a half. The first work required of the two-phase machine was to supply a 15-hp motor a mile and a half from the station over an existing circuit. An extra wire was run, and from that circuit there were also furnished incandescent lights to stores and dwellings. Later on a fire occurred in a mill, destroying its engine, and two motors of 20-hp each were installed there upon this circuit, giving perfect satisfaction. The business increased so as to necessitate putting in a larger machine, and to-day power, incandescent and arc lights are furnished from this one machine. The station has five alternating current machines, of from 750 to 1,500 lights capacity, as good to-day as when they were bought, but two-phase machines will be substituted for them. The item of repairs on ordinary apparatus is enormous, while with these two-phase machines, including the transformers and motors, not one cent has been spent. The five machines referred to will be displaced by one two-phase machine, and instead of dynamo attendants bobbing from one end of the switchboard to the other and reading five ammeters and voltmeters, they will then have to read but one. No difficulty has been experienced on the two-phase lines in operating motors and lamps simultaneously on the same circuit, even with one side carrying a considerably larger load than the other.

The Glasgow and West of Scotland Technical College.

BY ANDREW PINKERTON.



THIS famous Technical College was created in 1886 by the amalgamation of three previously rival institutions, Anderson College, College of Science and Arts, and Allan Glen Institution, and by the inclusion of the Atkinson Institution. Anderson College, the first technical college, started with the appointment of Dr. Garnett to the chair of natural philosophy and chemistry in 1796. Anderson College also embraced a medical school, beginning with the appointment of Dr. Burns to the chair of surgery and anatomy in 1800. On the creation of the Technical College, the medical school was organized as a separate institution.

In 1823 the members of the mechanics' class of Anderson College started a separate institution, the Mechanics' Institution, with Dr. Birkbeck, a previous Anderson College professor, as honorary patron. Three days later the formation of the London Mechanics' Institution was decided on, with Dr. Birkbeck as president.*

The Atkinson Institution never reached practical work, the funds being left to grow, and are now used to provide bursaries in the Technical College.

The Allan Glen Institution started in 1853 to provide free elementary education. On the school boards dealing with this question, the trustees obtained enlarged powers, and in 1878 the institution was reopened as a secondary and technical school, with well equipped laboratory, workshop, and class rooms, and soon became the best example of a technical school in Great Britain.

ALLAN GLEN INSTITUTION.

The Technical College, as now constituted, is under the direction of a very representative Board of Governors, 30 in number, and the work is carried on by a staff of 10 professors, 19 lecturers, 5 extension lecturers, 12 teachers in the industrial art department, and 17 chief assistants. Besides these there is the separate staff in Allan Glen Institution, under headmaster John G. Kerr, M. A. Pupils enter Allan Glen Institution at about 10 years of age, after undergoing an entrance examination. As they go forward in the classes they get, besides a sound general education, instruction in chemistry, electricity, mathematics, mechanics and other engineering subjects, accompanied by practical work in the chemical and physical laboratories and workshops. These are well equipped, the workshop containing 12 turning lathes, a drilling machine, forge, etc., and having provision for moulding and casting from the patterns made. Pupils in the highest class usually specialize for chemistry, engineering or art. There are numerous bursaries and scholarships to assist pupils in the institution, and three bursaries open to pupils going on to a university, or day technical college, or school. The Technical College proper may be divided into day and evening courses. Both courses have departments in mechanical engineering, naval architecture, electrical engineering, architecture, metallurgy, chemistry, agriculture, mathematics and physics. The day course has also departments in civil engineering, chemical engineering and mining engineering, while the evening course has departments in building construction, mining, chemical industries, textile industries, art industries and commerce. The diploma of the college is granted to day students in the various departments who complete the course, usually lasting three years, and pass the requisite examinations. The certificate of the college is granted to evening students who complete the course, usually lasting four years, and pass the prescribed examinations. In electrical engineering the course of study embraces higher mathematics, higher physics, higher dynamics, natural philosophy, mechanical engineering, chemistry, and electricity, accompanied with a great amount of practical training in the workshops and laboratories. The student for the diploma has to pass an entrance examination in general education, and a science or diploma examination at the end of each year. The assessor in the final examination is Lord

ELEC. WORLD N.Y.

PROF. ANDREW JAMIESON.

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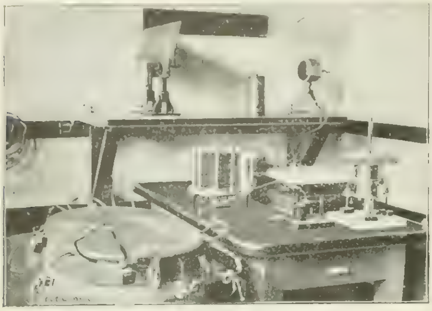
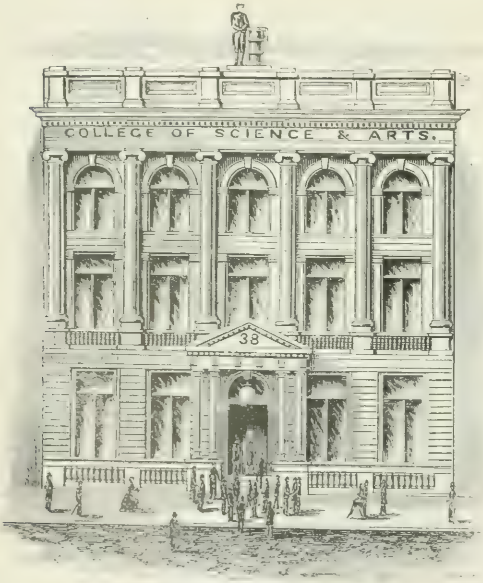
* The Glasgow Mechanics' Institution changed its name in 1881 to The College of Science and Arts, and remained so till the creation of the Technical College.

Kelvin (Sir William Thomson). The college is amply fitted for practical and laboratory work. There are wood-working and metal working shops well supplied with machine tools, and all work is done to scale drawings. There is also a shop for plumber work practice. The physical laboratory has an engine, dynamos, storage cells, optical bench, polariscopes, etc., and accommodates 30 students. The chemical laboratory for general chemistry consists of a general laboratory, advanced laboratory, gasometric analysis laboratory, special laboratory for combustion analysis, furnace work, etc., and a laboratory for spectrum analysis, etc. It is situated in Anderson College, and is what made the college most famous.



Cable Testing Apparatus.

The "Technical Chemical Laboratory" is for the study of chemistry as applied in commerce specially. It consists of a large separate building, containing general and smaller laboratories, gas analysis and balance rooms, museum and lecture room, and special provision is made for private work by inventors, etc., with or without the professor's assistance. Students are expected and encouraged to make original research. Courses of lectures are delivered on such subjects as destructive distillation, dyeing processes, etc. It is also equipped with a special laboratory for photography. The metallurgical laboratory is fitted with assaying laboratory, furnace room with wind furnaces, coke and gas muffles, etc. There is a general drawing office, and a prime movers' drawing office and laboratory. The latter is fitted for steam and gas engine experimenting and testing, and with apparatus for steam generation experiments, etc. In the drawing office senior students take up some special form of motor, and receive special instruction in the practical design and calculations regarding it.



College of Science and Arts.

The electrical engineering laboratory is the one of most interest to readers, and it is the best equipped in the college. It consists of four rooms, and has a steam engine specially designed by the professor for accumulator charging and experimental work. There are four dynamos, accumulators, ammeters, voltmeters, galvanometers of all kinds, transformers, Wheatstone bridges and testing sets, and provision for making all kinds of tests and experiments. Some of the apparatus merits special attention, having been used by Lord Kelvin and Prof. Fleeming Jenkin on Atlantic, Brazilian and other cable expeditions. One special piece of apparatus is a splendid low resistance bridge (shown in initial cut), presented to the college last year by Messrs. Siemens Bros. & Co., London, in recognition of good work done by the students in testing their new type "Obach" dry cell. A great number of the instruments used are made by the students in the laboratory workshop. The laboratory owes much of its success to its untiring head, Prof. Andrew Jamieson, who is widely known in the electrical world. He has spared no exertion to secure its success, to increase its equipment and to promote to the utmost the interests of his students, who are now to be found in all parts of the world.

Jointing.

What is called the extension scheme consists of instruction given outside the college by teachers in connection with it. The subjects taken up are plumbing, agriculture and fisheries. In connection with agriculture lectures are given under the auspices of the various local boards on agriculture and chemistry, as well as practical instruction in butter making and experiments carried on in fertilizing, crop raising, etc.

Anderson College, with Young Laboratory Building to the Left.

The department of industrial arts is one not met with in many technical colleges. It comprises courses in house painting and decorating, ornamental metal work, lithographic drawing and design, modeling, cabinet making and furniture work.

The Weaving College is the outcome of a previous unsuccessful endeavor to found a technical college. Failing the whole scheme, this part was started, right in the heart of the weaving district, and has already proved a great success. It contains 26 power and 20 hand looms fitted for all kinds of work, and lecture appliances to explain the intricacies of weaving.

Among the past professors the occupants of the chemical chair in Anderson College are perhaps best known, and include Dr. Birkbeck, Dr. Ure (author of "Dictionary of Arts and Manufactures,") Thomas Graham, Dr. Penny, Dr. Thorpe (now principal of Somerset House Laboratory), and Dr. Dittmar; among others may be mentioned Dr. Carey Foster (now Professor of Experimental Physics, University College, London), Prof. George Forbes, etc. Among famous students may be mentioned Dr. Livingstone, Lord Playfair, Dr. James Young (founder of the mineral oil trade in Scotland), etc. Among the present staff perhaps the most familiar names to electricians are Prof. Jamieson and Prof. Blyth, while the chairman, Sir John Neilson Cuthbertson, is one of the most progressive of Scotch educationalists.

SOME OF THE ELECTRICAL APPARATUS.

It is scarcely possible in the limits of this article to do more than glance at some of the departments of the college, but this may give an idea of the varied and important work carried on by this institution. Any reader desiring to know more of the history of the college will find full information in an admirable book, "The First Technical College," by Prof. Sexton.

An Unjust Patent Statute.

BY ELIHU THOMSON.

Now that decided attention has been called, by the decision of the Supreme Court of the United States, interpreting Revised Statute No. 4,887, to the relations existing between patents taken out in the United States and abroad, it occurs to me that it would be interesting to note at this time some of the disadvantages under which the American inventor has labored in the past, and under which he still labors, and not only in so far as it concerns the taking out of patents, but also in relation to the publication of new matter or to the inventor's place in the history of an art.

While the decision of the Supreme Court makes it plain that the wording of the law in relation to the limitation of United States patents by foreign patents is to be taken instead of what would seem to me to have been the evident intent of the original enactment, I wish to point out some of the injustices under which the American inventor has suffered from this law, as it has been and is now interpreted, in comparison with inventors and workers abroad.

An American inventor making application for a patent has been and will still remain under the disadvantage of being required to perfect his United States patent before applying for patents abroad, and in order to secure valid patents abroad he must refrain from publication of any new matter which he may have discovered until such foreign patents have been obtained, as the mere publication nullifies the right to take a patent in most important foreign countries. But it is practically impossible, as is well known, under our system of patent examinations, to control the time of issuance of a patent in the United States, and if the application should become involved in an interference, which is more than apt to occur with inventions of any considerable importance, the issuance of a patent may be tied up for an indefinite period of years. During this period there is every prospect of the same subject matter being worked upon abroad, or the matter becoming published, especially if the invention undergoes development in the United States. The inventor, therefore, if he desires foreign patent protection must take his foreign patents and stand the shortening of the term of the United States patent; or, if the interference proceedings or other delays last during the life of the shortest foreign patent, he receives a patent which has already expired when it issues, a "still-born" patent, so to speak.

Again, in the race between two interfering inventions the weaker party finding that he will probably lose the interference in the United States may easily transfer his scene of activity to foreign countries, while the stronger party, feeling that he does not wish to ruin his United States interest at the same time refrains from patenting abroad. In this case the party who is likely to come out ahead here does come out at the last without any foreign patents, while the other party to the interference may come out with several valid foreign patents but no United States patent.

Now, I do not think it requires any argument to show that the evident intention of the United States law when it was first passed was not to bring about this state of things and so handicap the honest American inventor. Nor is this all. The position of the foreign inventor, under the United States law, has been that he could make his applications in foreign countries whenever he felt like doing so and receive his patents, and, after an indefinite period thereafter, he was at liberty to apply for a United States patent and obtain a patent only limited by the shortest term foreign patent. Prior publication here would not affect his rights. Prior publication does affect the United States inventor's rights abroad. Does not this amount to a discrimination against the United States inventor? And would it not really tend, were there not other favorable influences, to discourage invention here?

But there is still another point which I consider of the greatest importance. Owing to the conditions under the law as it exists, the United States inventor, no matter what the importance of his work may be, is debarred from publishing it until the issuance of his United States patent, which may take a year or two in the Patent Office, unless he is ready to forego some of the years of its life by taking out foreign patents at once after his United States application has been filed. He is, therefore, under restraint as to publication if he wishes to protect his foreign rights at all. And, let us ask, what has been the effect of this condition of affairs? Has it not been that an undue proportion of the history of many new advances, especially in the electric art, has been first published abroad? Has it not been that publications of new material have often been made abroad when in fact the same subject matter had been worked out here, in some cases years before? Does it not result in the credit for new work or the making of history, as it were, in a new art, being accorded in larger measure to workers abroad than would otherwise be the case? Now, suppose that instead of this law having existed at all, inventors who had made valuable discoveries or inventions were at liberty to apply for their United States patents and were equally at liberty to apply for at once and obtain, without prejudice to their United States rights, foreign patents on the same inventions, then they might freely publish at once their work and obtain the credit for it to which they are entitled, and which under the present condition of affairs has often been taken from them on account of the enforced delay of waiting for the issuance of the United States patents before applying for foreign patents. I have known it to be the case, and I have not the slightest doubt that others actively at work in the electric field have had the same experience, that the first entrance into the electrical literature of some new and important advance has been through the foreign publications, when, in fact, the broad subject had been worked over and was known for a long time previously here, but was withheld on account of this unfortunate state of patent laws in this country.

The United States is entitled to take its proper place, not only in the actual work acccomplished, but in the literature which naturally accompanies the work, and without such a restraint as now exists. The question arises, how long is the United States worker to be so handicapped, or practically put under a ban, by ill-considered laws? This is a question which I have often asked myself, and the answer to which, I have no doubt, has been sought by many who have experienced the same hardships.

Power Transmission.

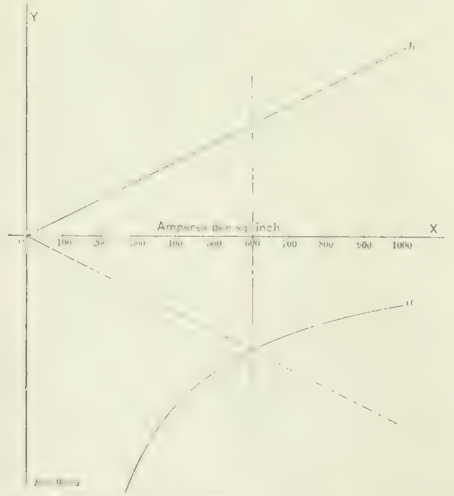
BY OSSIAN CHYTRÆUS.

For power transmission of some length the best present engineering is to convert the power into electrical energy and through proper conductors transmit it to the place for it to be utilized or distributed. It is clear that the transmitting of power has an economical limit in regard to the distance, since the interest, depreciation and attendance of the stations and the line at a certain distance from the generating station make the power cost more at this point than if it were produced there by steam.

One of the factors which determine this distance is the kind and size of conductor. To get this of the proper dimensions is thus an important problem for an economical power transmission. We know that increasing the cross sectional area of the conductor for the same current decreases the power lost in the conductor and *vice versa*. If we then know the cost of the power lost in the line and also the cost of the conductor and the cost of such items as are proportional to an increased cross sectional area of the conductor, we can, by calculation, get the most economical size of the conductor.

The cost of power lost in the line is, if the power source is greater than our need, dependent upon the cost of the power at the terminals of the generating station. If the power at the generating station is not sufficient so that power must be produced by steam at the receiving station, the cost is dependent upon the cost of the electrical power produced at the receiving station by steam. If the power is not sufficient, but we do not wish to make up for the further need at the receiving station, the value of the power lost is fixed by the profit on the power at the receiving station plus the cost of the power at the terminals of generating station.

The cost of the erected conductor is fixed by the price of the conductor and such items as are proportional to the weight, as the freight to the place of its erection, the cost of the pole line, the work of erecting the line, etc., etc. The cost of the ground over which the pole line is going and the fencing in of the line, etc., have on the other hand, nothing to do with an increase of the cross sectional area of the conductor.



RELATION BETWEEN POWER TRANSMITTED AND SIZE OF CONDUCTOR.

If we now, for a certain power transmission with a given E. M. F. for different current densities per square inch of cross sectional area of the conductor, figure the cost of the power lost in the line, the interest and depreciation on the cost of the copper and such items as are proportional to the increased conductor; then, for the current densities at which the sum of these is the smallest, the capital outlay is also the smallest for that power.

For this case let us assume that 1.000 kw are to be delivered 15 miles from a generating station at a voltage of 10,000. Further, let us assume that the yearly cost of an electrical kilowatt delivered to the line is $15, which includes buildings, the mechanical and electrical generating apparatus, step-up transformers and every item proportional to an increase of the installed capacity of the generating station.

Let us assume the cost of the copper for the line at the place of its erection to be 15 cents per pound, which includes such items as grow in proportion to an increased size of conductor. The interest and depreciation of the copper in the line we will assume to be 8 per cent. and the interest and depreciation of the generator station, etc., to be 10 per cent.

The values we get from the above data are represented in the accompanying diagram, where the ordinates of the curve *a-a* represent the interest and depreciation on the cost of the copper in the line, and the ordinates of the straight line x-b the cost of the power lost in line. The ordinates of x-b are proportional to the abscissæ when the ordinates of a-x are inversely proportional to the abscissæ. It is well known that they are least when they are equal, and this is, under the above conditins, at 605 amperes per square inch cross sectional area.

It can be seen from the diagram that the density per square inch of the cross sectional area of the conductor is independent of the power, the E. M. F. and the distance. This, however, may be made to appear more clear from the following explanation:

Call the power transmitted P watts, the E. M. F. E volts and the distance between stations K feet. Then the amperes in the line are $\frac{P}{E}$ and the cross sectional area of the conductor required for a density of X amperes per square inch is $\frac{P}{EX}$ square inch. The resistance of the line, if the resistance of one cubic inch of copper is a ohms, is:

$$\frac{X \times E \times K \times a \times 12 \times 2}{P} \text{ ohms.}$$

The watts lost in line are:

$$\frac{P^2}{E^2} \times \frac{X \times E \times K \times a \times 12 \times 2}{P}$$

which reduces to $\frac{X \times P \times K \times a \times 12 \times 2}{E}$ watts.

The value in dollars of these watts is, at b dollars per watt per annum,

$$\frac{X \times P \times K \times a \times b \times 12 \times 2}{E}.$$

The number of cubic inches of copper in line is, for X amperes per square inch,

$$\frac{P \times K \times 12 \times 2}{E \times X} \text{ cubic inches.}$$

The interest and depreciation in dollars on the cost of the copper in line are at c dollars per cubic inch,

$$\frac{P \times K \times c \times 12 \times 2}{E \times X}.$$

Then from the above, the most economical density is:

$$\frac{X \times P \times K \times a \times b \times 12 \times 2}{E} = \frac{P \times K \times c \times 12 \times 2}{E \times X} \tag{1}$$

and

$$X \times a \times b = \frac{c}{X}$$

and finally.

$$X = \sqrt{\frac{c}{a \times b}} \tag{2}$$

If now for a, the resistance of one cubic inch of copper, we substitute $\frac{7}{10^7}$; for b, the value per watt per annum of the power lost in the line, substitute $0.015; for c, the interest and depreciation per cubic inch of copper in line, substitute $0.00384, which values correspond to the above assumptions, we get 605 amperes per square inch.

When the current density per square inch is determined from equation (2), it remains to determine for what current load the actual cross sectional area shall be figured. We know that in a conductor the loss is proportional to the square of the current, and when, as is mostly the case, the maximum value of the current is far above the average working current, it is doubtful for what current load we should figure the conductor. At the generating station, the machinery, building, etc., must be for the maximum output, so that the factor due to this is nearly the same whether the full capacity is utilized or not. The cost of the power lost in line is, under these conditions, proportional to the resistance of the conductor. The cost of the conductor, on the other hand, is inversely proportional to the resistance, and the sum of these two is least when they are equal.

Let the maximum current for a certain power transmission be I amperes. If we then in equation (1) substitute $\frac{E}{P}$ for I and figure the resistance R of the line, we get:

$$R = \frac{K \times c \times 12 \times 2}{X \times I \times b.} \text{ ohm.}$$

This value of R we shall find corresponds to a cross sectional area of the conductor figured for the maximum current I with X amperes per square inch cross sectional area of the conductor, when X is determined from equation (2).

Electrical Execution.

At a meeting of the New York Prison Association in New York City last week, Dr. Augustin H. Goelet gave an account of his observations at the recent execution of the negro murderer Hampton at Sing Sing, and read the report of Dr. T. E. Oertel on a microscopical examination made of the blood and tissues of the executed criminal.

Dr. Goelet, in referring to the controversy recently excited by D'Arsonval's statement that the electric current as employed in the New York State prisons for the execution of criminals does not create absolute death, partly ascribed it to the apparently negative results of the official examinations of the bodies of the first six criminals executed by electricity at Sing Sing prison. Had the official pathologist, he said, who assisted at these post mortems not limited his examination of the brain to one case, he would have been able to discover what has only now, three years later, been demonstrated. Even in the single case when such an examination was made, it was admitted that minute extravasations of blood in the brain due to rupture of blood vessels were found, but not only did the report attach no special significance to this fact, but it was not even thought of sufficient importance to warrant a similar examination in any of the other five cases.

After giving abstracts from the report of himself and Mr. A. E. Kennelly in The Electrical World of Feb. 16, 1895, Dr. Goelet read the pathological report of Dr. Oertel on the examination of the blood and of tissues from various organs of the criminal. The deductions drawn by Dr. Oertel from his examination are as follows:

1. The chief action of the electric forces is upon the blood and the blood vessels.

2. The red blood corpuscles have less power of resistance to this force than have the white ones.

3. That one or more of the elements, the presence of which is required for the coagulation of the blood, is by the electric force changed or destroyed.

4. Some germicidal agent formed in the blood, precluding the continued existence and multiplication of putrefactive organisms.

5. The liver seems to be the organ, of those examined, most susceptible to the force exerted.

6. Of the organs examined, the lungs offered the most resistance to the force in question.

7. The force exerted is sufficient to rupture the brain tissues and the smaller vessels of the brain, thus producing universal hemorrhages in its substance.

8. No destruction of the cellular elements of the tissues seems to have been produced.

9. The deviations from the normal conditions, as noted, are sufficient to produce a lethal result.

In conclusion Dr. Goelet stated that death was instantaneous and apparently painless, which latter must be true, as electricity travels faster than the nerves can transmit painful impulses. The great and sudden rush of blood to the internal organs and to the cranial cavity was the cause of an enforced apoplexy which was overwhelming. This state of affairs was doubtless produced by the intense muscular contraction forcing the blood to the internal cavities where no resistance existed to oppose it, and the microscopical examination confirms this opinion, since it was found that the liver was engorged with blood, while the lungs, which are compressed by the diaphragm and chest walls, contained no unusual quantity of blood except in the upper part. It may, then, be confidently asserted that the death was painless, and if, therefore, murder, as the law declares, must be expiated by the death penalty, electricity should be universally adopted as a method of accomplishing this in the most humane manner.

Explosions in Underground Electric Mains and Suggestions How to Prevent Them.

BY ARTHUR SHIPPEY.

The many explosions in underground conduits which have recently taken place, and are becoming more frequent in all parts of the world, naturally set us all thinking as to what can be the actual cause of some of them. Therefore, in order to solve the problem we must consider the subject matter in all its bearings, and I think, to do this, that explosions in electric mains should be classed under three headings, viz.: 1. Those that are brought about by carelessness, which, of course, can be greatly reduced by more stringent rules being introduced and enforced to prevent them. 2. Those proved to be caused by short circuits, faulty fuses, corrosion, overheating of the main cables, sparking, etc. And, third, those that frequently mysteriously occur, the cause of which as yet remains unsolved.

Many suggestions, from time to time, have been promulgated by several of our scientists, both in England and abroad, but none, so far as I can learn, have ever suggested or even hinted at what I believe to be one of the real causes that has brought about several of these disasters which have so frequently occurred in various parts of the country in a most mysterious way. My "theory" is that many of these explosions which have taken place both here and on the Continent during the past ten years have been brought about under certain atmospheric conditions, and are caused by lightning flashes being conveyed to the earth through lightning conductors which need not—in order to cause an explosion—be fitted in the immediate vicinity where such explosions actually occur, for lightning waves are known to travel underground for many miles until they reach, or are absorbed, by water or damp earth, both of which have a great affinity for electricity. Then, again, it must not be forgotten that the principal thoroughfares of all large cities, in which the electric mains are being laid, are composed of a compound substance of a semi-metallic nature consisting of earth and pulverized metals brought into existence by reason of the wear and tear of thousands upon thousands of tons of iron tires, carriage wheels, horseshoes and other pulverized metallic substances, into which compressed compound there is laid a network of gas, water and bare copper electric mains, a combination of which forms an absolute and complete passage for the conveyance of the flashing currents. Therefore, this is one of the problems to be solved among others, and some method introduced by which explosions will be prevented from this cause in the future. I base my theory, which I claim to be fundamental, on the fact that many mysterious explosions have occurred in districts where thunder and lightning have been hovering about in the vicinity at the time. Hence, I am convinced that this is one of the real causes which has brought about the actual firing of explosive mixtures which naturally accumulate in the culverts and manholes of some systems.

I think Sir David Salamon's suggestion as to filling up the open spaces and manholes with small sand bags, in order to prevent excessive accumulation of explosive gas, a very good idea, and his plan should be thoroughly tried. In England, Major Cardew has called special attention in his recent reports to the importance of using proper fuses, and it is to be hoped that the Board of Trade and also insurance offices will now insist upon contractors being more particular as to the type of main fuses, also fuse links, used by them, for undoubtedly to the slipshod and makeshift manner this section of the industry is frequently scanted over in many instances, could be traced not only several explosions which have occurred in the mains, but also many of the mysterious fires which have occurred in electric circuits by reason of those faults which, if more carefully studied, would greatly tend to reduce the causes enumerated in category No. 2, as above described.

If you can spare space in your journal to record my views upon this subject, please do so, as the theory and suggestions made may assist in solving the problem relative to the causes of several very mysterious explosions which have occurred both in American underground electric mains, as well as those which are continually taking place on this side of the water. It would be interesting to obtain the views of American engineers versed on the subject, and whose ideas and experiences, if recorded, may throw more light on the subject, and thus assist in preventing these sad disasters and losses of life in the future, unfortunately brought about by reason of the leakage of gas from old faulty gas mains, known to exist in many districts where electric cables are continually being laid.

The Demand for Electrical Engineers.

BY FREDERICK H. FORD.

In a recent issue of a technical paper, devoted to the interests of electricity, there appeared an article, copied from the New York *Sun*, in regard to the demand for educated engineers. The writer made the statement that, in his opinion, the field of electrical engineering offered more promise of wealth and fame than "law, the grocery business, writing or knife grinding."

Although no editorial comment was made upon the article, its appearance in a technical paper would give added weight to the opinions of its writer in the mind of a young man making a choice of occupations.

A great mistake is being made in continually holding up the profession of the electrical engineer as one offering almost unlimited possibilities in the matter of salaries and demand for men. This mistake is most frequently made by persons who probably really know nothing whatever of the subject, and who are of the class who are continually making the statement that "electricity is in its infancy; and the laws which control its working are but little understood."

The aim of the present article is not to question the value of a technical education for the electrical engineer, but to give some facts in regard to the demand for young men with such an education.

At the present time there are probably not more than half a dozen entirely distinct companies in the country that would be able to furnish the entire electrical equipment for a plant for light or power of more than 500 hp capacity. In these large works the design and planning of both plants and machinery is under the immediate charge of two or three electricians who have a thorough understanding of the practical requirements of their work as well as the theories which govern it. The ideas which they furnish are carried out by the draughtsman in an almost purely automatic manner by the use of tables and slide rule. In the shop the work is carried on from working drawings, and no special knowledge of electricity is required. When the machines are tested for efficiency or other qualities, the work is done according to some scheme worked out by the chief electrician, and the results are worked out by means of formulæ selected by him to fit the case in hand. In many cases the persons making the test know nothing of the reasons for what they do. In the smaller factories the apparatus is often designed by some outside engineer. It is turned out from working drawings, and no attempt is made to test the machines in any way. Often there is no one in the factory who can, with justice, lay claim to the title of electrician.

In the central station for power and light we find the same conditions. The aim of the supply companies has been to turn out machines of the utmost simplicity of design and construction. To such a degree of perfection has this been carried that all parts of a machine liable to injury or wear are made interchangeable, and it only requires a fairly good mechanic to make what repairs are needed. The work of keeping the machinery running is a matter of such simplicity that almost any mechanic is thought equal to the task after a few months' experience.

The capital invested in the electrical industries of the country is largely in the form of stock companies. The larger companies have been gradually absorbing the smaller ones, and have united among themselves. This has lessened the demand for educated electricians, the executive departments of the companies uniting having been combined into one department. The closing down of many large works owing to financial trouble or patent litigation has also thrown a large number of men having both experience and ability on the market, thus causing the supply of engineers to be in excess of the demand. The struggle for place caused by this state of affairs has forced down the wages to such an extent that the average engineer will not receive a better salary than the head bookkeeper of a large wholesale concern.

The statement that for the average young man the field of electrical engineering offers more promise of success than "law, authorship, the grocery business or knife grinding," may be questioned.

He will be obliged to spend at least six years in preparation before he will be able to earn enough to barely pay his expenses, and during the greater part of this time he will be paying out money instead of earning it. The same time spent in preparation for either law or medicine would qualify him for beginning practice, while the time spent in business or journalism should find him in a good position. In the law or medicine he is working for himself, and he reaps the benefit of whatever success he may have. The young engineer will in most cases not have the capital needed to start in business for himself, and is forced to accept a subordinate position with some company.

Here he will get but a part of the profit coming from any success on his part, the greater share going to his employer, while he will suffer for his failures as much as if he were working for himself.

The young man choosing electrical engineering as a profession must do so with the understanding that he will have to work hard and long, and for wages which are not large in relation to the work done. For the young man who loves engineering enough to work for engineering, and not for wealth, there is as good a field in electrical work as in any branch of engineering. The idea that there are positions with large salaries attached waiting to be filled by him is a mistake. There are but few large salaried positions at best, and they are filled by men having large experience and influence with the capitalists back of the company.

The demand in electricity at the present time is not for educated electricians, but for educated capitalists; for men who will see that it is better to hire men who know why things should be done, and who will look after economy in the output, rather than to hire cheap men and waste the salary of a good man in inefficient methods of working.

When capital has been so educated, then and not until then will the relation between work done and pay received by the engineer compare favorably with that of the lawyer, the doctor, the writer and the merchant.

The Borchers Battery[1].

Dr. Borchers has replied in a recent number of the *Zeitschrift für Elektrotechnik und Elektrochemie* to the criticisms[2] which have been advanced on the cell devised by him for the direct production of electrical energy from the energy of gaseous fuel, and, seeing that the matter has led to a considerable amount of discussion in our correspondence columns, we append a translation of his letter defending his position:

On the Reactions in the Borchers Cell.

A reference appears in this journal (*Zeitschrift für Elektrotechnik und Electrochemie*) under the above heading, dealing with a criticism by Mr. Reed[3] of my paper read before the German Electro-Technical Society, or perhaps of an imperfect translation of it. I need not here repeat the objections urged by Mr. Reed, but may deal with them at once as follows:

1. With regard to the confusion which Mr. Reed supposes me to have made between cuprous chloride and metallic copper, I need do little but repel the insinuation as absurd. The behavior of a solution of carbon monoxide in cuprous chloride is thus described by C. Winkler in his text book on technical gas analysis:

"For the absorption of carbon monoxide a solution of cuprous chloride is used, with which the gas forms a compound Cu_2Cl_2CO. The cuprous chloride can be used either in acid or ammoniacal solution; but the latter is generally to be preferred, as the carbon monoxide in presence of excess of ammonia gradually yields ammonium carbonate and metallic copper, which is deposited on the walls of the absorption vessel. The reaction takes place according to the equation,

"$Cu_2Cl_2CO + 4NH_3 + 2H_2O = 2Cu + 2NH_4Cl + (HN_4)_2CO_3$; and has as its result a continual suppression of the carbon monoxide absorbed, and also the protection of the solution from oxidation by the presence therein of the metallic copper which is correspondingly deposited."

2. I not only thoroughly recognize the possibility of the reaction expressed by the equation $O + Cu_2Cl_2 + 2HCl = 2CuCl_2 + H_2O$, but I have actually indicated that this equation is likely to occur primarily in the cathode compartment, as may be seen by reference to an article in the *Chemische Industrie*, XXII., November 15, 1894.

The final and sole product of my gas cell is never cupric chloride when its working takes place normally. We have seen above that carbon monoxide possesses the power of depositing copper from a solution of a cuprous salt, being itself oxidized to carbon dioxide, as may be demonstrated by taking the equation quoted above from Winkler, and eliminating all that is not essential to its occurrence. It then becomes

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[1] From the London *Electrician*.

[2] See THE ELECTRICAL WORLD (Digest) Nov 10, Dec. 8, 15, 29, 1894.

[3] See THE ELECTRICAL WORLD of Dec. 22, 1894, in which the article of Mr. Reed originally appeared.

$$(a)\ Cu_2Cl_2 + CO = Cu_2Cl_2CO, \text{ and}$$
$$(\beta)\ Cu_2Cl_2CO + H_2O = Cu_2 + 2HCl + CO_2.$$

Disregarding the presence of ammonia, a solution has been prepared by the action of carbon monoxide, capable, under certain circumstances, of depositing copper. These circumstances consist chiefly in the avoidance of the formation of too much free hydrochloric acid. Ammonia neutralizes hydrochloric acid. The reaction given by Reed also needs hydrochloric acid, thus:

$$O + Cu_2Cl_2 + 2HCl = 2CuCl_2 + H_2O.$$

If, then, we were to take this reaction to represent that occurring in the cathode compartment, and the former pair of equations for those taking place in the anode compartment and regard them as primary, or if we were to have in two vessels completely separated from one another cuprous chloride treated with carbon monoxide in the one and cuprous chloride saturated with air in the other, and were to unite these two liquids to form a circuit the reaction would then doubtless occur according to the equation $Cu_2 + 2Cu_2Cl_2 = 2Cu_2Cl_2$. In fact, a cell would be formed from the action of cupric chloride upon copper regarded as reduced by the carbon monoxide. I need scarcely cite an authority to justify the statement that cuprous chloride is formed by the action of cupric chloride upon copper, whether as actual metal or regarded as separated from solution. If, then, the four fundamental equations be added together, thus

$$Cu_2Cl_2 + CO = Cu_2Cl_2CO$$
$$Cu_2Cl_2CO + H_2O = Cu_2 + 2HCl + CO_2$$
$$Cu_2Cl_2 + 2HCl + O = 2CuCl_2 + H_2O$$
$$2CuCl_2 + Cu_2 = 2Cu_2Cl_2$$

their arithmetical sum will be found to be $CO + O = CO_2$.

3 and 4. These points have been in great measure dealt with. It is obvious that if carbon monoxide be absent, or present in insufficient quantity, the oxygen of the air will produce an undue amount of cupric chloride which will, of course, favor the solution of the copper as cuprous chloride according to the equation already quoted. It is not to be wondered at that approximately the same current can be obtained when carbon monoxide is not used, considering the small output of current and the possibility of the formation of copper and cupric chloride, but in that case the current is obtained at the cost of the copper composing the apparatus; that is, according to a method possible indeed but not proposed by me. Mr. Reed's remaining remarks can be dealt with together with those made by Robert Mond[4] in No. 869 of the *Electrician*. The last-named investigator has experimented with various combinations and collected the results of his measurements in the following table:

Anode.	Solutions	Cathode.	Volts
1 Carbon.....	Hydrochloric acid, 25 per cent.....	Copper....	0 6006
(2) Carbon	Cupric chloride in hydrochloric acid....	Copper....	0 4655
(3) Carbon	Cuprous chloride in hydrochloric acid ...	Copper....	0.3774
(4) Carbon	Carbon in copper oxychloride in HCl... Copper in cuprous chloride in HCl.......	Copper..	0 4315
(5) Carbon	Carbon in copper oxychloride in HCl .... Copper in copper carbonic oxide chloride in hydrochloric acid.	Copper....	0 4407
6 Carbon	Carbon in cuprous chloride in HCl and air. Carbon in cuprous chloride in HCl and carbonic oxide.	Carbon.. .	0 0015
(7) Carbon	Carbon in cuprous chloride and HCl and air. Carbon in cuprous chloride in HCl and coal gas.	Carbon.	0 0050

At the end of the table is the remark "these figures seem to me to throw a strange light upon the source of electricity in Dr. Borchers' cell." No details are given as to the method of carrying out the experiments; such details are especially to be desired for experiments 6 and 7. Experiments 1 to 5 support the view, already mentioned, that the first action of the oxygen at the cathode is to form cupric chloride, and the first action of the carbon monoxide tends to cause the separation of copper, so that the voltage measured is that proper to the action of cupric chloride on metallic copper. As regards experiments 6 and 7, I may say that I have not concealed that at first I worked with two carbon electrodes. But it very soon became clear to me that a carbon electrode is an excellent transferrer of oxygen, but does not similarly favor the solution of carbon monoxide; on the contrary, unless particular care be taken to remove all oxygen from a carbon plate previously exposed to air and to keep it free from contact with all air during the working of the cell, such a plate would, if only one part of it were in contact with the air, be capable of bringing oxygen directly, at the anode, to the carbon monoxide or to the copper regarded as separated thereby; to judge by the results, this appears to have happened in Mr. Mond's experiments. On account of these difficulties I have abandoned the use of a carbon electrode in the anode compartment; the exclusion of oxygen, which is necessary, would increase the technical difficulties of construction. When the use of copper is substituted for that of carbon, precautions must merely be taken so that the carbon monoxide prevents the attack of the copper thus employed. Whether that be possible in a large scale plant must be decided by further experiments. But yet another consideration restrained me from the use of two carbon electrodes. Mr. Mond has had the goodness to support my decision by his experiments quoted above. (1) According to his second experiment, the circuit "carbon—cuprous chloride—copper" gives a voltage of 0.3774. (2) On the other hand, however, according to the experience of all gas analysts, a solution of carbon monoxide in cuprous chloride tends to deposit copper. But if we examine the condition of experiments 6 and 7 it is plain that here are three substances present in the anode compartment; viz., copper (regarded as separating from the solution), cuprous chloride, and carbon, which, according to Mr. Mond's second experiment, themselves constitute a cell. It is to be understood that I would not withhold any further experimental results whether favorable or the reverse. But I must ask for some consideration if delay occur. Besides my ordinary occupation, I have a good deal of literary work to be completed in the first half of this year, thus absorbing the whole of my time. I am therefore obliged to put off further experiments until I can give them my whole attention. I must beg those who make trial of my cell to turn to the original paper, and not to trust to translations. I must also request those who publish experiments which are unfavorable in tendency to describe the conditions of experiment accurately. Discussion is otherwise valueless.

In the same number of the *Electrician* appears the following letter from Mr. H. H. Barnes, Jr.:

Dr. Borchers' long-looked-for statement in defence of his element having appeared in No. 15 of the *Zeitschrift für Elektrotechnik und Elektrochemie*, a few further remarks on the subject in connection with it may be of interest.

Passing over in utter silence the hydrochloric combination, with which, it will be remembered, he originally obtained the best results, he deals exclusively with the processes in a cell with ammonia as solvent, and advances the following equations as of primal importance:

$$Cu_2Cl_2CO + 4NH_3 + 2H_2O = Cu_2 2NH_4Cl + (NH_4)_2CO_3 \quad (1)$$
$$Cu_2Cl_2\,CO + H_2O = Cu_2 + 2HCl + CO_2 \quad (2)$$
$$Cu_2Cl_2 + 2HCl + O = 2CuCl_2 + H_2O \quad (3)$$
$$2CuCl + Cu_2 = 2Cu_2Cl_2 \quad (4)$$

Eliminating from (1), a generally accepted equation, "all that does not really change," he deducts (2), and from (2)—(4), which are given without taking account of the presence of ammonia, he concludes that the sum total of *all* the reactions amounts practically to $CO + O = CO_2$.

Now, (2) is contrary to facts, and can only stand as (1) with NH_3 in abundance, in which case $(NH_4)_2CO_3$ is the final product, of the element, and not CO_2 as such. This is a most vital difference, and not to be overlooked; but it is by no means the only vulnerable point.

It will be seen from (1), (3), partially altered, and (4) that theoretically no copper is consumed; but then (3) is only one of many ways in which higher salts can be formed, among others being, for instance,

$$3Cu_2Cl_2 = 3O = Cu_4Cl_2O_3 + 2CuCl_2.$$

It is, therefore, evident that, not being able to confine chemical action to the processes given in (1)—(4), the copper plates will be attacked by the $CuCl_2$ formed in other ways, and this with telling effect, as the salts resulting from (1) greatly facilitate corrosion.

Taken as a whole, Dr. Borchers' article contradicts his former statements, as his own equation (1) not only gives $(NH_4)_2CO_3$ and not merely CO_2 as final combination, but he also says: "It must be left to future experiments to decide if elements (Betriebs-elemente) can be constructed in which copper is not attacked," whereas four months ago he laid great stress on the fact that no noticeable decrease in weight was ever observed.

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[4] See the ELECTRICAL WORLD (Digest), Feb 2, 1895.

From the above it will appear that it was premature to say his cell would undoubtedly remain prototype.

Electricity Direct from Fuel.

BY C. J. REED.

The expression "electricity direct from fuel" is understood to mean the conversion of the energy of fuel into electrical energy without the intervention of a thermo-dynamic or a thermo-electric process, that is, without any operation that necessitates the primal degradation of the energy into heat.

In this sense any primary battery evolving electrical energy from zinc or other metals reduced by fuel to the metallic state produces electricity direct from fuel. But this is not the sense in which the expression is generally used. This galvanic process has always necessitated the splitting up or destruction of chemical reagents that either become waste products or require a costly and continuous regeneration.

The expression commonly and almost invariably refers to a problem the practical solution of which has not yet been published, if it is known. The problem may be stated as follows:

The conversion of the energy of fuel (including fuel gases, such as carbon monoxide and hydro-carbons) into electrical energy by oxidation without transforming the energy into heat and without the destruction of chemical reagents or the formation of waste products that require regeneration.

Numerous attempts have been made to oxidize carbon electrodes by fused oxidizing agents, such as nitrates, chromates, etc., also by oxidizing solutions. But it is evident that such attempts are not even in the right direction, as they all involve the destruction of chemical reagents that make the operation more expensive than the zinc battery.

Others have attempted to solve the problem by a sort of thermo-galvanic process in which a set of chemicals and electrodes are alternately heated and cooled, absorbing heat during the first and evolving electric current during the second of these operations. If success should be attained in this direction it could evidently be nothing better than the conversion of heat into electrical energy, which is not the problem under discussion here.

Perhaps the most absurd of all attempts to solve this problem are those in which a set of reagents and electrodes are supposed to evolve electrical energy while being heated and then absorb energy while cooling, by a reversible chemical reaction which does not take place. Such a battery is described by Mr. S. Skinner, in the *London Electrician*, of Feb. 15, 1895, "On the Tin-Chromic Chloride Cell." (See THE ELECTRICAL WORLD Digest, March 9.)

So far the only real attempts to solve the problem, as stated above, are those in which fuel gases and oxygen gas were supposed to combine in contact with incorrodible electrodes, such as platinum or carbon. In the presence of platinum black there is no question that this reaction takes place at least in the case of hydrogen. It was probably obtained by Grove and other early investigators. It was undoubtedly obtained by Heringand Dobrowolsky in 1883. (See ELECTRICAL WORLD, Feb. 23, 1895, page 220.)

But it has not yet been demonstrated that this reaction takes place in presence of plain carbon electrodes, nor even with platinum electrodes in the absence of platinum black. To test this question in regard to oxygen and hydrogen, the writer has tried an experiment which will be described in the near future.

The most sensational announcement that has appeared recently relating to this subject was the paper by Dr. Borchers, read before the German Electro-Chemical Society in October, 1894 (see also THE ELECTRICAL WORLD Digest, Dec. 8, 1894), in which he claims to have obtained the direct cold combustion of carbon monoxide and other fuel gases in contact with a solution of cuprous chloride in hydrochloric acid without the use of platinum black, using only carbon and copper electrodes.

By ignoring the actual chemical reactions which took place he inferred that the energy of his battery was due to the direct combination of carbon monoxide and atmospheric oxygen. On the strength of this error he calculated that he had produced electrical energy by the direct combination of carbon monoxide and atmospheric oxygen with an efficiency between 26 and 38 per cent. He also mentions that another similar battery containing an alkaline instead of an acid solution of cuprous chloride gave similar but inferior results. With this statement he dismisses the alkaline battery as being worthy of no further notice.

In a communication to THE ELECTRICAL WORLD of Dec. 22, 1894, the writer pointed out the fallacy of Dr. Borchers' inferences, and showed the source of electrical energy to be the action of the chemicals used upon the copper electrode, and also that the same results could be obtained without any fuel gases.

As Dr. Borchers had dismissed the subject of the alkaline battery without giving any figures and without making any claim for it, I did not consider it necessary to allude to it in my former communication.

Since that time a number of investigators have tried the experiment, as I suggested, both with and without the fuel gases.

Their results, most of which have been published in the *London Electrician* and abstracted in the Digest of THE ELECTRICAL WORLD, all confirm my original statements in regard to the Borchers battery.

But Dr. Borchers dies hard. He appears to be one of those who, "convinced against his will, is of the same opinion still."

In a recent number of the *Zeitschrift für Elektrotechnik und Elektrochemie*, translated in the *London Electrician* of Feb. 22, 1895 (see above.—ED.), Dr. Borchers, while denying it in words, admits, so far as any evidence to the contrary is concerned, that the hydrochloric acid battery which he had described, and on which his claims were based, is a mistake. It is natural that he should wish to let himself down easily. He, therefore, abandons his acid battery, and with considerable exertion shows that my criticisms do not apply to the alkaline battery which he did not describe, and on which he has not yet given the public any figures. Evidently he still tries to believe that he has produced electricity by the direct combination of carbon monoxide and atmospheric oxygen. This belief seems reasonable for one who, like Dr. Borchers, has not given proper attention to the chemical reactions involved, and has drawn all his conclusions from the fact that with a certain arrangement of apparatus and chemicals he obtains an electromotive force of 0.56 volt.

In commenting on this subject the editor of the *London Electrician* strikes the keynote in the following words: "Qualitative observations such as have been published are, in a matter of this kind, worse than useless. They darken counsel. It does not suffice to record the current and voltage obtained; a complete chemical balance sheet must be made out."

Examining Dr. Borchers' new balance sheet we find he now relies on the following equation quoted from Winkler:

$$Cu_2Cl_2CO + 4NH_3 + H_2O = 2Cu + NH_4Cl + (NH_4)_2CO_3$$

A mere inspection of this equation should have convinced Dr. Borchers that no atmospheric oxygen or oxygen from any source except from water takes part in this reaction. The oxidation is accomplished solely by the decomposition of water and reduction of cuprous chloride to metallic copper, the reaction being exactly equivalent, so far as the electric current is concerned, to the reduction of cuprous oxide to metallic copper in the well-known copper-zinc alkaline accumulator. In the copper-zinc accumulator the cupric oxide is reduced first to cuprous oxide and then to metallic copper, and the reduction of one grain of cuprous oxide is equivalent to 0.36 ampere-hour at about 0.6 to 0.7 volt, or about 0.23 watt-hour; while in Dr. Borchers' "direct" battery which he now proposes the reduction of one gram of cuprous chloride is equivalent to only 0.27 ampere hour at probably not over 0.4 volt (he gave no figures on this battery), or 0.11 watt-hour.

That this arrangement of Dr. Borchers is a primary battery I do not think there is any reason to doubt. But that it is not a battery in which the electrical energy is derived from the combination of carbon monoxide and atmospheric oxygen is equally evident.

There is nothing remarkable in the oxidation of carbon monoxide by an oxidizing agent, such as chlorine, cuprous chloride (which in this case acts as an oxidizing agent), chromic acid, etc., but this is not the problem Dr. Borchers claimed to have solved.

As to the direct combination of carbon monoxide and oxygen in absence of platinum black, or even in presence of platinum black, it still remains to be proved.

I would, in this connection, call attention to the observation Remsen and Southworth (Sill. Amer. J. [3], xi., 136) that carbon monoxide is not oxidized even by ozone, either in diffused daylight or direct sunlight.

The following is a complete list of references, as they appeared in our "Digest," to all the articles which have appeared on this subject: **Nov. 10; Dec. 8, 15, 29, Feb. 2, 9, 16, 23; March 2.** Allied articles on the same general subject of gas and heat batteries were abstracted or referred to in the "Digest" **July 21, Sept. 15, Oct. 6, Dec. 8, 15, 22; Jan. 5, Feb. 2, 16; March 9.**

Electrical Power Transmission.—XVI.

BY LOUIS BELL, PH. D.

Before taking up the practical task of line calculation it is necessary to consider somewhat at length the electrical difficulties that must be encountered and which impose limitations on our practically achieving much that in itself is desirable and useful. We have seen already that the secret of long distance transmission lies in the successful employment of very high voltages, and whatever the character of the current employed the difficulties of insulation constantly confront us. These are of various sorts, for the most part, however, those that have to do with supporting the conducting line so that there may not be a serious loss of current via the earth. Next in practical importance come those involved in insulating the conductor as a whole against, first, direct earth connections or short circuits in underground service, and second, ground or short circuits, if the line is an aerial one.

In a very large number of cases no attempt is made to insulate the wire itself by a continuous covering, and reliance is placed entirely on well insulated supports. In most high voltage lines this is the method employed, partly for economy and partly because there is well-grounded distrust in the durability of any practicable covering under varying climatic conditions and the constant strain imposed by high voltage currents.

So far as supports go, it is evident that while the individual resistance of any particular one may be very great, the total resistance of all those throughout the extent of a long line to which they are connected in parallel to the earth may be low enough to entail a very considerable total loss of energy. The possibility of such loss increases directly with the number of supports throughout the line. The most obvious way of reducing such losses would be to considerably increase the distance between supports. This process evidently cannot go on indefinitely, for mechanical considerations, and hence the greatest advance can be made in reducing the chance of loss in individual supports.

Most of the present practice consists merely of an extension of the methods that were devised for telegraphic work. These were quite sufficient for the purpose intended, but are inadequate when applied to modern high voltage work. The ordinary line consists, then, of poles bearing on pins of wood or metal secured to cross arms, bell-shaped glass or porcelain insulators. To grooves on or near the top of these the line wire is secured by binding wire. Loss of current to earth in a line so constituted takes place in two ways. First, the current may pass over the outer surface of the insulator, up over the interior surface, thence to the supporting pin and so to earth. Second, it may actually puncture the substance of the insulator and pass directly to the supporting structure.

The first source of trouble is the commoner and depends on the nature and extent of the insulating surface, and even more on climatic conditions. The second depends on the thickness and quality of the insulating wall which separates the wire from the pin. To avoid leakage an insulator should be so designed that, first, the extent of surface shall be as long and narrow as possible; second, that this surface shall be both initially and continuously highly insulating. The first condition is met by making the insulator of comparatively small diameter and adding to the length of the path over which leakage must take place by placing within the outer bell of the insulator one or more similar bells (usually called petticoats). These not only help in the way mentioned, but they are likely to be tolerably dry even when the exterior surface is wet, and thus help to maintain the insulation.

A good glass or porcelain insulator made on these general lines gives excellent results with ordinary moderate voltages, say up to 3,000 volts. When the insulators are new and clean they will quite prevent perceptible leakage and for the voltage mentioned are satisfactory under all ordinary conditions. When higher voltages are employed the results may be at first good, but they are unlikely to stay so unless the climatic conditions are exceptionally favorable. Most glass permits a certain amount of surface leakage, even when new, although generally not enough to be of practical importance, but even the best of it weathers when exposed to the elements, so that in time the surface becomes slightly roughened and retains a film of dirt and moisture that is a very tolerable conductor. Even while perfectly free from this deterioration at first, it is generally hygroscopic, because it is in a trifling degree soluble even in rain water, and tends to retain a slight amount of moisture. Thus in damp climates glass is likely to give trouble when used on a high voltage line. As regards temporary fall in insulating properties a searching fog or drizzling rain is worse in its effects on insulators than a sharp shower or even a heavy rain, which tends to wash the outer surface free of dirt, and affect the comparatively clean interior but little.

Much cheap porcelain is also hygroscopic owing to the poor quality of the glaze, and it has the considerable further disadvantage of depending on this glaze for much of its insulating properties. Glass is homogeneous throughout its thickness, while porcelain inside the glaze is porous and practically without insulating value. Nevertheless porcelain which is thoroughly vitrified, the ordinary glaze being replaced by an actual fusing of the surface of the material itself, is decidedly preferable to glass, being tough and strong, quite non-hygroscopic and of very high insulating value. The surface does not weather and the insulation is well kept up under all sorts of conditions. If the vitrification extends, as it should, considerably below the surface, the insulator will resist not only leakage, but puncture, better than any glass. The process of making this quality of porcelain is somewhat costly, since the baking has to be at an enormous temperature and long continued, but the result is the most efficient insulating substance in use.

Surface leakage is more to be feared than puncture at all voltages, since the absolute insulation strength of the material can be made high enough by careful attention to quality and sufficient thickness to withstand any voltage within our command, and that continuously barring mechanical injury. But leakage can never be depended on; it is a function of moisture, drifting dust, and things meteorological generally, besides which, it can take place in serious amount at voltages which otherwise would be very easy to work with.

As the result of all recent experiments, it may be confidently stated that danger from actual breaking down of the insulation by puncture need not be at all feared up to certainly 15,000 volts with any good modern high voltage insulator. With the best insulators at present attainable the voltage just mentioned can easily be doubled without serious danger of breaking through the material.

At such high electrical pressures, however, the difficulty of stopping surface leakage becomes formidable, especially in bad weather. Glass insulators become almost useless, and only the best porcelain is to be trusted—even this with some reservations. To reinforce the insulation of the surface it has been quite usual to take recourse in the extraordinary insulating properties of heavy mineral oil. Imagine the lower edge of the outer bell of any insulator folded inward so as to form a deep groove opening upward all around the insulator. Fill this hollow with oil and it is evident that if surface leakage takes place at all it must be across the surface of this oil. Various modifications of this plan will be shown later.

Such an oil insulator is quite free from surface leakage so long as the oil surface is kept clean and in good condition. This is, however, very difficult to do and there is great danger that the oil surface from the combined action of dirt and moisture will degenerate into a species of conducting slime. Where dust is very prevalent the oil is specially likely to give trouble; it is far better able to cope with moisture alone than with moisture *plus* dust. From what has been said it is clear that line insulation is largely a matter of climate. Where it is uniformly warm and dry almost any kind of insulator will suffice, provided the material has tolerable insulation strength and the insulator is of passably good design. With a climate foggy in summer and sleety in winter even the best porcelain insulators will be severely tried at high voltages.

The record of what has actually been done in the transmission of electrical energy at high voltages is comparatively short, and gives no very valuable data for the important work over long distances that must be done in the next few years. The experience with arc light circuits at 5,000 volts or above, working over lines from 20 to 40 miles long, is already considerable. Seventy-five to 125 light dynamos are now common, the latter giving in the vicinity of 6,250 volts, and this from open-coil armatures of which the maximum voltage is roughly equal to that of an alternator of the same nominal voltage. The lines are usually, almost always, of wire having no very high insulating properties, supported on common glass insulators, often without an interior petticoat. One hundred and fifty light generators are in occasional use and now and then two machines of 75-light capacity or more are operated in series for considerable periods. This practice is commoner than is generally supposed.

Alternating circuits of 5,000 volts or more are now not at all uncommon either here or abroad. Several of them have been in operation long enough to be thoroughly tested. An 18-mile transmission at a little over 5,000 volts, to Guadalajara, Mexico; an 11-mile 5,000 volt line to Hartford, Conn.; another (three-phase) 14 miles to the works of the Oelikon Company, at 7,700 volts, and the Tivoli-Rome plant, 18 miles at 5,000 volts, have been in steady and successful operation for two years or more. A number of others, probably a score in all, of less prominence, owing to shorter length of lines and smaller capacity, are in regular operation at 5,000 to 6,000 volts. Most of the lines are of bare copper wire supported on oil insulators of glass or porcelain. They have been uniformly free from all serious trouble.

In the vicinity of 10,000 volts the experiments are fewer but none the less conclusive. Only two commercial plants have been regularly operated at such a pressure. One is the well-known Ferranti station working a 10,000-volt main from Deptford to London, about 11 miles, and using a concentric underground cable. The plant has experienced various vicissitudes and has not been steadily operated, but the troubles are not generally chargeable to the mains, which have, however, been a little uncertain in their performance. The other case is the lighting plant in San Antonio Canyon, California. This consists of a single alternating generator of 150 kw at 1,000 volts. Raising transformers establish a line pressure of 10,000 volts, at which current is transmitted to Pomona, 16 miles distant, and to San Bernardino, 28 miles. At each of these places is a substation with reducing transformers and regulating apparatus. The current is used exclusively for lighting and the plant has been in thoroughly successful operation for a couple of years. The line is of bare copper supported on good-sized, double-petticoat glass insulators without oil. There has been practically no trouble from leakage, even during the winter, when rains are of almost daily occurrence, no insulators have been punctured, and the only trouble on the line has been of a very trifling character and due to accidental causes, such as a tree branch, an occasional insulator broken by a charge of shot and the like. The line has been worked long enough to develop any probable latent troubles, and is a sufficient demonstration of the entire practicability of 10,000-volt transmission of energy, at least in a favorable climate.

Of systems operated at more than 10,000 volts there are at present none, but experiments have been not infrequent and generally successful. The most noted of these is the Lauffen-Frankfort line, 108 miles long (three-phase), worked somewhat irregularly during the latter part of the summer of 1891. Operations were generally at 13,800 volts, though on a few occasions this was temporarily doubled. There was no noticeable leakage, but an insulator was now and then punctured even at the lower pressure, producing a tiny, irregular hole clear through from the neck of the insulator to the supporting pin. The insulators which supported the bare copper line were of porcelain with oil grooves. The line worked well in all sorts of weather, but the total period of operation was too short to give this brilliant experiment much value as a precedent.

Most of the large electrical manufacturing companies have during the last few years carried on experiments on high-voltage transmission, mostly with short lines near their factories. The range of voltages has varied from 10,000 to 25,000 or 30,000, and the concurrent experience has been that at the lower pressure mentioned successful working can be attained under almost any circumstances. At 15,000 volts indications were still very favorable, but at pressures of about 20,000 insulation begins to be very troublesome, both from extensive leakage in bad weather and occasional puncture. Here porcelain shows its marked superiority and special insulators of this material can be depended on to keep down leakage and resist puncture at more than 20,000 volts under ordinary circumstances. There has not yet been enough experimentation at these higher limits to determine the probable effects of time and bad weather.

Let us now sum up our present knowledge of the transmission of electrical energy over high-voltage lines. From a considerable amount of experience, we are sure that there is no real difficulty in establishing and maintaining adequate insulation of either direct or alternating currents up to an effective pressure of 10,000 volts. Above this the experiments are less conclusive, but there is good reason to believe that satisfactory results can be reached up to 15,000 without very extraordinary precautions. With good climatic conditions 20,000 or 25,000 may be considered practicable, but certainly involve unusual precautions not yet determined by experience.

At still higher voltages the difficulties are likely to multiply rapidly, and a point will ultimately be reached at which the cost of insulating devices will overbalance the saving of copper due to increased voltage. This point is at present indeterminate, and will always depend on the amount of power to be transmitted, the permissible loss in the line and unknown variables involving repairs and depreciation, cost and depreciation of transformers and so on. It is quite impossible from present data to set such a limit even approximately, for we know as yet nothing of the relative difficulty of insulating voltages considerably above the range of our experience. Only guesses are in order as to the availability of very high voltages. Personally, the author would not hesitate to undertake a transmission at 50,000 volts effective pressure in a climate like that of Southern California, with the full belief that the task would be successfully accomplished. The next few years will show great progress in this direction.

(To be continued.)

Practical Notes on Dynamo Calculation—XXIX.

BY ALFRED E. WIENER.

Chapter 49. *Dimensioning of Magnet Cores.*—The sectional area of the magnet cores being found by means of the formulæ and tables given in Chapter 48, their *length* and their *relative position* must be determined.

(*a*) *Length of Magnet Cores.*

In the majority of types the length of the magnet cores has a more or less fixed relation to the dimensions of the armature, and definite rules can only be laid down for such cases where the length of the magnets is not already limited by the selection of the type.

Two points have to be considered in dimensioning the length of the magnets. The longer the cores are made, the less height will be taken up by the magnet winding; the mean length of a convolution of the magnet wire and, consequently, the total length of wire required for a certain magnetomotive force will, therefore, be smaller the greater the length of the core. On the other hand, the shorter the cores are chosen the shorter will be the magnetic circuit of the machine, and, in consequence, the less magnetomotive force will be required to set up the necessary magnetic flux.

Of these two considerations—economy of copper at the expense of additional iron on the one hand, and saving in magnetomotive force and in weight of iron on the other—the latter predominates over the former, from which fact follows the general rule to make the cores as short as is possible without increasing the height of the winding space to an undue amount.

In order to enable the proper carrying out of this rule, the author has compiled the following Table LXIII., which gives practical values of the height of the winding space for magnets of various types, shapes and sizes.

TABLE LXIII.—HEIGHT OF WINDING SPACE FOR DYNAMO MAGNETS.

Size of core.		Bipolar types.				Multipolar types.			
		Cylindrical cores.		Rectangular or oval cores.		Cylindrical cores.		Rectangular or oval cores.	
Diameter of circular cross section.	Area of rectangular or oval section.	Height of winding space.	Ratio of winding height to diameter of core.	Height of winding space.	Ratio of w'd'g height to diam. of equal circular section.	Height of winding space.	Ratio of winding height to diameter of core.	Height of winding space.	Ratio of w'd'g height to diam. of equal circular section.
Inches.	Sq. ins.	In.		In.		In.		In.	
1	.8	½	.50	...	....	¾	.75	...	....
2	3.1	¾	.375	1	.50	1¼	.625	1½	.75
3	7.1	1	.33	1¼	.42	1½	.50	1⅞	.625
4	12.6	1¼	.31	1⅝	.41	1⅞	.47	2¼	.56
6	28.3	1½	.25	2	.33	2¼	.375	2⅝	.44
8	50.3	1¾	.22	2½	.31	2⅞	.36	3	.375
10	78.5	2	.20	2¾	.275	3¼	.325	3½	.35
12	113.1	2¼	.18	3	.25	3⅝	.30	4	.33
15	176.7	2¼	.15	3¼	.22	4	.27	4½	.30
18	254.5	2⅜	.13	3½	.20	4⅜	.24	5	.28
21	346	2½	.12	3¾	.18	4⅞	.23	5½	.26
24	452	2⅝	.11	4	.17	5¼	.22	6	.25
27	573	2¾	.10	4¼	.16	5¾	.215	6¾	.25
30	707	3	.10	4½	.15	6¼	.21	7½	.25
33	855	3¼	.099	5	.15	6¾	.205	8¼	.25
36	1018	3½	.097	5½	.15	7¼	.2	9	.25

In *bipolar* machines, such as the various horseshoe types, in which the length of the magnet cores is not limited by the form the field magnet frame, the radial height of the magnet winding in case of *cylindrical magnets* varies from one-half to one-tenth the core diameter, according to the size of the magnets, and, in case of *rectangular* or *oval* magnets, is made from .5 to .15 of the diameter of the equivalent circular cross-section. For *multipolar* types, in which the length of the magnets is of a comparatively much greater influence upon size and weight of the machine, it is customary to set the limit of the winding height considerably higher, in order to reduce the length necessary for the magnet winding. For *cylindrical* magnets to be used in multipolar machines, therefore, the practical limit of winding height ranges from .75 to .2 of the core diameter, and, for *rectangular* or *oval* magnets, from .75 to .25 of the diameter of the equivalent circular area according to the size.

In case of emergency the figures given for *rectangular* cores may be used in calculating *circular* magnets, or those given for *multipolar* types may be employed for *bipolar* machines.

In order to keep the winding heights within the limits given in Table LXIII., the lengths of *cylindrical* magnets have to be made from 3 to 1 times the core diameter for *bipolar* types, and from 1 to ½ the core diameter for *multipolar* types; those of *rectangular* magnets from 1⅔ to ¾ the equivalent diameter for *bipolar* types, and from 1¼ to ⅔ the equivalent diameter for *multipolar* types; and the lengths of *oval* magnets, finally, from 1½ to ¾ the diameter of the equivalent circular area for *bipolar* types, and from 1¼ to ⅝ the equivalent diameter for *multipolar* types.

In the following Tables LXIV., LXV., LXVI., LXVII., the dimensions of *cylindrical* magnet cores for *bipolar* types, of *cylindrical* magnet cores for *multipolar* types, of *rectangular* magnet cores, and of *oval* magnet cores, respectively, have been calculated. In the former two of these tables the lengths and corresponding ratios are given for *cast iron* as well as for *wrought iron* and *cast steel* cores, in the latter two for *wrought iron* and *cast steel* only. From Tables LXIV. and LXV. it follows that *cast iron* cores are made from 20 to 10 per cent. longer, according to the size, than *wrought iron* and *cast steel* ones of the same diameter, the lengths of cast iron cores of rectangular or oval cross section can therefore be easily deduced from the figures given in Tables LXVI. and LXVII.

TABLE LXIV.—DIMENSIONS OF CYLINDRICAL MAGNET CORES FOR BIPOLAR TYPES.

Total flux in webers.	Dimensions of magnet cores in inches.					
	Wrought iron and cast steel			Cast iron.		
	Diam. d_m	Length. l_m	Ratio. $l_m : d_m$	Diam. d_m	Length. l_m	Ratio. $l_m : d_m$
70,000	1	3	3.0	1½	4½	3.0
150,000	1½	3¾	2.5	2¼	5¾	2.56
275,000	2	4½	2.25	3	7	2.33
425,000	2½	5	2.0	3¾	8¼	2.20
600,000	3	5¾	1.92	4½	9½	2.11
850,000	3½	6½	1.86	5¼	10¾	2.05
1,100,000	4	7½	1.87	6	12	2.0
1,700,000	5	9	1.80	7½	14¼	1.9
2,500,000	6	10½	1.75	9	16½	1.83
3,300,000	7	12	1.72	10½	18	1.71
4,500,000	8	13½	1.70	12	20	1.67
5,500,000	9	15	1.67	13½	22	1.63
7,000,000	10	16	1.60	15	24	1.60
8,500,000	11	17	1.55	16½	25½	1.55
10,000,000	12	18	1.50	18	27	1.50
15,000,000	15	22	1.46	22½	32	1.42
22,500,000	18	25	1.39	27	37	1.37
30,000,000	21	28	1.33	31½	41	1.30
40,000,000	24	31	1.29	36	45	1.25
50,000,000	27	34	1.26	....	....	....
60,000,000	30	36	1.20		....	..
75,000,000	33	38	1.15		....	...
90,000,000	36	40	1.11	. .		...

TABLE LXV.—DIMENSIONS OF CYLINDRICAL MAGNET CORES FOR MULTIPOLAR TYPES.

Total flux per magnetic circuit in webers.	Dimensions of magnet cores in inches.					
	Wrought iron and cast steel.			Cast iron.		
	Diam. d_m	Length l_m	Ratio. $l_m : d_m$	Diam d_m	Length. l_m	Ratio. $l_m : d_m$
275,000	2	2	1.00	3	3½	1.17
600,000	3	2¾	.92	4½	4½	1.00
1,100,000	4	3½	.875	6	5½	.92
1,700,000	5	4	.80	7½	6¾	.90
2,500,000	6	4½	.75	9	8	.89
4,500,000	8	6	.75	12	10½	.875
7,000,000	10	7½	.75	15	13	.87
10,000,000	12	9	.75	18	15	.83
15,000,000	15	11	.73	22½	18	.80
22,500,000	18	13	.72	27	20	.74
30,000,000	21	14½	.69	31½	22	.70
40,000,000	24	16	.67	36	24	.67
50,000,000	27	17	.63	....	.	....
60,000,000	30	18	.60	....	. .	..
75,000,000	33	19	.58	....	....	....
90,000,000	36	20	.56	....	....	....

TABLE LXVI.—DIMENSIONS OF RECTANGULAR MAGNET CORES. (WROUGHT IRON AND CAST STEEL.)

Total flux per circuit. Webers.	Cross section				Length			
	Breadth inches	Width inches	Area, square inches	Diam. of equiv circular area d_m.	Bipolar types		Multipolar types	
					Length	Ratio $l_m : d_m$	Length l_m.	Ratio $l_m : d_m$.
500,000	2	3	6	2¾	4½	1.64	3½	1.27
700,000	2	4	8	3¼	5	1.57	4	1.25
1,000,000	2	6	12	3⅞	5½	1.40	4½	1.14
1,400,000	2	8	16	4½	6	1.33	5	1.11
1,200,000	3	4½	13.5	4⅛	5½	1.31	4½	1.08
1,600,000	3	6	18	4¾	6¼	1.30	5	1.04
2,300,000	3	9	27	5⅞	7½	1.28	6	1.02
3,200,000	3	12	36	6¾	8½	1.26	6½	.96
2,000,000	4	6	24	5½	7	1.26	5¾	1.03
2,750,000	4	8	32	6⅜	8	1.26	6¼	.98
4,250,000	4	12	48	7⅞	9¾	1.24	7½	95
5,500,000	4	16	64	9	10¾	1.20	8½	.95
4,750,000	6	9	54	8¼	10	1.20	8	.96
6,500,000	6	12	72	9½	11½	1.20	9	.94
9,500,000	6	18	108	11¾	13½	1.15	11	.94
12,500,000	6	24	144	13½	15½	1.15	12½	.93
8,500,000	8	12	96	11	13	1.18	10½	.96
11,000,000	8	16	128	12¾	15	1.18	12	.94
17,000,000	8	24	192	15⅝	17	1.12	14	.90
13,000,000	10	15	150	13⅞	16	1.15	12½	.90
17,500,000	10	20	200	16	18	1.12	14	.875
26,000,000	10	30	300	19½	20	1.03	16	.82
19,000,000	12	18	216	16½	18	1.08	15	.90
25,000,000	12	24	288	19	20	1.05	16	.84
38,000,000	12	36	432	23½	22	.94	18	.77
30,000,000	15	22½	337.5	20¾	20	.96	17	.82
40,000,000	15	30	450	24	22	.92	18	.75
50,000,000	15	37½	562.5	26¾	24	.90	19	.71
38,000,000	18	24	432	23½	22	.94	18	.765
47,500,000	18	30	540	26¼	24	.915	19	.74
57,000,900	18	36	648	28¾	25	.87	20	.70
55,000,000	21	30	630	28⅜	25	.88	20	.71
66,000,000	21	36	756	31	26	.83	21	.68
77,000,000	21	42	882	33½	27	.81	22	.66
75,000,000	24	36	864	33¼	27	.81	22	.66
90,000,000	24	42	1008	35¾	28	.80	23	.64
100,000,000	24	48	1152	38¼	30	.785	24	.64

TABLE LXVII.—DIMENSIONS OF OVAL MAGNET CORES. (WROUGHT IRON AND CAST STEEL.)

Total flux per circuit. webers.	Cross section.				Length.			
	Breadth, inches.	Width, inches.	Area, square inches.	Diam. of equiv. circular area d_m.	Bipolar types.		Multipolar types	
					Length l_m inches.	Ratio $l_m : d_m$.	Length l_m inches.	Ratio $l_m : d_m$
600,000	2	4	7.14	3	4½	1.50	3½	1.17
1,000,000	2	6	11.14	3¾	5¼	1.40	4¼	1.13
1,300,000	2	8	15.14	4⅜	6	1.37	5	1.14
1,400,000	3	6	16.06	4½	6	1.33	5	1.11
2,200,000	3	9	25.06	5⅝	7½	1.33	6	1.07
3,000,000	3	12	34.06	6½	8½	1.28	7	1.05
2,500,000	4	8	28.56	6	7¾	1.29	6	1.00
3,900,000	4	12	44.56	7½	9½	1.27	7½	1.00
5,250,000	4	16	60.56	8¾	11	1.26	8½	.97
5,500,000	6	12	64.26	9	11	1.22	8½	.945
8,750,000	6	18	100.26	11¼	13	1.16	10½	.93
12,000,000	6	24	136.26	13⅛	15	1.14	12	.915
10,000,000	8	16	114.14	12	14	1.17	11	.92
15,000,000	8	24	178.14	15	16	1.065	13	.87
15,000,000	10	20	178.5	15	16	1.065	13	.87
24,000,000	10	30	278.5	18¾	20	1.065	16	.85
22,500,000	12	24	257	18	18	1.00	15	.835
35,000,000	12	36	401	22½	21	.93	17	.755
35,000,000	15	30	400	22½	21	.93	17	.755
55,000,000	15	45	625	28¼	25	.885	20	.71
50,000,000	18	36	578	27	24	.885	19	.70
60,000,000	18	42	686	29½	25	.85	20	.68
70,000,000	21	42	787	31	26	.82	21	.66
80,000,000	21	48	913	34	27	.79	22	.645
90,000,000	24	48	1028	36	28	.78	22½	.625
100,000,000	24	54	1172	38	30	.78	24	.62

(To be continued.)

Electrodynamic Machinery—XXVII.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

134. From the preceding considerations it is evident that while it is possible to design a bipolar generator for any desired output, yet, in practice, simple bipolar generators are not employed for outputs exceeding 250 kw, and, in fact, are seldom employed for more than 100 kw, since their dimensions become unwieldy and their output, per pound of weight, smaller than is capable of being obtained from a well designed multipolar machine.

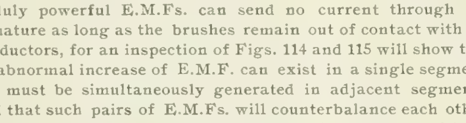
In the same way a quadripolar generator can be made to possess any desired capacity; but, in the United States, practice usually increases the number of the poles with an increase in the output of the machine. Thus, it is usual to employ a four pole or six pole generator for outputs of from 25 to 75 kw, and 12 poles for a generator of 400 kw capacity.

FIGS. 120 AND 121.

135. Should the armature of a multipolar generator not be concentric with the polar bore, *i. e.*, if it is nearer one particular pole than any of the others, the reduction in the length of the air gap opposite such pole, will reduce the reluctance of that particular magnetic circuit, and by reason of the increased flux through the armature at this point induce a higher E.M.F. in the segments of the armature adjacent to the pole than in the remaining segments. If the armature be not interconnected; *i. e.*, if it employs as many pairs of brushes as there are poles, these unduly powerful E.M.Fs. can send no current through the armature as long as the brushes remain out of contact with the conductors, for an inspection of Figs. 114 and 115 will show that no abnormal increase of E.M.F. can exist in a single segment, but must be simultaneously generated in adjacent segments, and that such pairs of E.M.Fs. will counterbalance each other. When, however, the brushes are brought into contact with the armature conductors, thereby bringing the various segments into multiple connection with one another, a tendency will exist for the more powerful E.M.F. to reverse the direction of current through the weaker segments.

136. Whether this tendency will result in an actual reversal of current depends upon the difference of E.M.F. between the segments, their resistance, and the external resistance or load.

Let A and B, Fig. 120, represent the E.M.Fs. of any two segments in a multiple-connected Gramme-ring armature and let the E.M.F., E, of A be greater than the E.M.F., E', of B. Owing to drop of pressure in the internal resistance r, the pressure e, at the terminals p, q, will be less than the E.M.F., E, of the stronger segment A. If e is greater than E', a current of strength $\frac{e-E'}{r}$ will pass through the segment B, in the direction opposite to that in which its E.M.F. acts. If e be equal to E' there will be no current throught the segment B, while if e be less than E' a current will be sent through B in the direction in which its E.M.F. acts, but of strength less than that supplied by segment A. Thus, in Fig. 121 the E.M.F. E of the stronger segment A, is represented by the ordinate $e+d$. Owing to the resistance r, in the segment A, a drop of pressure d will take place within it, and the pressure at its terminals will be e volts. If E' be less than e, the stronger segment A will send a current back through the segment B, while if E' be greater than e, both segments will contribute current through the external load resistance R ohms.



FIGS. 122, 123 AND 124.

For example, a separately excited quadripolar generator of say 100 kw capacity, supplying 1,000 amperes at 100 volts terminal pressure, has a resistance in each of its four armature segments A, B, C, D, of $\frac{1}{100}$ ohm; then, provided its four magnetic circuits are balanced or equal, the full load on each segment will be 250 amperes, and the drop in each 2.5 volts; so that the four E.M.Fs. will be, Fig. 122:

	E. M. F.	Drop. Volts.	Current. Amperes.	Power. Watts.
A	102.5	2.5	250	625
B	102.5	2.5	250	625
C	102.5	2.5	250	625
D	102.5	2.5	250	625
			1,000	2,500

The power expended in each segment of the armature by the current as I^2R, will be $\frac{250 \times 250}{100} = 625$ watts, and the total I^2R loss in the armature, 2,500 watts.

137. Considering one of the segments, say C, as normal, and that A, owing to magnetic dissymmetry, gives an E.M.F. two volts in excess; B, one volt in excess; and D, one volt in deficit; the excitation necessary for 1,000 amperes total output will produce (Fig. 123) the following conditions; namely:

	E. M. F. Volts.	Drop Volts.	Load. Amperes.	Power. Watts.
A	104	4	400	1,600
B	103	3	300	900
C	102	2	200	400
D	101	1	100	100
			1,000	3,000

138. The effect of magnetic dissymmetry in the segments under the assumed difference of three volts, will produce, at full load, a difference of output among the segments, ranging from 100 to 400 amperes, while the total power wasted in the armature winding will be increased 20 per cent.; namely, from 2,500 to 3,000 watts. The armature will, therefore, be raised to a higher temperature, owing to the magnetic dissymmetry, but this increase in temperature will not be localized, since, although at one moment a greater amount of heat is being produced in certain segments than in others, yet, owing to the rotation of the armature, the portions of the armature constituting these segments is constantly changing.

139. Suppose now the external circuit be entirely removed, the brushes remaining in contact with the conductors (Fig. 124), so that the circuits through the armature segments are complete, then the following conditions will hold:

	E. M. F. Volts.	Drop. Volts.	Current. Amperes.	Power. Watts.
A	104	1.5	150	225
B	103	0.5	50	25
C	102	–0.5	– 50	25
D	101	–1.5	–150	225
			0	500

An inspection of these values shows that a difference of three volts between the E.M.Fs. of the four segments, produces a reversal of current through C and D, at no load, with a useless expenditure of 500 watts. Consequently, between no load and full load, there will be a change from an expenditure of power with reversal of current in the weaker segments, to an excessive drop and expenditure of power without reversal of current.

140. Although this difficulty, arising from the unbalanced magnetic position of the armature, does not, in practice, give rise to any serious inconvenience, when mechanical construction is carefully attended to, yet windings have been devised by which it may be altogether avoided. For example, if all the turns be so connected that their E.M.Fs. are placed in series, then a single pair of brushes will be capable of carrying the current from the entire armature which will only be divided into two circuits; or, the segments may be so interconnected that turns in distant segments may be connected in series so as to obtain a more general average in the total E.M.F. Such windings are always more or less complex, and the reader is referred to special treatises on this subject for fuller details.

The formula for determining the E.M.F. of a multipolar Gramme generator armature is,

$E = \Phi n w$ C.G.S. units, where Φ is the useful flux in webers, or the flux entering the armature through each pole, n the number of revolutions per second of the armature, and w the number of turns on the surface of the armature counted once around. If, however, the armature be series connected, so that instead of having p circuits through it between the brushes, where p is the number of poles, there are only two circuits, then the E.M.F. will be $E = \frac{p}{2}\Phi n w$, while if, as in some alternators, the circuit between the brushes be a single one, the E.M.F. of the armature will be $p\Phi n w$.

142. Fig. 125 represents the magnetic circuits of an octopolar generator, the dimensions being marked in inches and in centimetres. The field frame is of cast steel, and the armature core is formed of soft iron discs. Let us assume that there are 768 turns of conductor in the armature winding, and that the speed of rotation is 172 revolutions per minute, or 2.867 per second.

Assuming an intensity of 9,500 gausses in the armature, it may be required to determine the E.M.F. of the machine.

The cross section of the armature is 31.1 × 13 = 404.3 sq. cms., but allowing a reduction factor of 0.92 for the insulating material between the discs, the cross section of iron is 372 square centimetres. The total flux passing through the cross section of the armature will, therefore, be 372 × 9,500 = 3,534,000 webers.

The useful flux through each pole will be twice this amount, or 7,068,000 webers, so that the E.M.F. of the generator will be:

$$E = \Phi n w = 7{,}068{,}000 \times 2.867 \times 768 = 1.557 \times 10^{10} = 155.7 \text{ volts.}$$

This will be the E.M.F. of the generator, provided all the armature segments are connected in parallel as shown in Fig. 115. If, however, the armature winding be so connected that only a single pair of brushes and a single pair of circuits exists through the armature, the E.M.F. would be 4 times as great, while if the armature could be connected in a single series, the E.M.F. would be 8 times as great.

In order to determine the M M.F. necessary to drive this flux through the armature we proceed as follows:

We first determine the cross section, the mean length, and the intensity in each portion of the magnetic circuits. One of the eight magnetic circuits through the armature is represented by the dotted arrows at A (Fig. 125). We may assume that the flux through the cores is 7,068,000 × 1.3 = 9,188,400 webers; 1.3, being the approximate leakage for a machine of this type; in other words, of all the flux passing through the cores $\frac{10}{13} \times 100 = 76.9$ per cent. approximately may be assumed to pass through the armature, half through each cross section.

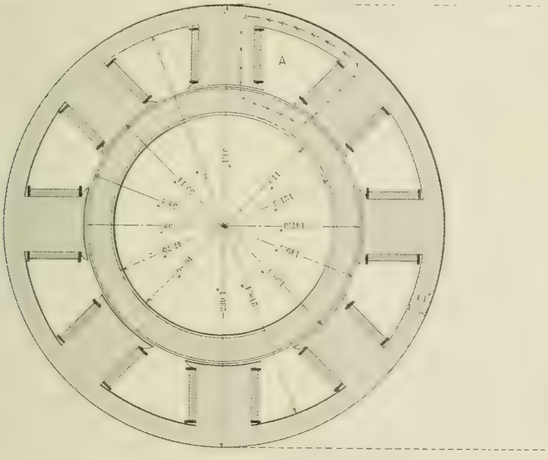


FIG. 125.

	Cross section. Sq. cms.	Flux. Webers.	Intensity. Gausses.	Length. Cms.
Field core	644	9,188,400	13 430	40
Yoke	354	3,534,000	9,980	76
Armature	254	3,534,000	9,500	50

The entrefer, or gap of copper, air and insulation, existing between the iron in the armature and in the pole faces, is 1.5 centimetres in length, while the polar area is 41 centimetres × 34 cms. wide, equals 1,400 square centimetres in cross section. From these the reluctance in the magnetic circuit through the armature is

	Length. Cms.		Reluctivity.	Cross section.	Cross section carrying armature flux.	Reluctance. Oersteds.
Field core	40	13,430	0.002	342	263.1	0.000,304
" "	40	13 430	0.002	342	263 1	0.000,304
Yoke	76	9,980	0 001	254	354 0	0 000,215
Entrefer	1.5		1.	700		0 002,142
"	1.5		1.	700		0.002,142
Armature	50	9,500	0.0008	372	372	0.000,107,5
						0.005,214,5

The M. M. F. required to drive a total flux of 3,534,000 webers through this circuit will be

3,534,000 × 0.005,214,5 = 18,430 gilberts
= 14,660 ampere turns
= 7,330 ampere turns on each spool

With 600 turns on each spool, the current would be 12.22 amperes.

Laboratory of Houston and Kennelly, Philadelphia.

(To be continued.)

Electrical Difference of Potential.

To the Editor of The Electrical World:

SIR:—Having taken considerable interest in the discussion conducted in your columns concerning the electrical difference of potential analogy advanced by Mr. Waddell, I beg leave to present a point in which, if wrong, I shall be glad to be corrected. To my mind the trouble seems to hinge on a rather loose use and possible confounding of the terms "E. M. F." and "difference of potential"

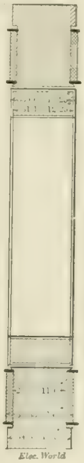
Force in general is that which moves or tends to move matter; and whatever electricity may be, electromotive force is certainly that force which moves or tends to move electricity. Difference of potential, on the other hand, is the result of work done, and is measured in terms of work. In the case of the voltaic cell alluded to by Mr. Waddell, the E. M. F. is that force which causes the travel of the ions and with them their respective charges. The result of the procession of atoms is that the copper is charged positively with respect to the zinc. This difference in charge constitutes a difference of potential and the procession of the charged atoms will continue until the force tending to move them is exactly balanced by the difference in electrical pressure which their motion has created. When this state of affairs is reached, no more work is done until the back pressure (difference of potential) is relieved by connecting the plates and allowing a current to flow. The point is, that while difference of potential is an E. M. F., all E. M. Fs. are not differences of potential.

In the case of a wire moving with uniform velocity in a uniform field, the cutting of the lines of force is (or causes) an E. M. F. and produces a transfer of electricity in the conductors, sufficient in amount to charge the opposite ends of the wire to a potential difference which is exactly equal to the E. M. F. and *opposite in direction.*

This is a condition of equilibrium and no more requires energy to maintain it than it does to hold a stone away from the earth. Mr. Waddell's analogy is defective in that it does require energy to maintain a difference of pressure in the box, due to the air slipping past the paddles, but if instead he substitutes an equal number of closely fitting pistons (frictionless of course) I think the analogy holds in all respects, at least as far as it is possible for a mechanical analogy to represent a phenomenon whose ultimate nature is so little understood.

D. R. LOVEJOY.

NEW YORK, N. Y.



Dangers in Kite Flying.

The French journal *Cosmos* records the case of a lad who was flying a kite, and while drawing it in a thunderstorm gathered, the lightning from which traveled down the string burning it and rendering him unconscious; the kite was only about 300 feet high when the accident took place.

Electrical Misinformation.

Referring to the electrical transmission of power from Niagara to Buffalo, an electrical contemporary says editorially: "We think it is safe to say that this transformation of the water power into electricity will not be with an efficiency of more than 85 per cent.; that the *transmission efficiency* will not exceed 75 per cent.; that the *transformation* at Buffalo will not average 75 per cent., and that the *distribution* in Buffalo will not be at greater efficiency than 80 per cent." In the same article it is stated that the transmission loss in the 110-mile Frankfort-Lauffen experiment was "but 25 per cent.," whereas the entire losses—from the generator, step-up transformer, line, step-down transformer and final distribution—were, in fact, between 24.7 and 31.5 per cent., the power transmitted varying from 78.2 to 197.4 hp.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors, or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 922 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French, or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

[illegible] Regenerative Armatures for Short Air Space Dynamos.—An Institution paper by Mr. Sayers is reprinted in full with the discussion (but unfortunately without the illustrations) in the Lond. "Elec. Eng.," Feb. 15. He describes the development of his commutating device (see Digest, June 10-17, July 1 and Sept. 16, 1893). It was found that it was often a serious drawback that these machines could be run in only one direction, but this difficulty has been solved by the present arrangement, which he describes as follows: "In these figures there are represented two sections of the main winding of a drum armature—a commutator coil, which is connected to the main winding at the junction between the coils mentioned, and a commutator blade. The direction of winding is the same in the two figures, but in the first the direction of rotation is represented as being clockwise, while in the second it is counter-clockwise. A little study of these two diagrams will show that the commutator coil acts in precisely the same way in whichever direction the armature rotates, the brushes being always set with a backward lead, so as to bring the side of the commutator coil which is behind the point of connection to the main winding under the edge of the flux horn. In both cases only one side of the commutator coil is operative, the other side being in a position in the interpolar gap where normally there is no effective field." He shows an analogy between the problem of sparkless commutation and the problem of preventing knocking in a high speed engine; the inertia of the reciprocating parts must be overcome by the steam pressure, so the reversal of the current against the self induction must be overcome by internal E. M. Fs. and not by the make and break action at the commutator. Regarding the number of segments in the commutator he states that the necessity formerly found for using a large number ceases to exist in these machines, in which the number is governed by the difference of voltage which it is advisable to allow between adjacent commutator segments. He discusses the design of slotted armatures; the opening at the top of the slot should be as wide as is consistent with the increased production of eddy currents in the field magnet and it should not exceed 1.5 times the air space; the number of conductors should be as small as is consistent with the cost of manufacture. He discusses parallel running, stating that machines for this purpose must not have a rising characteristic; he suggests an arrangement of compound machines which will run in parallel, it is usual, however, in central station work to use shunt machines; with short air space machines considerable generative power is required in the armature in order to get even a moderate fall in the characteristic. He describes a system of rocking brush holders for reversing motors in which the friction of the brushes causes them to be carried around with the armature until brought up to certain stops. In discussing constant speed motors he states that with his arrangement he obtains the lightest weight and minimum cost with the best regulating qualities. He gives a description with data of his 80-kw dynamo. In the discussion Mr. Crompton believes that Mr. Sayers justly claimed to have solved the difficulty of the trouble with commutators in short air space designs. Mr. Anderson states that there is a saving of about 25 per cent. in weight in these machines. Mr. Mordey admired the arrangement but believes there would be sparking. Mr. Parshall referred to some experiments in the same direction stating that a machine of 1,000 and another of 2,000 hp were shown at the World's Fair where they worked well without sparking; he doubts whether the economy in weight, as compared with some recently designed machines, had been demonstrated; the weight of the armatures seems excessive as also the weight of the copper on it. Mr. Esson believes the extra coils add considerably to the cost of the machine.

The Niagara Dynamos.—Prof. Forbes, in a communication to the Lond. "Elec. Rev.," Feb. 22, questions a recent statement that alternators with outside revolving fields have been made before, and he asks for further information, stating that his American patent No. 518,944 would be void if any prior publication exists; he claims that it was only by adopting this type that the requirements of the turbine makers at that plant could be met.

Armature Fault Testing.—A simple and practical method is described by Mr. Brousson in the Lond. "Elec. Rev.," Feb. 22. It is a method for finding a fault in the armature winding without unsoldering the connections to the commutator. A suitable current is passed through the armature from brush to brush, sufficiently large that there is a measurable difference of voltage between the commutator segments; each brush must not make contact with more than one segment at a time; one terminal of a low reading high resistance voltmeter is connected to one brush and the other to the frame of the machine; it is advantageous to be able to alter the resistance in the voltmeter circuit in order to give suitable readings; the armature is turned slowly by hand until that position is reached in which the voltmeter records the smallest deflection, the commutator segments to which the faulty coil is attached will then be under the brush which is connected to the voltmeter; the maximum deflection will be obtained when the faulty coil is under the other brush; to find which of the two coils connected to the segment is the faulty one the voltmeter readings must be carefully noted when the brush touches the segments on each side, the faulty coil is then the one which is connected between the two segments which give the lowest readings. If the insulation is broken down in two distinct parts the deflections on the voltmeter will not increase or decrease regularly as the armature is turned; when two faults are close together there is no difficulty in locating the position, but it is not so simple when they are far apart The insulation resistance can be measured approximately in the usual way by this same method.

Researches with a Rotary Field.—A paper of some length by Mr. Bragstad, describing some researches, is published in the "Elek. Zeit.," Feb. 21; the direction of investigation is the same as in the paper of Dr. Duncan published in THE ELECTRICAL WORLD July 7, but the method used is entirely different, as Duncan's method can be used only when there is current in the armature. He used a two-phase motor of a somewhat old type; the first tests were made with continuous currents with the armature at rest; he measured the distribution of the field over the surface of the armature; a small coil was attached to the armature and connected with a ballistic galvanometer; the results are given by curves. Another set of tests was made with the armature in motion, by the insertion in the air gap of thin fixed wires parallel to the shaft. From these experimental investigations he finds that at no load, currents on which a positive torque is exerted exist almost only between two pole pieces; this torque is largely compensated by an opposite one existing at the point of strongest induction; the accompanying armature currents represent a large loss of energy and produce heat in the armature; when loaded the currents, on account of the slow speed, are quite weak, while the strongest currents are not well utilized on account of the weak magnet induction existing at that place; one should therefore strive to have the strongest current where the perpendicular component of the magnetic induction is the strongest; the efforts made in practice to have a constant field velocity are therefore in the right direction; how far the result is accomplished must be shown by measurements made with modern machines.

Rotating Alternating Field.—In "L'Elettricista," Feb. 15, Mr. Malagoli investigates the properties of an alternating magnetic field which is kept in uniform rotation, so as to perform one revolution in the time of a complete period. He suggests utilizing these properties in an apparatus intended to double or to halve the frequency of an alternating current. By superimposing a rotating alternating field and a Ferraris field, he thinks it possible to obtain a steady one.

Core Losses in Transformers.—The paper of Mr. Wilson (see Digest last week) is concluded in the Lond. "Elec.," Feb. 22. He gives the diagrams of the connections in the tests, also tables and curves showing the results of his measurements; tests were made for determining the stray field by means of exploring coils, from which he concludes that as far as one can judge, and with the assumption of uniform distribution of the induction, every element of the core experiences each half period a maximum induction intensity about as great as on open circuit, although at any epoch the linear distribution is not the same on account of the stray magnetic field; the loss observed on full load is less than one might reasonably expect from magnetic hysteresis alone.

LIGHTS AND LIGHTING.

Substitute for a Vacuum.—Mr. Forster, in the Lond. "Elec. Rev.," Feb. 22, suggests that as the new element, "argon," which exists in the atmosphere, is an inert gas, it might be applied with success for filling the bulbs of incandescent lamps. (Would it not be much more expensive to obtain a bulb full of this gas in its pure state than it would to produce a vacuum, and does it follow that because it is chemically inert it would answer the same purpose as a vacuum in an incandescent lamp, in which not only the chemical but also the physical properties play an important part?)

Small Inside Reflectors for Alternating Arc Lamps.—The question of priority is discussed in a communication from the Helios Company in the Lond. "Elec. Rev.," Feb. 22.

POWER AND HEAT.

Arc Welding.—The paper of Mr. Foster (see Digest last week) is concluded in the Lond. "Elec. Eng.," Feb. 22. He describes the application of arc welding to altering a very large piston and discusses at some length repairs of steam boilers, giving a list of repairs which have been made; in several cases cracks again occurred through the repaired joints but he believes that by slightly increasing the total thickness by building up the metal at this point, the trouble can be entirely overcome. Another important application is in cutting and boring; holes may be pierced in this way with great rapidity and they may be elongated into slits of any required length; an illustration is given of a large wrought iron pipe in which a large number of holes were pierced in this way at the rate of two or three per minute. He describes the plant and apparatus required. Regarding the necessary precautions he states that the carbons should not be copper plated, should be sound and hard, having a metallic ring when struck, and must burn with little or no dust, which would render the metal brittle; when building up the metal, the additional metal should have the same composition and the slag should be removed from each layer before commencing to add another; a ridge of gannister clay should be formed to keep the molten metal in place; the surrounding metals should be well heated with a long and steady arc to insure gradual solidification; whenever possible each layer of new material should be hammered immediately after the carbon is withdrawn, and if this cannot be done the withdrawing should be gradual. Regarding the quality of work done, a number of welds were made by this as also by the usual smith's process and were tested; the "average ratio of weld to solid" of the electric welds was 85.5 per cent. for iron and 80.8 for steel; a comparison of the hand welded bars with those electrically welded will in every case show a higher ratio for the latter; the economy of the system as used in several places is claimed to be established beyond a doubt; it is not proposed as a substitute for all cases of welding nor for riveting, but rather as an additional method capable of extensive application under conditions where the other methods are inapplicable; simplicity and ease of transportation are among the chief advantages; he suggests the use of such a plant on board a small steam craft in a harbor, for making repairs on vessels.

Thawing by Electricity.—Mr. Edmunds, in the Lond. "Elec. Rev.," Feb. 22, recommends the use of electrical heat for thawing gas and water pipes; he describes an arrangement (which seems unnecessarily complicated) which is drawn into the pipe, and which in a recent test worked very well; a complete thawing was effected in four minutes.

Electric Lighting Engines.—Those used in the station in Vienna are well illustrated in large plates in Lond. "Engineering," Feb. 22.

Working Ships' Turrets.—A communication on this subject by Mr. Maxim is published in Lond. "Engineering," Feb. 22.

Long Distance Transmission of Power.—An interview with Dr. Bell, of the General Electric Company, is published in the "St. Ry. Jour." for March. He considers the present outlook for transmission plants most excellent; the principal difficulty concerns the transmission line, its maintenance and guarding against accidents or malicious injury; he considers 5,000 to 15,000 volts within the range of fair practicability if the climatic conditions are favorable; he would not hesitate to make it 30,000 to 50,000 in a climate like that of some parts of Mexico; the limitation for transmission is the maintaining of the line; transmitting cheap water power up to 10 or 15 miles will nearly always pay if the amount is reasonably great, 100 to 1,000 hp; up to 30 miles a fair proportion of the propositions investigated indicated commercial success; from 30 to 50 miles a few, but beyond 50 very few indeed; in one case of 150 miles it would have been a certain commercial success, as the climate was extremely favorable, coal at the receiving end costing $40 a ton in gold; the voltage proposed was 20,000. To his knowledge, the long power transmission plants are four, of about 18 miles each, one at Genoa, Italy, another from Tivoli to Rome, a third into Biberest, Switzerland, and a fourth into Guadalajara, Mexico; they are all of considerable size, involving several hundred horse power; there is a small lighting plant in California operated over a distance of 28 miles; the voltage at San Bernardino is 10,000, and that at the others between 5,000 and 6,000; two of the plants are operated by continuous currents with several generators in series; in the Rome plant the generator gave 5,000 volts directly. There is a serious difficulty in utilizing the current from the Niagara plant in Buffalo on account of the inability to run incandescent lamps without changing to direct current. He believes that a very large part of the power transmitted over long distances will be used in multiphase motors; also that they are displacing continuous currents motors for most purposes, as they are not afflicted with the commutator; he does not believe that they will be used on street railways in cities but certainly in interurban and long distance work; they require at least three wires, but for interurban work the double trolleys would constitute no serious objection; if used for street railway service there will be no more burning out of the armatures; he has never succeeded in burning out the armature of a polyphase motor even in the hardest kind of experimental work, although he sent currents through them until the leads burnt off.

Electric Motors for Driving Machine Tools.—Supplementing the paper of Mr. Richmond, abstracted in the Digest last week, the "Eng. News," Feb. 28, publishes parts of a letter from Mr. Melotte, giving some additional information regarding the Herstal (Belgium) installation. Since the electric motors were installed the shop has been enlarged, and the power plant will soon have a capacity of 5,500 amperes at 125 volts; the reason for this increase is more particularly in the increase of useful work done by the workmen operating the machine tools; at the outset the output was estimated at 150 pieces per workman, but the establishment of the piece-work system so stimulated the workmen that the output was raised to an average of 300 pieces per day; at first 16 hp motors were connected to a shaft, but they were soon found to be developing 30 hp; the shafts were, therefore, cut in the middle and a motor placed at each end; he calls attention to the difficult situation of this gun factory; if instead of this motor transmission it had adopted mechanical transmission, the difficulty of increasing the transmitted power would have been enormous. He favors high speed motors except for very large units of 1,000 hp and over; heavy machine tools which take 1 hp or more can be operated advantageously by separate motors, but small machines should be operated in groups of three or four by small counter shafting driven by a 2-hp motor.

Niagara Falls Power Plant.—"El'ty," March 6, contains a paper by Mr. Perkins on the municipal ownership of the Niagara power distribution for Buffalo; the subject is also discussed editorially. A paper by the same author on lubricating bearing cooling devices in this plant, including an illustration, is published in the "West. El.," March 9.

Electric Annealing of Armor Plate.—The "Elec. Eng.," March 6, contains an article by Prof. Elihu Thomson, in which he describes the Lemp process, by which the Harveyized armor plates are annealed in order to enable them to be drilled and tapped. These plates have a skin of very hard steel, and it is necessary to anneal them in places where they are to be drilled; the most intense oxyhydrogen flames were found ineffective, but the annealing was accomplished very satisfactorily by the electric process, which consists in passing a current between two blocks of copper laid on the surface and forming the ends of a transformer circuit like in the well-known welding process; after the heating, the temperature is slowly lowered by a very gradual diminution of the current, so as to prevent the too rapid cooling by the conduction of the heat to the massive back plate, which would act as a chill; the use of alternating currents favors the concentration of the heating effects, the self induction effect or reactance is least when the current flows through the surface of the plate and any current which branches from the electrodes and enters deeply into the plate has a longer path of greater self-induction. Highly satisfactory results have been obtained by this process at the Cramp shipyard, and he believes that there is no doubt that the apparatus and process will soon become one of the necessary features in a modern establishment for the construction of armored vessels.

Tempering Hair Springs.—A process is briefly described in the "Sibley Jour." for January, which consists in passing a current through the spring, heating it to the requisite color, at which point it is quenched; by prolonged action of the current during the quenching the interior of the wire can be kept soft if desired; the most perfect method of annealing is obtained by allowing a very slowly diminishing current to traverse it.

TRACTION.

Accumulator Traction.—According to the "Elek. Zeit.," Feb. 21, accumulator cars are to start running regularly within a few days on one of the lines in Berlin.

Electric Traction.—A paper by Mr. Dawson, chiefly of local interest, including some data, is published in the Lond. "Elec. Rev.," Feb. 22.

Power Station Test.—The "Eng. News," March 7, reprints at considerable length a first prize thesis by Messrs. Colles and Gallaher, of Stevens Institute of Technology. It contains a description and the results of a very elaborate test made of a railway power station at West Haven, Conn., in which the Westinghouse "Kodak" arrangement is used, and is said to be one of the most recent designs of that company (the station was erected nearly three years ago). The chief object of the test was to show the value of this type of power plant; a brief description of the plant is given, including considerable data; the average number of car miles per day is 2,040, the average number of passengers per day 11,000; the tests were made in May, 1894, and deal largely with the steam power plant. Although the reprint contains a large amount of data, it is stated that the most important of it is given in an appendix which is not reprinted. As an experiment a recording wattmeter was used to measure the whole output of the station; they point out that the output calculated by multiplying the average amperes with the average voltage will generally give a greater quantity than the true one, as the voltage is highest when the current is lowest and the reverse; specimen charts of the recording instruments and voltage diagrams are given. From a long table of data it appears that the station efficiency—that is, the ratio of the electrical to the indicated hp—was 67.11 per cent., and the coal used per electrical hp per hour was 3.068 pounds; in the text they give 3.08 lbs. for an electrical hp delivered on the line during well loaded hours but for one or more entire days it was 3.6 lbs. Regarding the leakage on the line, records from 50 to less than 1 ampere were obtained, the larger value being due to cars left standing with the trolleys on the wire and the lamps turned on, but the latter accounts for only 9 amperes. Tests on the line were made, as also an attempt to determine whether bonding made any difference; from the table it appears that the bonding was followed by a loss, but this shows that figures are misleading, which they explain, and conclude that bonding certainly made a difference, as shown by tests made before and after bonding. A table gives the results of tests of current consumption on a motor car. An average of the station test gives the following: Average number of cars (motor and trailer cars reckoned separately) running during test 16.5, number of car miles 1,474, average electrical hp per car 11.6, average amperes per car 18.2, average electrical horse power hours per car mile 1.55, coal used per car mile 4.76 lbs., cost of coal used per electrical horse power hour 0.473 cent, cost of coal per car mile 0.733 cent. The true value of the station efficiency given above is probably between 75 and 80, and that of the line is 89; the total operating expenses including coal, oil, water and pay roll is 1.5318 cents per car mile, or 0.988 cent per electrical horse power hour; from tests made before and after bonding they show that the saving is sufficient to make it pay to bond the rails if the work cost anything less than $14,100 (not including, however, the cost of damage to water and gas pipes by insufficient bonding). The low line efficiency discounts to a great extent the showing of the station, and shows the fallacy of reckoning that element by car miles instead of by electrical horse power hours; they point out that the difference between an active and a lazy engineer is usually of more significance that that between an economical and an uneconomical design of the station. The ground space per horse power of the whole plant was only about five square feet.

Electrical Traction on Steam Roads.—Some further data regarding the electrical branch of the N. Y., N. H. & H. R. R. is given in the "Elec. Eng.," March 6. The line is perfectly level, seven miles long, reasonably straight, and is an exceptionally favorable place for experimenting. The equipment is to be made interchangeable with their standard cars, and will at first consist of six motor cars, each with two motors of 100 hp; they are expected to draw a trailer with ease; they are 50 feet long and are entered from the side; there will be four baggage cars 30 feet long, of which two are fitted with two motors and two with four motors; it is expected to have the line running in May. The same company is contemplating establishing electrical power plants at the terminals of all branch lines which radiate from the trunk lines.

Electrical Power for Cable Roads.—According to a note in "Eng. News," Feb. 28, a Chicago line is about to try the use of electric power for operating street railway cables, and if it is a success all the company's cable lines will run by electrical instead of steam power; how it is to be applied is not explained.

Electric Towing.—The "Eng. News," Feb. 28, gives some data regarding the operating expenses on the Bourgogne Canal in France, where electric power has been used for a year and a half. There is an evident saving in time and money by the use of electricity; for transporting 1,000 tons 11.65 hours and $20.40 were required with steam, while with electricity these figures were 11.01 and $14. The time of service is too short for drawing any definite conclusions, but the owners believe that the new system will be profitable in the end.

Rail Bonding and Its Bearing on Electrolytic Corrosion.—A communication by Mr. Low, forming a discussion of the recent Institute paper by Mr. Farnham, is published in the "St. Ry. Gaz.," March 2. He considers that the problem of electrolytic corrosion and rail bonding must be considered conjointly; he gives the conditions which cause electrolysis, and describes a peculiar case in which the pitting invariably occurred on the inside of the pipe, working outward; he favors the three-wire system; electrolytic corrosion will not occur when the following requirements have been complied with: "No cross bonding at points where the mains show permanently negative potentials. Heavy cross bonding at points where the mains show permanently positive potentials. Rail bonds of absolute permanence and reliability. High conductivity in track return circuit. Greatest possible resistance from tracks and mains at points where the mains show permanently negative potentials. Generators to permanently feed positive to line and negative to track and main. Heavy bonding between the negative side of generators to various proper points of mains not heretofore designated."

Power Stations.—An illustrated description of a new power station in Chicago is given in the "St. Ry. Jour." for March. A long and well-illustrated description of the street railway system of Buffalo is published in the "St. Ry. Jour." for March. A description of the Columbus Central Railway station, with some illustrations, including a diagram of the switchboard connections, are given in the "Elec. Rev." March 6. A well-illustrated description of some length is contained in the "St. Ry. Jour." for March.

Lyons-Ouilins Street Railway.—A description of this French road is given in the "St. Ry. Jour." for March; the apparatus for it was built in this country.

Motor Repairs.—The article by Mr. Shepard, giving practical hints, is continued in the "St. Ry. Jour." for March.

Tower Wagon.—Several forms are described and illustrated in the "St. Ry Jour." for March.

Snow Plow.—A "home built" plow is described and illustrated in the "St. Ry. Jour." for March. The same number describes the snow and wreckage system in the Chicago Railway Company.

Prospects for Cable and Electric Traction in England.—A short article by Mr. McCallum is contained in the "St. Ry. Jour." for March.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Profitable Plants for Small Towns.—A recent paper by Dr. Luhn is reprinted in abstract and discussed editorially very favorably in the "Elek. Zeit.," Feb. 21; he describes a small plant in a small town in which the electric light plant and the water supply plant are combined into one; the result is very favorable, as the economy from the water sold (by meter at about 4c. per m^3.) covers the total cost, and the income, at the rate of about 7.5c. per kw hour for the electrical energy, is therefore clear profit; the population is 3,000 and the engine power is 50 hp; it includes a battery of accumulators capable of supplying 200 lamps for 7 hours; only two men are required for running the plant; during the night there is no attendance, the current being derived from the accumulators; the supply of water is sufficient for all purposes except for a fire during the night in which case the current from the accumulators runs a pump to supply the extra demand; it is claimed that the Helios Company, which installed this plant, deserves the credit for the first practical application of electric power for fire engine purposes.

Cost of Small Plants.—An editorial note in the Lond. "Elec.," Feb. 22, gives the following estimates of the relative costs of a gas and an electric light plant for a small town or village. An average size gas works will cost from $3,000 to $3,500 for every 1,000,000 cb ft. capacity per annum; at 5 cb ft. as equivalent to 12 cp per hour and 60 watts for 16 cp, this amount of gas is equivalent to about 9,000 kw hours; assuming the annual load factor to be 15 per cent. it will require a plant capacity of about 16.8 kw; Mr. Crompton's estimate of $400 to the station and mains per kw for the low pressure system is regarded as being well above the average; this brings the cost to $2,670 for the electrical plant.

Amortization.—In a communication to the "Elek. Zeit.," Feb. 21, Dr. Haas criticises some of the statements of Mr. Prucker in his article abstracted in the Digest Feb. 16.

ELECTRO-PHYSICS AND MAGNETISM.

Electrodes Sensitive to Light.—The Lond. "Elec.," Feb. 22, abstracts briefly from the "Zeit. fuer Phys. Chem." an article by Mr. Luggin describing an electrode which he claims to be much more sensitive than any hitherto used; a plate of platinum is coated with silver bromide and is then duplicated with a similarly coated plate in a solution of bromide of potassium; exposure to diffused daylight gave 0.5 volts; for weak lights the rise is uniform up to a maximum after which it remains constant; the rate is more marked for stronger lights but is then not directly proportional to the light, besides being also lowered by a previous exposure; continuous and alternating lights of the same intensity do not produce the same effects; the plates do not remain constant.

Double Refraction of Electric Rays.—A paper by Mr. Mack from the "Weid. Ann.," Vol. 54, page 342, is translated in the Lond. "Elec.," Feb. 22; with slabs of wood from 25 to 40 cm thick, analogues of all the well known optical experiments were produced with the aid of oscillators, mirrors and spark gaps.

Retardation of Polarization in Dielectrics.—A translation of the recent paper by Mr. Arno (see Digest, Feb. 9) is published in the Lond. "Elec. Rev.," Feb. 22.

Propagation of Magnetization.—A Royal Society paper by Dr. J. Hopkinson and Mr. Wilson on "the production of magnetization of iron as effected by the electric currents in the iron" is abstracted at some length with some of the illustrations in the Lond. "Elec.," Feb. 22, and is to be concluded in the next issue; a brief abstract is given in the Lond. "Elec. Rev." and "Elec. Eng.," the latter publishing also the discussion, which, however, is not of particular interest. The paper deals with the same subject as that abstracted in the Digest, July 14, but the experimental work was carried out with larger apparatus; the object was to investigate the changes occurring at different depths in a solid core of an electromagnet, in terms of the time after reversal has been made; the magnet was made up of different concentric parts each wound with an exploring coil with which the propagation of the magnetization from the outside to the inside was measured; diagrams of the apparatus and connections are given. The general character of the results was quite unexpected; the curves are given but no general conclusions are drawn in the present portion; the length of time that the currents in the cores exist was somewhat surprising; the induction occurs very rapidly near the surface, less rapidly at some depths and slowly at its centre; with certain magnetizing forces it takes 4 minutes before the central core of a magnet 12 in. in diameter, attains a maximum. The application of the results to magnets with cores of other sizes is pointed out and conclusions are to be drawn (presumably in the next portion) as to the appropriateness of general practice in regard to the sizes of wires or plates used in transformers. The whole paper, which contains a very large number of curves, illustrations and tables is published in the "Phil. Trans. of the Royal Soc. of Lond.," Vol. 185, p. 93, and may be obtained under separate cover. The article does not admit of being abstracted; it is doubtless the most complete investigation of the kind which has been published.

Propagation of Magnetism.—"L'Elettricista," Feb. 15, contains a paper by Prof. Aseoli in which the author points out the analogies between the propagation of magnetism in magnetic circuits and the propagation of heat according to Fourier's theory. He explains the exponential law for the magnetization of an iron bar, as experimentally verified by Prof. Pisati.

Slow Changes in the Permeability of Iron.—The Lond. "Elec." and "Elec. Rev.," Feb. 22, reprint the first part of a Royal Society paper by Mr. Mordey. The conclusions of this paper were given in the Digest, Jan. 12; the present reprint contains the tables, curves and the illustrations of the apparatus. The phenomenon discussed is the gradual increase in the energy absorbed in producing a given magnetization, when iron is magnetized for a long time by rapidly alternating currents; the paper is an account of a careful investigation of the subject.

Magnetic Circuits.—In "L'Elettricista," Feb. 15, Mr. Giorgi begins a series of articles on the applications of the theory of magnetic circuits. In this issue he shows how this method may be applied to a vigorous treatment of some of the scientific problems.

Influence of Temperature on the Pull of Permanent Magnets.—Results of some tests by Mr. Pictet from a recent Academy paper are printed in "L'Elec.," Feb. 23. The magnet weighed about 500 grams; the figures are given for every 5°; for + 30 the attractive force in grams was 61.04 for — 50 it was 68.15 and for — 100 it was 75.8.

Magnetization Curves.—A long article in Lond. "Engineering," Feb. 22, on the Hadfield Steel Foundry contains a series of curves of different qualities of magnet iron and steel made by that company.

Self-Induction in Iron Wires.—A paper by Mr. Klemencic from the "Weid. Ann.," Vol. 53, page 1,053, is reprinted in abstract in the "Elek. Zeit.," Feb. 21. In straight wires of magnetic metal it is not the length and thickness but the magnetic permeability which is the chief factor; he gives the results obtained with three wires each 1 m long and 2 mm in diameter giving the values of the E. M. F. induced in the iron, which it was found increases more rapidly than the current especially for a soft iron and least for Bessemer steel; in comparison with non-magnetic metals the values are 5.2 times as great; with very strong currents such a wire of soft iron may have a self-induction coefficient of more than 1 km. He also examined the axial magnetization and finds that the permeabilities in circular and axial directions are different from each other; with soft iron the circular is smaller than the axial but with hard iron and steel it is the reverse.

The Animal as a Machine.—An editorial in the "Sibley Jour." for January refers to this subject, stating that it has been proved that the efficiency of the vital machine is higher than that of any known artificial motor, and that "it is coming to be believed that the machine is chemico-electro-dynamic."

ELECTRO-CHEMISTRY AND BATTERIES.

Borchers' Battery.—The leading editorial in the Lond. "Elec.," Feb. 22, gives a general review of the discussion of this cell, referring also to Dr. Borchers' reply to the critics, which will be found reprinted elsewhere in the present issue. The editorial states that this reply disposes of all the criticisms on the ground of want of identity of the conditions. In summing up the matter it states that it has been shown that unless exceptional care be taken it is extremely easy to mistake the E. M. F. yielded by the attack of the copper electrode for that produced by the oxidation of the gas, but with one exception the critics have failed to demonstrate that Borchers fell into this error; the statement of Messrs. Barnes & Veesenmeyer (see Digest, Feb. 23), if not refuted, is absolutely fatal to Borchers' claims, this statement is, that an identical cell produced no product of carbon dioxide; Dr. Borchers must disprove this or his cell is discredited. A record of the current and voltage is not sufficient, as a "complete chemical balance sheet must be made out." The same journal publishes a communication from Mr. Barnes criticising the reply of Borchers; he claims that one of the reactions will take place only with ammonia in abundance and the final product will then be a carbonating of ammonia and not carbon dioxide, which is a most vital difference; although theoretically no copper is consumed, yet the copper plates will be attacked by the cuprous chloride formed in other ways. He believes that Dr. Borchers' reply contradicts his former statements and he now admits that it must be left to future experiments to decide if elements can be constructed in which the copper is not attacked, whereas four months ago he laid great stress on the fact that no noticeable decrease in weight was ever observed.

Headland Grid.—An illustration of this plate is given in the Lond. "Elec.," Feb. 22. The plates are composed of rows of rectangular "gridded" tubes containing the active material; a positive weighing 5 pounds may be discharged at the rate of 25 amperes and then has a capacity of 50 ampere hours, the grid forming considerably over one half of the weight.

Accumulators with Powdered Lead.—Some illustrations and data concerning these accumulators, as made in France, are published in "L'"Elec.,' Feb. 23.

Cyanide Gold Extraction.—The report of a recent litigation is published in the Lond. "Elec. Rev.," Feb. 22.

A description of the usual process, taken from a recent paper by Messrs. Butters and Smart, is published in the Lond. "Elec. Eng.," Feb. 22.

Present State of the Electrochemical Industry.—A paper of some length by Mr. Lucieno is published in the "Bul. Soc. Belge. d'Elec.," June-September, a reprint of which is begun in "L'Elec., Feb. 9. He discusses the industries in which electricity has been applied with success, those for which it has been proposed and those for which its application is possible; existing plants are referred to and in many cases the figures are given; it is probably one of the best summaries of the kind recently published. In conclusion he gives an alphabetical list of chemicals with references where the description of the electric process may be found.

[illegible]—A recent paper of Mr. Ostwald, giving some practical hints, which was abstracted in the Digest, July 21, is reviewed briefly in an editorial in the Lond. "Elec. Rev.," Feb. 22.

Electrical Bleaching of Textile Fabrics.—A lecture by Mr. Matos, delivered before the Franklin Institute, is reprinted in the journal of that Institute for March. He reviewed the entire field of textile bleaching by the ordinary methods, and details the electrolytic processes which have been advanced from time to time. The chief objection to the common process of bleaching vegetable fibres is that the strength of the material bleached is considerably impaired, owing to the formation of oxy-cellulose, and also to the fact that after bleaching has been even successfully accomplished, the fibre or yarns may be quite harsh to the touch, caused by the formation of insoluble salts of calcium, which are almost impossible to remove from the fibres by washing, and which, of course, cannot be removed by chemical means without injury. Cotton is the easiest fibre to bleach; linen, jute, etc., require very great care and attention on the part of the operator. Electric bleaching, so far as it may be called "electric," depends on the electrolysis of a solution of some soluble chloride, like magnesic, sodic, or aluminic. This solution is pumped through an electrolyzer with zinc and platinum electrodes; the electrolyzed solution passes from the electrolyzer on to a single, or series of bleach vats, wherein the final operation is conducted, which may require varying lengths of time, depending upon the strength of solution (usually a 5 per cent. solution of the salt), the kind of bleach desired and the quality of material acted upon; as a general rule, the time required is much less than is required for a chloride of lime bleach. Wool or animal fibres, including silk, have not yet been bleached by means of electrolyzed solutions, owing to the peculiar "yellowing" action of compounds of chlorine on them. The bleaching of paper pulp is carried out now on a large scale, and the results are better than those obtained by the lime method. Pulp digested in either the caustic soda or the sulphite processes, is bleached with equal facility. The principle is the same as employed for fibres and yarns, but certain changes are required in the plant, so as to facilitate the progress of the pulp from one stage to another without loss. Provision must also be made to save the impoverished bleach liquid, which is replenished by adding fresh quantities of the salt. One chief advantage of the electrolytic process over others is that the material bleached only requires a good rinse or wash, and it is finished; no treatment with acid is required. The lecture was illustrated with a series of photographs of machines in actual use.

Accumulator.—A correction of a formula in the recent article describing the Schafer-Heinemann accumulator (see Digest, March 2) is given in the "Eng. & Min. Jour.," March 2.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Accurate Measurements of Strong Currents.—A method devised by Dr. Sahulka is described in the "Elek. Zeit.," Feb. 21; it appears that this method is to be used in the government testing bureau in Vienna. The only method which can be claimed to be accurate is the one using the electrodynamic balances, but for wide ranges this would require a large number of balances; in the new method two such balances will suffice up to say 100 amperes; two circuits are required, in one of which the current is kept at 1 ampere by means of the usual electrodynamic balance; in this circuit there is connected the fixed coil of a second balance whose movable coil is in a shunt circuit to a resistance through which the main current flows; this resistance is made of sheets of manganin; the drop in voltage in this circuit can be so adjusted that it is about 2 volts by altering the resistances, and the current through that coil will therefore always be constant; an accuracy of 1-10 of one per cent. is easily obtained by this method and the apparatus is always used at its greatest sensitiveness. For alternating currents he suggests a similar method in which the shunt to the manganin resistance forms the primary circuit of an ironless transformer having a ratio of 1 to 7, the secondary of which gives the current which is led into the movable coil; the ohmic resistance of the primary coil is small as compared with its apparent resistance, so as to simplify calculations.

Alternating Current Curves.—Dr. Fleming's paper (see Digest last week) is continued in the Lond "Elec.," Feb. 22, in which he gives some reproductions of the curves, among which are several for a Mordey alternator and others of a Thomson-Houston, with and without a load. A curious point about these curves is that while there is a lag of 50 per cent. of the current behind the voltage, for the zero values, there is no lag at all for the maximum values. He claims to have established without a doubt that a water resistance constitutes a perfectly non-inductive load for an alternator; the time for taking a curve with this apparatus requires two to three hours or more "according to luck" but he believes it can be reduced to 10 or 15 minutes and that the process may ultimately become quite as easy as that of taking an indicator diagram.

Photographic Registration for Magnet[illegible] Instruments.—The "Elek. Zeit.," Feb. 21, abstracts a paper by Messrs. Schering and Zeissig from the "Weid. Ann.," Vol. 54, page 1,039, in which they describe an apparatus for recording the deflections in observations made with magnetometers and galvanometers, in some of these it is necessary to record the time in seconds. Four metres from the mirror there is an illuminated scale the image of which is reflected into a photographic camera; below this there is another scale the image of which is also reflected in the camera by a fixed mirror; to record the time there is a clock with dials instead of hands, the image of part of which is also reflected in the camera by the fixed mirror; the incandescent light for illuminating the scales is automatically lit every 10 seconds for 1 second.

Alternating Current Curves.—Dr. Fleming's article, mentioned in the Digest last week, is given in abstract with an illustration of the apparatus and a sample curve, in the "Elec Eng.," March 6.

Electric Gauge.—A convenient form is described by Prof. Ryan and Mr. Macomber, in the "Sibley Jour." for January. It is in the form and appearance of a watch, and answers well for measuring currents of not less than 20 amperes, and of pressures less than 125 volts; the readings can be depended upon within 3 per cent.; a calibration of the readings is given.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Protection Against Strong Currents.—In the "Elek. Zeit.," Feb. 21, Mr. Sesemann discusses the subject of the protection of telegraph and telephone apparatus against lightning and strong currents and describes and illustrates an apparatus which he devised, based on a long experience with such circuits; it consists essentially of a fuse wire in a glass tube mounted conveniently for inspection; with every four circuits there is another fuse in the earthing wire; German silver wire of 0.08 mm melts with about 1 ampere; the fuse for the earth wire may be made to fuse at 10 amperes; in his experience he has found that when coils suffer from atmospheric discharges the injury is usually due to a spark and not to overheating, but he cites two cases in which wires of 0.5 mm and 1.5 mm were melted by atmospheric discharges.

Automatic Telephone Switchboard.—A recent paper by Mr. Mueller is abstracted in the "Elek. Zeit.," Feb. 21. He points out briefly some of the advantages of the Nissl apparatus (see Digest June 2, Sept. 1).

Signal Repeaters.—The Grimes system used on English railways is described briefly and illustrated in the "Elek. Zeit.," Feb. 21.

Pacific Cable.—A letter from the Lond. "Times" referring to a recent communication by Mr. Sandford Fleming is reprinted in the Lond. "Elec. Eng.," Feb. 22.

Telegraphic Exhibition.—A telegraphic exhibition was held in Rome, on Feb. 3, for the benefit of the Sicilian towns damaged by the recent earthquake. The Italian Government exhibited an interesting collection of historical telegraphic appliances, from the Chappe telegraph to the most recent systems.

MISCELLANEOUS.

Educational.—A communication by Prof. Gerard of Liege on the education of electrical engineers is contained in the Lond. "Elec.," Feb. 15. He describes the method used by himself, advocates the construction of instruments by the students and the careful carrying out of a few experiments rather than many carried out less carefully.

Biographical.—A portrait and biographical sketch of Royal E. House, by Mr. Pope, is published in the "Elec. Eng.," March 6. Some reminiscences of Mr. Eickemeyer are given in the "Elec. Eng.," March 6.

New Book.

ELEMENTARY LESSONS IN ELECTRICITY AND MAGNETISM. By Silvanus P. Thompson. D.Sc., B.A., F.R.S., F.R.A.S. New edition, revised throughout with additions. New York: Macmillan & Co. 625 pages, 297 illustrations. Price, $1.40.

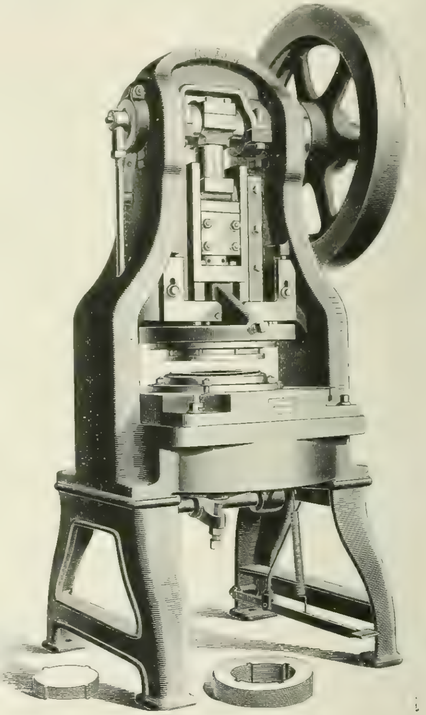
This is a new edition of a work issued in 1881, and it has been largely increased by numerous insertions necessitated by the progress of science in thirteen years, during which an international system of electric units has been adopted and the researches of Ewing, Hopkinson and others have advanced the science of magnetism; electric transmission and transformation have forced the study of alternating currents as applied to motors, transformers and telephones; storage batteries have become of great commercial importance, electric lamps are made in millions, currents for lighting and power are supplied from central stations, and meters and measuring instruments have come into the market. Along with these advances in practice we have the theories of Faraday as developed by Clerk Maxwell, more generally understood, thanks to the labors of Heaviside, Lodge, Hertz, Poincaré and others. And yet many are slow to give up the idea that the copper wire is the medium for transmitting electric energy, and credit this property to the dielectric surrounding the wire.

One would think that this great progress and advance of ideas would necessitate an entirely different presentation of the subject of these lessons from that in 1881. Instead of writing a new book, however, the author has incorporated in the old one a number of modern illustrations and descriptions of apparatus, together with new units and some statements of recent discoveries and modern views. Consequently the whole is patchy. If one had the time and the capacity for logical arrangement he could no doubt find sufficient data in this book for producing a series of rather popular and instructive lessons in electricity and magnetism. As it is, however, the work is perhaps the best in the English language for starting into the study of electrical science.

New Armature Disc Stamping Presses.

The requirements of armature work for electric motors and dynamos have led to the construction of presses which differ in essential points from those used for other styles of sheet metal work.

The accompanying engraving illustrates one of two presses which have been designed by The E.W. Bliss Company, Brooklyn, N. Y., especially for this class of work. In both the presses the "throw out pads," usually controlled by heavy springs, are operated in an absolutely positive manner and consume a very small fraction of the power of the press.



STAMPING PRESS.

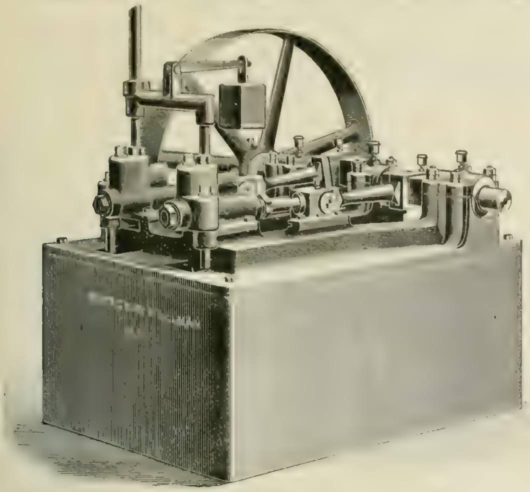
It will be seen that, in addition to the usual slide carrying the punch, there is a bottom slide, actuated by an outside crank connection, which operates the dies and "throw out pads" through the radial slots in the bolster. Two cross pieces adjustably attached to the frame of the press actuate the "throw out pads" of the punches by striking against them on the return motion of the main slide.

The press shown is more particularly designed for cutting simultaneously the inside and outside of plain rings, with or without key notches, such as are shown on the floor in the illustration. These presses will cut up to about 20 inches outside diameter in this class of work. These rings or discs are then subsequently notched in a notching machine.

The other press, above referred to, is most frequently used for cutting the whole disc, including all the notches, at one blow, and can be used for that class of work up to 11 or 12 inches in diameter. Beyond that size, this press is usually furnished with back gearing and sometimes with a body casting of steel, instead of cast iron. It can, however, be also used for plain rings up to 24 or 30 inches in diameter. It is also a useful machine for cutting the smaller sections for armatures of large generators, in which case the outside of the sections and the holes in same are generally punched simultaneously.

A New Belt Driven Pump.

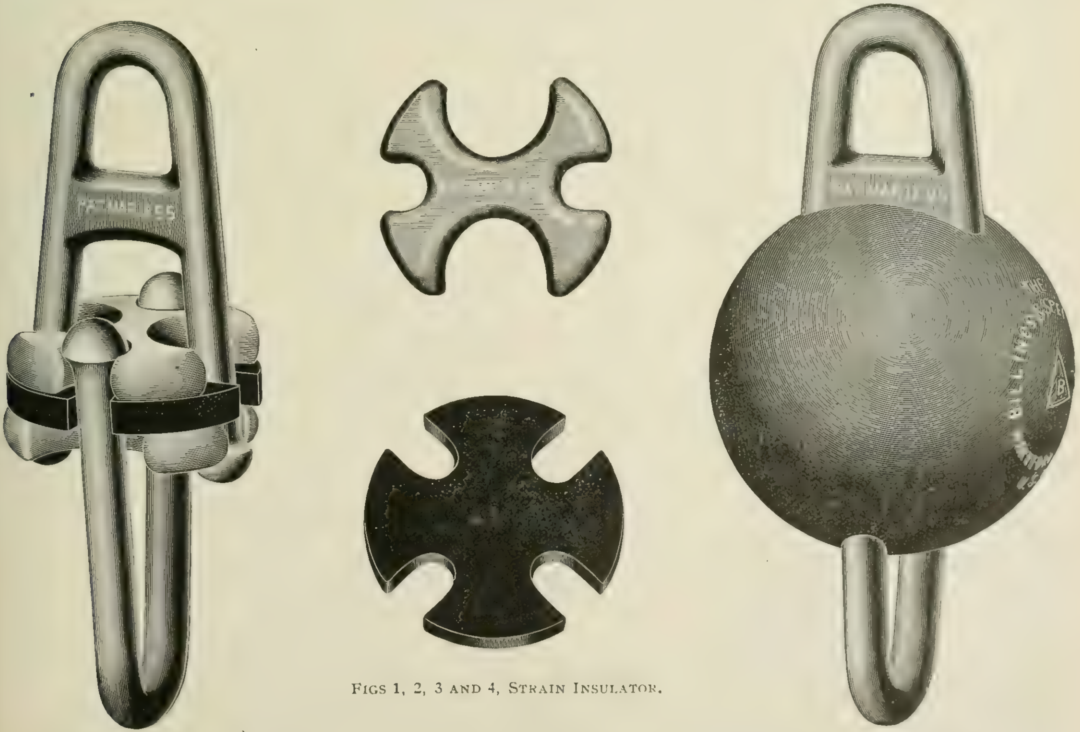
We illustrate below a double acting, two plunger pump manufactured by the "W. & S." Hydraulic Machinery Works, 204 East 43d Street, New York. This pump is very compactly arranged, as the engraving shows, and the cross heads are provided with ample wearing surface and are well gibbed. The suction valve raises only on the outward stroke of the piston, the inward stroke driving one-half the water forward and the balance to the front side of the piston, past the pressure valve, whence it is forced forward on the next outward stroke of the piston. The reservoir forms a broad and substantial foundation for the pump and is 40x32x20 inches. The pumps are built in eight sizes, ranging from a delivery of 450 cu. in. at 9,000 lbs. pressure per sq. in. up to 4,400 cu. in. at 800 lbs. per sq. in.



DOUBLE-ACTING PUMP.

Drop Forged Trolley Equipment.

The accompanying illustrations give a clear idea of the Billings & Spencer Company's new drop forged link strain insulator, which is being placed on the market by the Pettingell-Andrews Company, of Boston and New York. The metal portions of the link strain are furnished in either Tobin bronze or steel, the latter being nickel plated or galvanized as desired. Fig. 1 shows the interior construction of the device and Fig. 2 the rubber disc employed to electrically separate the two links. Fig. 3 is the metal holding plate and Fig. 4 represents the complete link strain with the exterior insulating ball. This ball is constructed of a material known as colophite, the invention of Mr. S. J. Hoggson, of New Haven, Conn. The adhesive and elastic properties of colophite make it particularly useful for an insulating compound subject to constant strains and vibrations. It is unaffected by the atmosphere and is a natural preservative impervious to the influences of oxygen, snow, ice and moisture, which are sources of decay in perishable substances. A series of tests have been made of colophite on the Billings & Spencer drop forged link strains, and as a result thereof the company guarantees an insulation resistance of 200,000 megohms at 575 volts. The great advantage claimed for the drop forged parts is that all the pieces subjected to strain or wear are made from material that has a tensile strength of from 65,000 to 80,000 pounds per square inch. The crushing strength of the rubber disc is claimed to be 12,000 pounds. The link strain is furnished with interchangeable attachments which permit of its use as either a frog pull-off or an adjustable pole strain. The same company is also making a straight line trolley hanger with interchangeable parts and an independent colophite insulated stud with $\frac{5}{8}$-in. thread, drop-forged of either Tobin bronze or steel. The feature of the straight line hanger is a separate bell made of either aluminium bronze or malleable iron, having interchangeable drop forged yokes of either Tobin bronze or galvanized steel for converting the hanger into either a single or double pull-off.



FIGS 1, 2, 3 AND 4, STRAIN INSULATOR.

Progressive Business Methods.

A fine example of wide-awake business policy is afforded by the five-page advertisement of the Bryan-Marsh Company in this issue of THE ELECTRICAL WORLD. There can be no question that the plan thus adopted by the Bryan-Marsh Company in introducing its lamps will create an impression not to be approached by the expenditure of even many thousands of dollars on catalogues, circulars, etc., while the convenience of this method of attracting public attenton stands in striking contrast with the annoying and time consuming labor of preparing and distributing catalogues and circulars. The advertisement also illustrates the growing tendency of large manufacturers to use increased space in order to present their claims in a manner more in accordance with their intrinsic importance. It is fair to assume that, as the art of advertising is more thoroughly studied and understood, the mode of procedure employed by the progressive concern referred to will be more extensively adopted by others.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

THE ELECTRICAL STOCK MARKET continued uneventful during the week, with the exception of General Electric and American Bell, in which there was considerable trading Monday and Tuesday, apparently due to the decision in the Bate Refrigerating case. Notwithstanding official statements that this decision does not appreciably affect the General Electric and American Bell companies, both stocks took a decided downward turn immediately upon the announcement of the decision—the former from 27 to 25⅝ in New York and the latter from 191 to 187½ in Boston. American Bell recovered later, however, and the trading amounted to nearly a thousand shares. The local trading in General Electric on Monday ran over 4,000 shares, the buying coming chiefly from shorts covering. The total sales of General Electric for the week were 33,460 shares. A downward tendency in Western Union and American District Telegraph is again noticeable this week, the latter having dropped from 45 to 41.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	128	130
Edison Electric Ill., New York	100	94	96½
" " " Brooklyn	100	..	108
" " " Boston	100	124	125
" " " Philadelphia	100	120	124
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	30	..
General Electric	100	26½	26
General Electric, pref	100	61	65
Westinghouse Consolidated, com.	50	30½	31
" " pref	50	48½	50

BONDS.

	Par.	Bid.	Asked
Edison Electric Ill., New York	1,000	105	106
Edison Electric Light of Europe	190	75	85
General Electric Co. deb. 5s	1,000	88¾	89

TELEGRAPH AND TELEPHONE.

	Par.	Bid.	Asked
American Bell Telephone	100	190	191
American District Telegraph	100	..	41
American Telegraph & Cable	100	90	92
Central & South American Telegraph	100	117	120
Commercial Cables	100	130	140
Erie Telephone	100	49	50
Gold & Stock Telegraph	100	105	110
New England Telephone	100	68	68¼
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	55	58
Western Union Telegraph	100	87	87⅛

ELECTRIC TRACTION STOCKS.

	Par.	Bid.	Asked
Union Ry. Co. (Huckleberry)	..	112	115
Brooklyn Traction, com	100	9	11
" " pref.	..	53	55
Long Island Traction	100	6¼	7
Rochester St. Ry	..	37	38
Columbus St. Ry	100	46	49
Louisville St. Ry. com.	..	37	39
" " " pref.	..	87	88
Cleveland Electric Ry	..	59	60
Cleveland City Ry.	..	68	70
North Shore Traction	100	20	24
New Orleans Traction	100	14½	17
pref.	100	55	60
Worcester Traction com.	100	..	13
" " pref	100	79	80
Metropolitan Traction, Philadelphia	.	97½	97¾
Philadelphia Traction	..	87	88½
People's Traction	..	48½	49
Binghamton R. R. common	..	100	..

BONDS

	Bid.	Asked
*Union Ry. 1st. mtge 6s.	105	108
*Westchester Electric 1st. mtge. 5s.	98	101
Rochester St. Ry. 1st 5s	95	97
*Columbus St. Ry. 1st 5s.	93	..
Columbus Crosstown 1st. 5s.	94	..
*Binghamton Railroad Co. 5s	99	100

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* With accrued interest.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 BROADWAY, NEW YORK, March 11, 1895.

THE INTERIOR CONDUIT & INSULATION COMPANY announces that on March 15 its general offices will be removed from 44 Broad Street to 527-531 West 34th Street, New York.

THE PECKHAM MOTOR TRUCK & WHEEL COMPANY has been compelled by largely increasing business to move its Boston office from Room 515 to Room 321, Exchange Building, where more commodious quarters are afforded.

THE MUNICIPAL ELECTRIC LIGHT COMPANY, Brooklyn, has declined to accept the additional franchise granted it by the Common Council two weeks ago, on the ground that the clause in the franchise giving the city the right to take possession of the plant at the end of 10 years at its original cost would interfere with the commercial prosperity of the company.

THE FIRM OF DYER & SEELY, 36 Wall street, has been succeeded by Dyer & Driscoll, Mr. H. W. Seely retiring from business on account of ill health. Mr. R N. Dyer is widely known throughout electrical circles by reason of his connection with the patent business of the Edison interests, and Mr. Edison personally during the past decade. Mr. D. H. Driscoll has been a member of the old firm of Dyer & Seely for seven years, and has had charge of all matters outside the electrical field.

THE ELECTRIC CONSTRUCTION AND SUPPLY COMPANY of New York has been organized to continue the business of the Electric Construction and Supply Company, which recently failed. The new company is organized under the laws of the State of New York, and it is understood that it will avail itself of such assets of the old company as it may deem desirable, and that some of the employees of the old company are to enlist under its banner. Mr. F. E. Kinsman, who was the original promoter of the first Electric Construction and Supply Company is the prime mover in the reorganization.

ENGLISH NOTES.

LONDON, Feb. 27, 1895.

MUNICIPAL TELEPHONY.—A debate is to take place in the House of Commons on Friday evening next on the subject of the granting of telephone licenses to municipalities.

ACCIDENTS AND EXPLOSIONS.—These continue to occur almost daily. Last week an official of the Bristol Corporation was killed whilst engaged in a job connected with a house transformer, and since then junction box explosions have occurred at Huddersfield and on the network of the St. Pancras Vestry. It is a relief to find that the gas companies are awakening to the proper sense of their duties in the matter of its explosions. At the last meeting of the South Metropolitan Gas Company the chairman, Mr. Geo. Livesay, alluded to the explosion on Southwark Bridge, and said that his company was quite alive to its duties, but the difficulties in the way of the proper supervision of gas pipes were immense.

CHEAP FUEL.—During the past week subscriptions have been invited for shares in a new company styling itself the "Empire" Economical Steam Producer Company. The object of this company is to manufacture a new kind of furnace grate for the consumption of cheap dust fuel, and as much as half of the capital is to be paid to the patentees for their inventions. The promoters of this scheme anticipate being able to get their plant fitted into one per cent. at least of the 300,000 stationary boilers in the United Kingdom, but it seems very doubtful whether dust fuel could be economically used in such a large proportion of boilers. It is rather amusing to note in the patent specifications that it is proposed to force a draft through perforations in the patent grate strong enough to keep the dust fuel floating clear above the grate, but the promoters do not say what is to prevent the fuel floating along the flues and up the chimney.

THE PROPAGATION OF MAGNETISM.—A special meeting of the Institution of Electrical Engineers was held last Thursday, when the members were treated to an interesting discussion by Dr. John Hopkinson, illustrated by some beautiful experiments on "The Propagation of Magnetism in Iron." Dr. Hopkinson's method of procedure is to bore out at different depths in an iron core tunnels in which he places detector coils; the ends being led to separate galvanometers. According to the diameter of the iron core and the strength of the magnetizing forces, the magnetism takes from a fraction of a second to 40 seconds or more to penetrate from the surface into the centre. This phenomenon was made admirably clear to the meeting by means of four galvanometers, the "spots" of which were thrown on to a screen. When the magnetizing current was turned on the top "spot" moved across the scale, and then in slow succession the "spots" underneath it, these belonging to galvanometers connected to exploring coils embedded in the iron at different depths.

General News.

NEW INCORPORATIONS.

THE DALTON TELEPHONE COMPANY, Dalton Ga., has been organized by Sam P Maddox, C. D. McCutchen, Jr., and J. C. Bivings.

THE SPARTANBURG TELEPHONE COMPANY, Spartanburg, S. C., capital stock $10,000, has been incorporated by J. T. Calvert, J. T. Jennings and others.

THE WICHITA MERCHANTS' TELEPHONE COMPANY, Wichita, Kan., has been incorporated by W. A. Minnick, G. W. Clements, J. M. Shakelford and others.

THE FULTON CHAIN TELEPHONE AND TELEGRAPH COMPANY, Boonville, N. Y., capital stock $4,000, has been incorporated by D. B. Sperry, D. Frank Sperry and others.

THE WHITE RIVER WATER POWER COMPANY, Tacoma, Wash., capital stock $2,000,000, has been incorporated to construct an electric power house in the Stuck valley, ten miles east of Tacoma.

THE CUSHMAN UNITED TELEPHONE COMPANY, Chicago, Ill., capital stock $20,000,000, has been incorporated by I. M. Cushman, O. O. Leabhart, and Joseph Barton to build telephone and telegraph appliances.

THE BATAVIA STREET RAILROAD COMPANY, Batavia, N. Y., capital stock $75,000, has been incorporated by Amos H. Stevens, A. B. Wilgus, J. S. Lindsay and others. The road is to be 7½ miles long and extend to Horseshoe Lake.

THE PHŒNIX TELEPHONE & MANUFACTURING COMPANY, Chicago, Ill., capital stock $100,000, has been formed to manufacture and sell telephone and other electrical goods and appliances, etc. LeR. Brown, E. E. Yaxley and J. H. Riley are interested.

THE ONTARIO ELECTRIC COMPANY, Ontario, Cal., capital stock, $100,000, has been organized to generate electricity for heat and power, and to operate water works, etc. John Jenkins, Chicago, Ill.; David Elcoat and Godtrey Stamm, of Ontario, Cal., are interested parties.

THE CITIZENS' ELECTRIC LIGHT & POWER COMPANY, Newark, O., capital stock $30,000, has been formed to generate and supply electricity for light, heat and power. The promoters are Wm. C. Taafel, Wm. D. Fulton, Frank G. Warden, Frank Owens and Wm. E. Miller.

THE CLEVELAND GAS & ELECTRIC FIXTURE COMPANY, Cleveland, O., capital stock $100,000, has been organized to make, buy, and sell gas and electric fixtures, copper and brass goods, etc. The promoters are Burton G. Tremaine, Bernard Schatzinger and Louis Paplous, all of Cleveland.

THE QUEENS COUNTY TELEPHONE, TELEGRAPH AND SUPPLY COMPANY, Oyster Bay, N. Y., capital stock $20,000, has been incorporated by Wm. L. Swan, Geo. W. Faller and others, to build and operate telephone and telegraph lines from Oyster Bay to Huntington, Flushing, Roslyn and intermediate points.

THE CITIZENS' LIGHT, HEAT AND POWER COMPANY, of Mahanoy Township, Shenandoah, Pa., capital stock $10,000, has been formed to supply light, heat and power. The promotors are John Riley and Harvey M. Wood, of 3,330 Woodland avenue, and John T. Lamorell, 506 E. 18th street, Philadelphia, Pa.

THE ANSONIA ELECTRICAL COMPANY, Ansonia, Conn., capital stock $56,000, has been formed to manufacture, buy, sell, etc., any and all kinds of articles, machines and supplies used in whole or in part for electrical purposes, etc. The promoters are Franklin Farrell, Franklin B. Platt, and Thos. Wallace, Jr., Ansonia, Conn.

THE AMERICAN COAL COMPANY, Seattle, Wash., capital stock $300,000, has been formed to mine, deal in minerals and fuel; operate steamboats, vessels, heater works, railways, telegraphs and telephones, and electric plants. The organizers are Frederick Nolte, P O. Skoyan, Alfred Meyers, W. A. Burleigh, Jr., and Geo. E. Wright.

THE MILAN, BIRMINGHAM & ELYRIA ELECTRIC RAILWAY COMPANY, Birmingham, O., capital stock $100,000, has been formed to construct and operate an electric railway and to furnish light, heat and power, etc. The organizers are Geo. W. Clary, C. P. Baker, H. P. Starr, H. D. Olds, W. L. Fay, F. Burk, E. H. Andress and C. A. Bristol.

THE FRANKLIN ELECTRIC ILLUMINATING COMPANY, Oyster Bay, N. Y., capital stock $25,000, has been incorporated for the purpose of supplying electricity for producing light, heat or power in the villages of Sea Cliff, Glen Cove, Red Spring, North Country and Dosoris. The promoters are Samuel Stenson, John Graham, Wm. A. Porter and others.

THE ALLENTOWN & READING ELECTRIC STREET RAILWAY COMPANY, Philadelphia, Pa., capital stock $108,000, has been formed to build an electric railway. Victor D. Barnes, Allentown; W. H. Kennedy, and P. J. Moore, Philadelphia, Pa., are interested. The company may be addressed in care of W. P. Rambo, 608 Penn Mutual Building, Philadelphia, Pa.

TELEGRAPH AND TELEPHONE.

READING, PA.—Steps are being taken to build a telephone factory in Reading.

BOYD'S, MD.—The Boyd's Telephone Company is in the market for electrical supplies.

HAZLETON, PA.—A long distance telephone line is to be built from here to Beaver Meadow.

HOLLAND, MICH.—W. A. Watson, of Grand Rapids, will establish a telephone exchange by April 1.

PALMYRA, MO.—Benjamin Moss and others have organized a company to establish a telephone system.

CHAMPAIGN, ILL.—Dr. P. S. Replogle has received a franchise to construct a telephone system in Champaign.

ATCHISON, KAN.—A new telephone company has been organized but will not begin operations until 300 names are secured.

CARTHAGE, MO.—Marion Caldwell, of the Phœnix Telephone Company, has been granted a franchise to establish a telephone system.

NYACK, N. Y.—M. F. Colgrove and others are organizing a company in Rockland County to connect the principal telephone lines of that county.

READING, PA.—Reading's Councils have granted the Pennsylvania Telephone Company permission to operate underground conduits in the city.

PITTSBURGH, KAN.—The Phœnix National Telephone Company, of Indianapolis has secured a franchise in Pittsburgh, Kan., and will construct a telephone system.

CANTON, O.—The Canton Telephone Company's franchise has been amended so as to permit the stringing of wires in cables on poles instead of in underground conduits.

SHARON, PA.—The Harrison Telephone Company has been granted a franchise to construct their lines through Sharon, and will operate in opposition to the Bell Telephone Company.

DUNKIRK, IND., will soon have its telephone system completed. The city has contracted with the Indiana Telephone & Construction Company, of Frankfort, Indiana, to use the Strowger Automatic Telephone Exchange.

CHAMPAIGN, ILL.—A company of capitalists is completing arrangements to put in a telephone exchange in Champaign and Urbana to compete with the Central Union. Connecting lines will be established with Danville, Decatur and Bloomington.

ELECTRIC LIGHT AND POWER.

MONTEZUMA, IND., is considering the question of putting in an electric light plant.

JAY, GA.—A fine mill is being erected by Messrs. Lance, Wood and others, to be run by electricity.

CAIRO, ILL.—A receiver has been appointed for the Delta Electric Light & Power Company.

NEW CASTLE, PA.—A complete system of electrical cranes will be put in the New Castle Steel & Tinplate Mill.

NEW LISBON, WIS.—The leading business and professional men of this city are advocating an electric light plant.

CENTRALIA, WASH.—The city has voted to issue 20-year bonds for the purpose of erecting an electric light plant.

MIDDLETOWN, N. Y.—The Middletown Light & Power Company is said to be in financial difficulty, a receiver having been appointed.

NEBRASKA CITY, NEB.—Plans and specifications for an electric lighting plant to cost $18,200 were accepted by the Council and placed on file.

CHESTER, PA.—The Chester Electric Light & Power Company are negotiating for a site for the erection of an electric light and power plant.

HOLLAND, MICH.—The Council committee on ways and means has recommended the issue of bonds for $12,000 to be used in extending the city's electric light plant.

MT. MORRIS, N. Y.—The Mt. Morris Electric Light Company has contracted with the city to furnish 1,200-cp arc lights every night until 1 a. m. for $57 per lamp per year.

NYACK, N. Y.—Abraham E. Benson, of New York City, will erect at the corner of Church street and Broadway, Nyack, a five-story building, to be electrically lighted by an isolated plant.

NORWALK, O.—The Norwalk electric light plant, which has been in the hands of assignees for some time, has been sold to B. P. Foster, of Toledo, for $13,000. The plant originally cost $50,000.

OAKLAND, CAL.—The Oakland Gas Light & Heat Company will enlarge its plant so as to be able to supply power, and the company is now in the market for $100,000 worth of new machinery.

CANAJOHARIE, N. Y.—The Canajoharie Electric Light & Power Company has made a contract with the village to furnish 30 arc lights of 2,000 cp each for $2 000 per year. The company has agreed to have the plant completed by June 1, but it will probably be finished by May 1.

CLEVELAND, O.—Sealed proposals will be received until March 16 for furnishing electric motors and machinery for operating the Columbus street double-swing bridge. Plans and specifications may be seen, and blank proposals can be obtained at the office of the chief engineer after March 11. J. H. Farley, director of public works.

MILWAUKEE WIS.—Sealed proposals will be received until March 12, 1895, for furnishing all materials and doing all work necessary to complete and install an electric light and power plant in the new City Hall, according to general specifications (and plan attached thereto) on file in this office. For further information address Wm. J. Fiebrantz, comptroller.

THE ELECTRIC RAILWAY.

ALTOONA PA.—The City Passenger Railway Company will extend its lines to Newburg.

ST. LOUIS, MO.—The Jefferson Avenue Railway Company will change its motive power to electricity.

KINGSTON, N Y.—The Colonial Street Railway Company is reported as being in the hands of a receiver.

PEORIA, ILL.—The Central Street Railway management will extend its line this spring to Springdale Cemetery.

ANNAPOLIS, MD.—Arrangements are being made to begin the construction of the Annapolis and Bay Ridge electric line.

NIAGARA FALLS, N. Y.—W. Caryl Ely has been granted a franchise to con[illegible] North Tonawanda.

NORTH ATTLEBORO, MASS.—A syndicate headed by Mr. E. R. Price have [illegible] for an electric railway.

DENISON, TEX.—The street car properties here have changed hands, and will be electrically equipped. Geo. L. [illegible] may be addressed.

POTTSVILLE, PA.—When the weather grows warmer the Schuylkill Electric Railway Company will commence $200,000 worth of trolley construction in Pottsville and suburbs.

PROVIDENCE, R. I.—The Narragansett Electric Lighting Company has received permission to maintain poles and wires along Arlington avenue from Humboldt avenue to Lloyd avenue.

VALPARAISO, IND.—A stock company has been formed composed of Chicago, Valparaiso and Hobart capitalists, to build an electric road from this point to Chicago. Freight to be shipped also.

AUGUSTA, ME.—In the House the bill to extend the charter of the Washington County Railway Company was amended to allow the construction of branch lines to be operated by either steam or electricity.

ALLENTOWN, PA.—A charter was granted by the State Department at Harrisburg to the Allentown & Reading Electric Railway Company, capital $108,000. Dr. J. S. Trexler, of Kutztown, is president of the company.

EDGEWATER (P. O. CHICAGO), ILL.—The electric power house of the Chicago & North Shore Electric Railway at Edgewater has burned down. The dynamos and most of the motor cars were destroyed. Loss $150,000.

CARLETON PLACE, ONT.—A charter has been granted for an electric railway 12 miles long between Napierville and Remi, Quebec, and another charter has been asked for a road between Lanark and Perth. The organizers will be ready about March 20 to make contracts for building both lines. James Fowler, Carleton Place, is interested.

GENEVA, N. Y.—Thomas Craig and others have purchased the Geneva & Waterloo electric railway, and will operate it in connection with the Seneca Falls & Waterloo Railway and with the Cayuga Park road, making a continuous line between Geneva, Cayuga and Cayuga Lake. It will be known a the Geneva & Cayuga Lake Traction Company.

PORTLAND, ME.—President W. R. Wood, Supt. E. A. Newman and others have returned from a trip to New York, Boston and other places, where they have been inspecting and contracting for electrical appliances for changing the car lines of the Portland Railway Company. Work will probably begin here April 1 and be completed by July 1. The three engines of the present Deering plant will be removed into the new station house, and in addition will be put in two large compound condensing engines, capable of developing 800 horse power each. When the whole system is equipped the company will have 21 miles of electric road.

PERSONAL NOTES.

MR. W. FRANK CARR, formerly general manager of the Roanoke Electric Light & Power Company, Roanoke, Va., has been appointed superintendent of electrical construction for the West Chicago Street Railway Company, vice Mr. J. S. Hill, resigned.

WHEN CHARLES E. BILLINGS organized the Billings & Spencer Co., of Hartford, Conn., in 1869, after having been connected with the Colt's Patent Fire Arms Company for six years, and afterwards with the gun factories of E. Remington & Sons, the process and methods of drop forging were crude, the work imperfect and the limits of practical application narrow. For a long time the latent possibilities in the system waited for the right man to develop them. It remained for the inventive talent of Mr. Billings, organizer and president of this company, to perfect the art of mechanical forging, which has been done on scientific principles. A single instance will illustrate. While visiting the Edison Machine Works in New York City in 1886, he noticed the method employed in making commutator bars. The segments were made in two pieces, united by rivets and solder. In conversation with the general manager of the works, the latter expressed the opinion that it was not possible to produce a commutator bar of one piece of wrought copper and give it the required shape. Mr. Billings, upon his return to Hartford, made a series of experiments, and in two months sent to the Edison Company an invoice of drop forged, pure lake copper commutator bars, each one made of a single piece of wrought copper, having a homogeneous molecular structure throughout, of the greatest possible density with an increased efficiency.

MISCELLANEOUS NOTES.

THE AMERICAN TELEGRAPH UNION was organized last week by a number of telegraph operators at a meeting in Clarendon Hall. About two hundred men were present. The meeting was called to order by Robert L. De Akers, who made an address advocating government control of the telegraph lines of the country. Mr. De Akers said the object of the organization was not for the purpose of precipitating or aiding strikes, but purely to expedite government control. Charles Matchett, a speaker on economic problems, also made a long address on government control. It was reported that similar organizations were being formed in Boston, Philadelphia, Chicago and other cities.

A COURSE OF SIX LECTURES on how electricity is now being utilized will be given by Prof. F. B. Crocker, in Room 11, Library Building, Columbia College, New York, on successive Thursday evenings at 8.15 o'clock, beginning March 21. These lectures will be very fully illustrated by experiments, and are specially intended for professional and business men who desire to obtain an intelligent idea of the present uses of electricity. Some of the subjects to be covered are "How Electricity Is Generated and Stored," "Alternating Currents," "Electric Railways," and "How Electricity Is Used for Lighting and Heating." Tickets for the course, at $5, may be obtained of the secretary or the president, Columbia College. Tickets will not be sold for single lectures.

A COURSE OF LECTURES ON ELECTRO-CHEMISTRY.—There has been started at the Johns Hopkins University an addition to the present electrical course, consisting of lectures and laboratory work on electro-chemistry. The work is being done by Mr. H. C. Jones, Ph.D., who has had a thorough training in this country and abroad under Ostwald. The course consists briefly of: 1. A historical sketch of electro-chemistry, including theories on electrolysis. 2. Electrical energy. 3. Discussion of the laws of Faraday. 4. The wandering of ions. 5. Conductivity methods and results. 6. Properties of ions. 7. Electromotive force. 8. Polarization. 9. Electrolysis. 10. Electro-chemical analysis. 11. Electro-metallurgy. There will be laboratory work in electrolysis and electro-metallurgy, and in such experiments as conductivity methods, etc. This course will be elective this year. It is attended by 50 students, of whom 27 are electrical engineers, 9 physicists, and 14 chemists.

Trade and Industrial Notes.

RALPH L. MONTAGUE, 1,504 Washington avenue, St. Louis, Mo., is publishing a handy wiring computer gotten up in chart form, which he is selling at a very reasonable price.

THE AMERICAN CIRCULAR LOOM COMPANY, Boston, Mass., is distributing a folder containing a number of strong testimonials concerning its flexible conduit, and a long list of users of the same.

MESSRS. WERNER & PFLEIDERER, Cannstatt, Wurtemburg, Germany, manufacturers of mixing and kneading machinery, include in their line mixing machines for use in the manufacture of arc light carbons.

MESSRS. DEEN & SCHAUM, Lancaster, Pa., announce that business in Lancaster is very good at present, and that the consolidation of the various electric light plants of that city has increased the motor business considerably.

MESSRS. H. B. COHO & CO., 203 Broadway, New York, announce among their recent contracts the electrical equipment for the Portland Apartments, Washington, D. C., and the new Lauderdale Building, Providence, R. I., and several motors for Messrs. Deen & Schaum, Lancaster, Pa.

H. E. COLLINS & CO., Pittsburgh, Pa., have just issued a very neat illustrated pamphlet describing the Caball vertical water tube boiler, for which they are sole United States agents. Very strong claims are made for the boiler, and a report is presented of a test made at Pittsburgh, which gives a very good showing.

STONE & WEBSTER, 4 Post Office Square, Boston, are distributing a pamphlet entitled "A Modern Power Plant," descriptive of a power station erected at Allentown, Pa., by the Industrial Improvement Company, of Boston. The plant is an interesting one and the designation embodied in the title of the book is very appropriate.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has secured the contract for the new station building of the Poughkeepsie (N. Y.) Electric Light & Power Company. The dynamo room will be 61x172 feet and the boiler room 60x77 feet, the whole to be covered with the Berlin Company's patent anti-condensation, corrugated iron roofing. This company also has a contract for an iron roof for the Hudson River Water Power & Paper Company's new machine shops.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is rejoicing over the decision in the Bate Refrigerating case. It is of particular value to the company in that it is enabled to be in the market again with the old reliable Packard lamp with platinum leading-in wires, which it has heretofore been unable to supply, owing to patent litigation. Where the merits of the old lamp are known the Electric Appliance Company states that a simple mention of the above facts brings in the business in a way that is making them decidedly happy.

THE NEW YORK ELECTRIC COMPANY, of Youngstown, O., is anxious to ascertain the whereabouts of A. F. Opperman, its former traveling salesman. It is reported that Opperman collected outstanding bills for the company, but entertained the opinion that he could use the money to better advantage than his employers, and accordingly decamped with something like $1,300. The shortage will not interfere with the company's operations, but its officials are desirous of finding Opperman and reconciling the difference of opinion as to the proper disposition of that money.

NORMAN HUBBARD, of 93 Pearl street, Brooklyn, manufacturer of the Packard vacuum pump, so largely used in the manufacture of incandescent lamps, reports a large increase in the number of inquiries received since the decision in the Bate case, indicating that there will probably be a number of new factories started. There are over 200 Packard pumps now in use by lamp makers in this country and Europe. These pumps are not intended for the final exhaustion of the lamp globes, but are used in connection with the carbon flashing apparatus and for operating mercurial pumps.

THE BILLINGS & SPENCER COMPANY, of Hartford, Conn., is now preparing to manufacture, in connection with its regular business of machinists' tools and drop forgings a line of drop-forged overhead trolley equipment. The experience and reputation of the company during the past 26 years is sufficient guarantee that the drop-forged trolley material they are now introducing will supply a long-felt want and will be generally accepted by the electric railways. The Billings patent drop-forged commutator bars are now in general use by street railways, and are very extensively used by some of the largest electrical manufacturing companies in the United States.

THE GOULDS MANUFACTURING COMPANY, of Seneca Falls, N. Y., was the successful bidder for triplex power pumps, boilers and engine for the new water works at Canandaigua, N. Y. This is to be an electrically operated pumping station, the plant consisting of a power station in Canandaigua and a pumping station at 33⅛ miles distant on the shore of Lake Canandaigua. The triplex pumps to be used for this plant will have 12x12-in cylinders and be capable of delivering 1,000,000 gallons per day each The pumps are to be driven by electric motors, current being supplied from the local power station. This plant will be the largest electrically operated water works in the United States.

AN EXCELLENT LITTLE DEVICE in the shape of a "date label" is being used by the New York & Ohio Company, Warren, O., makers of Packard lamps A small label is pasted on each lamp, on which is printed besides the candle power and voltage in the usual manner, three spaces headed respectively, Fin.——, Up——, B.O.——. In the first is marked at the factory the date on which the lamp is finished. The other two spaces are for the use of the consumer, to mark the date the lamp is put up and the date burned out. By this means users can be assured of getting "fresh" lamps, and can readily keep a record of their life. The device is certainly an evidence of good faith on the part of the maker and is a great convenience to the user.

MR. R. B. COREY will carry on an arc lamp and carbon business at 714 Havemeyer Building, New York City, with the Wallace Electric Company, Chicago, as western representatives John C. Knight, under whose arc lamp patents the Electric Construction and Supply Company manufactured this line of lamps, will be associated with Mr. Corey. The business will include the manufacture and sale of direct current lamps of all lengths and both plain and ornamental, twin lamps for direct current, alternating lamps, plain and ornamental, and street railway lamps; series arc lamps, plain and ornamental, and all styles of focussing lamps for photo-engraving, theatrical and photographing work, search lamps; in fact, everything that is practicable in the arc lamp line.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., reports the following recent sales made through its well-known western contractor, Mr. J. Holt Gates, of Chicago: two 65-kw new type direct-connected generators for Fort Dearborn Building, Chicago, to be used in connection with Ball & Wood engines; two 50 kw direct connected generators to be used with McIntosh & Seymour engines for the Lauderdale Building, Providence, R. I.; one [illegible] kw 220 volt generator to the Walter Ferris Coal Company, Salem, Ohio, and two 30-kw new type multipolar generators for the station of the Catasauqua Electric Light and Power Company, Catasauqua, Pa. The two generators last mentioned are of the Mather Company's latest type, and their speed does not exceed [illegible] revolutions per minute.

THE HEINE SAFETY BOILER COMPANY, of St. Louis has closed a contract for 1,332 hp for the new high duty dredge boat which the government has just contracted for. The boat is for Ohio and Mississippi river service, and is of about 1,000 tons burthen. It will be equipped with the highest grade of machinery, and is expected to make quick work with sand bars. The Heine Company feels particularly complimented by the selection of its boilers. The points of advantage in the Heine boiler which influenced its selection were its compactness, giving maximum power in minimum space; its economical use of fuel, involving smaller stocks of coal, and its ability to work with *extremely muddy water* just as it comes from the river. The special Heine mud drum permits deposit and removal of a large percentage of sediment in the water before it gets to the boiler proper.

Business Notices.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse; N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 5, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

535,010. TRANSFORMER; Fred S. Hunting, Fort Wayne, Ind. App. filed Feb. 25, 1892. A transformer comprising two or more circuits for inducing currents differing in phase, and cores influenced thereby so as to differ in inductive power, and a secondary circuit or circuits comprising in each a coil or coils wound on two or more of the cores in multiple.

535,027. RHEOSTAT; A. J. Shaw, Muskegon, Mich. App. filed Dec. 1, 1894. In a rheostat or like structure, the combination of a fixed conducting body adapted to be included in circuit, and provided with a rotatable contact and a pivoted or yielding contact finger movable against or over said rotatable contact.

535,042. TELEPHONE APPARATUS; O. L. Wullweber, Chicago, Ill. App. filed Jan. 7, 1893. The combination of a fixed frame having an arm for supporting the transmitter mouthpiece, of a ring fixed upon said arm for holding the mouthpiece, side projections on said ring and a folding extensible holder pivotally secured to such projections.

535,051. ELECTRIC ARC LAMP; H. P. Davis, Pittsburgh, Penn. App. filed Oct. 23, 1893. In an arc lamp a feed train for the movable carbon comprising a smooth brake wheel in combination with a pivoted brake lever having a notch, the sides of which are adapted to clip said brake wheel and a series and shunt coil adapted to cause said notch to hold and release said brake wheel.

535,052. ELECTRIC ARC LAMP; H. P. Davis, Pittsburgh, Pa. App. filed May 3, 1894. In a feed mechanism for arc lamps, a movable gear train for tripping the arc, an escapement for controlling the action thereof, a pivoted weighted stop located in the path of movement of said escapement and adapted to yield whenever the escapement is moved into engagement therewith and operating directly and solely by its weight to lock said escapement against movement.

535,060. DEMAGNETIZING APPARATUS; C. Houlgrave, Buffalo, N. Y. App. filed Jan. 22, 1894. An electromagnet comprising a solenoid having paramagnetic portions arranged externally, said paramagnetic portions consisting of two poles arranged diametrically opposite each other, and formed of laminals set on edge and arranged longitudinally of the solenoid windings, whereby an intense magnetic field may be formed within the solenoid.

535,067. ADVERTISING DEVICE; J. Montagner, Buenos Ayres, Argentine Republic. App. filed Dec. 15, 1894. A clutch comprising the combination of a plate secured to one shaft having two or more sets of apertures arranged in concentric circles, the apertures in the several circles being displaced angularly with reference to each other and a lever secured to the shaft carrying a plurality of pins, one of which will fit into one of the apertures.

535,069. LIGHT FIXTURE OR ANALOGOUS ARTICLE; W. McElroy and G. W. Bayley, Brooklyn, N. Y. App. filed May 9, 1891. An insulated coupling for light fixtures, comprising two tubular metallic sections insulated at their juncture by a washer of insulating material, the uppermost of said sections carrying an annular depending lip arranged out of electrical contact with the lowermost section and constructed of less outer diameter than the adjacent interior of the lowermost of said sections, whereby the drip through the coupling is precipitated within said lowermost section near its centre.

35,072. COOKING AND HEATING APPARATUS; H. G. O'Neill, Boston, Mass. App. filed Feb. 8, 1894. An article or utensil provided with an insulator and rigid conductors attached to the ends of the said insulator, and in combination with a range table or other support having depressible contact pieces arranged to receive the pressure of the said conductors or feet when the latter are set on them, circuit wires or equivalent conductors running to the said contact pieces and an electric lamp and connections arranged to be brought into the circuit when the said springs are thus depressed.

535,077. CIRCUIT INTERRUPTER FOR ALTERNATING ELECTRIC CURRENTS; H. N. Potter, Alleghany, Pa. App. filed Feb. 28, 1894. A circuit interrupting device, a number of non-arcing metal cylinders having gaps between them adapted to be bridged for the completion of a circuit, in combination with a shunt around one or more of said gaps, and device in said shunt for counteracting the arcing of lag in the current to be interrupted.

535,084. INSULATING CONDUIT FOR ELECTRIC CONDUCTORS; L. B. Stillwell and C. F. Scott, Pittsburgh, Pa. App. filed Oct. 25, 1894. A conduit for electric conductors comprising a plurality of tubes of insulating material, each consisting of telescoping joint-breaking sections, and all inclosed in a pipe or tube, the entire space in and around the said insulating tubes, except that occupied by the conductors, being filled with non-conducting liquid.

535,086. LIGHTNING ARRESTER; A. Wurts, Pittsburgh, Pa. App. filed Feb. 28, 1894. The combination with a plurality of non-arcing metal parts of a two part insulating holder therefor having oppositely arranged aligned sockets in which said non-arcing metal parts are seated, and passages leading outward from between said sockets.

535,090. ELECTRIC BATTERY; H. J. Brewer, New York, N. Y. App. filed May 2, 1892. The combination with a battery element, of a cover for the battery cell, a block or part of insulating material supported by the cover, a shank extending from said element into this block or part, a conductor fitting within said block or part in electrical communication with said element, and a set screw passing through said block or part and clamping the said strip of metal.

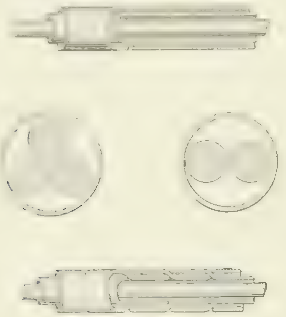
535,100 BURGLAR ALARM FOR GLASS DOORS; J. B. Gill, San Francisco, Cal. App. filed Feb. 27, 1893. In a burglar alarm a thin strip or film of metal applied to the inner face of glass doors, windows, etc., the continuity of which is broken and the ends provided with conductive metal inclosed by bibulous paper, connecting with the wires of a battery.

535,104. ARMATURE WINDING MACHINE; H. E. Heath, Windsor, Conn. App. filed May 15, 1894. In a winding or taping machine of this class an annular spool-carrier supported for rotation between peripherally disposed wheels or rollers and consisting of two rings having their inner faces mortised to form an elongated bearing for the axles of the tape-carrying spools, in combination with tape-carrying spools revolubly and removably supported in said bearings, spool-retaining tension devices, in connection with and adapted for preventing displacement of said spools and for regulating the tension of the tape as it is unwound from said spools, and means for rotating the carrier.

535,105. APPARATUS FOR WINDING ARMATURE COILS; H. E. Heath, Windsor, Conn. App. filed May 15, 1895. The combination consisting of a revoluble carrier having a retaining flange at one end thereof, a series of duplicate interchangeable former sections each comprising an annularly recessed hub with a transversely grooved peripheral flange at one end thereof, a combined guiding and locking device connected with said carrier and adapted for facilitating the positioning of the several sections relatively to each other and for locking them against rotation with each with relation to said carrier, and a binding-nut screwed upon the unflanged end of said carrier and clamping the several sections between said nut and the carrier-flange.

355,106. METHOD OF FORMING ARMATURE COILS; H. E. Heath, Windsor, Conn. App. filed May 15, 1894. The method of forming armature coils for dynamo-electric machines, which consists in first winding upon a former an elongated hexagonal coil having its opposite sides parallel with each other; and second, bending all of the short sides of said hexagon inwardly, without increasing the number of salient angles therein, and while maintaining the long sides in parallelism, to form two similar but oppositely disposed end portions, each of which has two parallel members perpendicular to the aforesaid long sides, and to form also a third short member connecting and [illegible] to each [illegible] said parallel members and in alignment with the opposite short member.

[illegible],107. WINDING OR TAPING MACHINE; H. E. Heath, Windsor, Conn. App. filed May 17, 1894. The combination with an annular spool carrier, of a stud, a tape carrying spool mounted upon said stud and adapted for rotation in a plane at an inclination to the plane of rotation for said carrier, and a clamp-screw adapted for pivotally securing said stud to one side of the carrier and for locking said stud in its adjusted position to prevent pivotal movement of said stud.



No. 535,084.—Insulating Conduit for Electric Conductors.

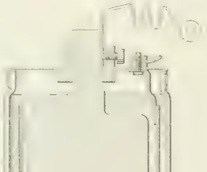
535,14[illegible]. SWITCH; C. S. Van Nuis, New Brunswick, N. J. App. filed Sept. 17, 1890. The combination of a switch arm, circuit terminals, contact plates secured to said circuit terminals and with which said switch arm makes contact, carbon contact plates also secured to said circuit terminals, and contact springs carried by said switch arm for making contact with said carbon contact plates.

535,158. METHOD OF AND APPARATUS FOR REGULATING ELECTRIC CIRCUITS; J. M. Bradford, Portland, Me. App. filed Jan. 9, 1894. The combination of a normally stationary current-varying device, electromagnets to govern the movements of said current-varying device, a stop-motion device to aid in controlling the movements of said current-varying device, electric circuits and a main current controller to cause said electromagnets and stop motion device to act oppositely by turns and driving gear to move said current-varying device progressively or retrogressively.

535,179. TYPEWRITING MACHINE ATTACHMENT; C. Spiro, New York, N. Y. App. filed Oct. 9, 1894. The combination with the type-bar, ligament and key-lever of a typewriting machine, of a fixed conductive bar, a pivoted contact arm carried by a pivoted device, a link connecting said arm with the key lever, a retarding mechanism, and a link connecting the same with said key lever whereby the contact arm is thrown out of operation in the downward or printing movement of the key-lever, and is brought into operation with retarded speed upon the return movement of the key-lever.

535,199. INCANDESCENT LAMP; F. L. Fowler, Philadelphia, Pa. App. filed July 30, 1894. The combination of a bulb having a projecting flange, the collar having a seat for said flange and having also external screw threads of different diameters, the filament carrying a plug screwed into the said collar, and a packing ring interposed between the said plug and the flange of the bulb.

535,214. CONTACT DEVICE FOR CONDUIT ELECTRIC RAILWAYS; F. E. Lodetti, Rondout, N. Y. App. filed May 4, 1894. The combination with a feed conductor having a casing provided with an entering slot, of a vehicle having an elastic guide arranged longitudinally, said guide being adapted to enter and move in the said slot, and a collector depending from the guide throughout its length and attached thereto at intervals and having electrical connections with a motor on the vehicle.



No. 535,090.—Electric Battery.

535,247. BATTERY TELEPHONE TRANSMITTER.; W. W. Jacques, Newton, Mass. App. filed June 22, 1894. A telephone transmitter with an electrode or variable resistance medium consisting of metal with its surface converted into one of its own salts.

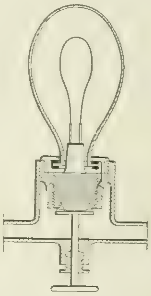
535,284. TELEPHONE TRANSMITTER; J. H. M. Goodman, Louisville, Ky. App. filed Sept. 19, 1894. A telephone instrument with the diaphragm and with two magnets having their opposite poles approximated and a mass of comminuted magnetic material interposed between such poles, of a spring or flexible arm forming a support for one of said magnets, and maintaining it in light contact with the diaphragm, and an adjustable arm forming the support for the other magnets.

535,289. TELEPHONY; W. W. Jacques, Newton, Mass. App. filed May 26, 1892. A method for transmitting vocal or other sounds electrically, which consists in passing through a multitude of loose contacts in a circuit an electrical current sufficiently strong to maintain said contacts in continuous rapid vibration and superimposing upon such vibrations due to sound waves.

535,294. CLOSED CONDUIT FOR ELECTRIC RAILWAYS; P. Murphy, Chicago, Ill. App. filed Jan. 9, 1894. The combination with a trolley wire of a normally closed circuit inclosing same said conduit, comprising a pair of hinged members with their edges normally closed together and traveling wheels supported on the car, and adapted to move on the exterior of said conduit, for engaging said hinged members to separate the same and permit the passage of the trolley support.

535,297. SECTIONAL CONDUCTOR SYSTEM FOR ELECTRIC RAILWAYS; A. Rosenholz, San Francisco, Cal. App. filed Oct. 11, 1894. An electric conduit and distributing switch, consisting of a hermetically inclosed and insulated main conductor having contact points exposed at intervals, sealed insulating casings with insulating journals turnable about the main conductor and inclosing the exposed portions thereof, said casings supporting independent sectional trolley wires upon the movable ends, and interior contact plates and armatures connected with the trolley wires, stationary cores fixed to and insulated from the main conductors projecting within the insulating casings and having contact plates adjacent to those carried by the casings, and insulated conducting wires coiled about the core, connected with the main conductor at one end, and with the contact end of the core at the opposite end.

535,299. COMBINED TELEGRAPH AND TELEPHONE SYSTEM; C. A. Shea, Boston, Mass. App. filed Jan. 3, 1893. In a combined telegraph and telephone system, the combination of two main lines, independent telegraph instruments therefor, a telephone or telephone converter, two branches proceeding from each telegraph instrument and oppositely wound about the telephone or converter coils, one of said branches at each side being connected with its main line, means for stopping telephonic impulses along the other branches and a telephonic circuit connection between the lines.



No. 535,199.—Incandescent Electric Lamp.

535,304. MOUNTING FOR ELECTRIC MOTORS; E. A. Sperry, Cleveland, O. App. filed April 13, 1894. In a power transmission for vehicles a bi-axle running gear, a motor mounted upon each axle through an elastic connection and extending therefrom in such a manner that its centre of gravity shall pass through a vertical at one side of the axle, an arm extending from one motor to the other attached to the motors at points on the opposite sides respectively of their centres of gravity.

535,321. ELECTRIC HEATER OR RHEOSTAT; J. H. Delany, New York, N. Y. App. filed Nov. 23, 1894. An electric heater or rheostat consisting of a base or support of porcelain or such like material, a heating or resistance conductor applied thereto, and a coating of vitreous enamel intimately united with the base and conductor, and securely uniting them, and an exposed contact plate or terminal embedded in and secured in position by the enamel coating.

535,324. ELECTRIC RAILWAY CONDUIT; W. T. Dulany, Jr., New York, N. Y. App. filed Dec. 14, 1894. In an electric railway conduit having a drainage cesspool connected therewith, the combination of the cesspool discharge pipe having a float check valve therein, an electrically operated pump having its suction pipe within said drainage cesspool and means whereby said pump is automatically started and stopped by variations in the level of the water in said drainage cesspool above the float check valve.

535,332. TRAIN SIGNAL FOR RAILWAYS; A. H. R. Guiley, S. Easton, Pa. App. filed Jan. 22, 1894. The combination of long thin plates bent downward and fastened at their ends, a series of standards secured to the tiles and plates, and a series of contact buttons inserted at intervals along the plate composed of plugs or bolts of non-oxidizing metal or of a metal which is protected by galvanic union with the iron of the plate and connected to the wire of the plate.

535,336. ELECTRIC LAMP SUPPORT AND CUTOUT; L. Johnson, New Albany, Ind. App. filed April 5, 1894. The combination of a supporting wire, hangers attached thereto, loops carried by the lamp, a carrier movable back and forth along the wire relative to said hangers, two sheaves journaled by the carrier, a rope passing from the lamp to each of said sheaves, thence in opposite directions to suitably located pulleys, and thence to a point at which it may be manipulated to move the carrier in either of its directions along the wire.

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TESLA'S LOSS.

The destruction of Tesla's laboratory by fire last week was a loss that will be deplored by the entire world, and is one of the most severe that could have befallen electrical science. In it were gathered the fruits of labor in fields of research that none but Tesla had ever entered, and therefore there is none to lend a hand in repairing the damage done. The expressions of sympathy heard on every side are assurances of the universal estimation in which the gifted inventor is held, not only among electricians who know the greatness of his work and have experienced the charm of his personality, but by the general public, which so thoroughly believe in the promise contained in his great researches. We merely echo, therefore, the sentiments of all when we offer our warmest sympathy to the great inventor in his trial, and express the hope that the loss is not irreparable, and will not long deprive the world of his labors thus interrupted.

RATING OF FEED-WATER HEATERS.

A number of prominent feed water manufacturers have started a movement having for an object the rating of closed feed water heaters with reference to the available heating surface. This is a commendable step in advance, which should receive the support of engineers, for heretofore the rating of these apparatus has had a basis far from satisfactory if, indeed, it can be said there was any rational basis at all. While users have of course suffered from this state of affairs, it has also served to handicap the more reputable dealers, who have been unable to support their arguments against the claims of unprincipled competitors through the lack of any convention as to the criterion to be applied in fixing the capacity of an apparatus. As stated above, the rating proposed, and which has already been adopted by a number of prominent makers, is based upon the quantity of heating surface, rating by horse power having been rejected on account of its indefiniteness. It is contended, and with reason, that a rating by horse power would be extremely unsatisfactory, not only on account of the great variation in the consumption of steam by different types of engines, but also from the fact that the mean difference of temperature between the exhaust and feed water varies very widely in different cases. While this rating by surface will be conducive to fair competition and furnish the educated engineer with the necessary data for his specifications, it would be meaningless to the ordinary purchaser, and therefore we think it might be well for manufacturers to supplement it with a table of data that the latter may be enabled to fix upon the quantity of surface required for his specific case. By assuming different mean temperatures in the heater, and fixing on an evaporative rate per square foot of surface, a table could be prepared applying to various rates of water consumption per horse power which would enable the user to select himself the capacity of feed water heater required in a given case, or would at least serve to place him on guard against the false application of surface data by unscrupulous sellers.

AN UNJUST PATENT STATUTE.

In our comments on the Bate Refrigerating decision we referred to the necessity of American inventors taking measures to have eliminated from the famous Revised Statute No. 4,887, the provision which so unjustly tends to shorten the life of an American patent when a foreign patent on the same invention is taken out. In our last issue Prof. Elihu Thomson discusses the same question and shows very clearly the extent of the injury the clause referred to may work. Among other things he brings out the point that the question is one that does not affect inventors alone, but also results in credit being accorded to other nationalities for discoveries in science and for inventions that in fact have been first made in this country, but their publication withheld here in order that the patent interest at stake might not be prejudiced. The matter is one, consequently, which affects our national pride, and therefore appeals to every American, aside from any interest he may have in patents or in our system of patent protection. One of the proudest claims for a people is the possession of the creative faculty, and when a government by its enactments virtually falsifies the record upon which history bases its verdict in regard to this point, it commits an unpardonable offense against patriotic pride. When to this is united a gross injustice to the class of its citizens who, through their inventions, have done so much to elevate the country to its present enviable industrial position, the offense takes on the aspect of a crime. We believe that through concerted action on the part of inventors, and by a proper representation of the case, on its merits, Congress will, now that it has passed beyond the power of the courts to remedy the evil, be inclined to view with favor the enactment of the necessary legislation. Owing, however, to the unpopularity of some of the interests most affected by the law in its present state, it would be well to keep the issue disassociated from these, and this could not be done better than by giving due prominence to the point brought out by Prof. Thomson.

DEFINITION OF POLYPHASE SYSTEMS.

In another column we print a letter from Mr. C. P. Steinmetz sustaining his definition of a polyphase system, based upon its feature of maintaining a constant flow of energy. While acknowledging the force of the argument advanced that this definition separates true polyphased systems from simple alternating systems in which differences of phase may exist, we cannot agree with its inferences that difference of phase is merely a secondary consideration in the definition of a polyphased system, or that a system relying for its action upon differences of phase should be excluded from that class because the flow of energy in its circuits is not constant. In technical science we believe a definition should rather be confined to the characteristics that have a practical bearing and which distinguish it sharply from other systems, than to those which have merely an ulterior interest. In the present instance no idea of the technical properties of a polyphased system can be obtained from a definition which applies with equal force to a direct current system. The characteristic by which it is thus distinguished is one that has no bearing whatever on the properties of polyphase systems which have brought them into use, and by which they are differentiated in technical science from other systems. We cannot see that the question is affected by the fact that differences of phase may be produced from a simple alternating circuit, as in that case the action is localized and has no effect on the system as a whole; it should rather be considered a case in which polyphase apparatus is used on a simple alternating circuit than furnish cause for a change in the definition of polyphase systems. We think the rational view is that since difference of phase is the property for which a polyphased system is employed, it should be defined with reference to that property and not with reference to one, the recognition of whose existence is practically a matter of indifference, and which is confusing by equally including direct currents. There is a limit to which the generality of definition may be carried, as Diogenes well illustrated when he sent a plucked fowl as an object lesson to the philosophers who defined man as "a featherless biped."

HIGH VOLTAGE ELECTRICAL LINES.

Dr. Bell in this week's installment of his serial on the electrical transmission of power includes an interesting discussion on the insulation of electrical lines of high voltage, to which we particularly direct our readers' attention. The matter of the electrical transmission of power has now reached a stage when this question becomes one of importance, and no one is better qualified than Dr. Bell, both from the theoretical and engineering standpoint, to point out the best solution admissible under our present commercial limitations and state of knowledge. As far as safety to life is concerned, the ideal high voltage line would appear to be that employed by Ferranti in London on a 10,000-volt circuit, consisting of underground concentric conductors with an iron pipe armor, the latter being grounded to dissipate the static charge. The great cost of this system, however, would be prohibitive in most cases, even when employed merely for distribution purposes, while in long lines it is probable that the capacity effect would introduce complications. Next in order come the usual systems of underground conductors, in which an element of danger is introduced through the possibility of one side of the line becoming grounded. For overhead lines of high voltage there can be no doubt but that the safest plan consists in the employment of bare wires, as in that case the danger from false reliance on insulation would be eliminated, and the sight of the bare wire would cause the necessary precautions for safety to be always observed, which otherwise are too often neglected. Any measure of safety that tends to give rise to a false sense of security in the face of danger is always liable to do more harm than good, and the insulation of high voltage overhead lines, on account of its liability to deterioration, both physical and mechanical, is a dangerous safeguard. With very high voltages an additional element enters from the insulation becoming weakened through the great stress to which it is subjected, thus rendering the line dangerous though in the best of condition with respect to the covering of the wire. In view of these considerations, a high voltage line should always be treated as dangerous, and the most obvious precaution should be to have it uninsulated in order that this precaution may more surely be observed.

Tesla's Laboratory Destroyed.

A fire in the building at 35 South Fifth avenue on the morning of March 13 utterly destroyed the laboratory of Nikola Tesla, which occupied the two upper floors. The destruction was most complete, nothing having been saved from the wreck. Mr. Tesla had occupied this laboratory for several years and in it were gathered all of the results of his labors for years in many lines of work, notably in the utilization of electrical currents of high frequency and voltage. All of the magnificent apparatus which he used to illustrate his lectures on high frequency effects was destroyed, with the latest forms of his new type of dynamo, which was approaching commercial completion, besides scores of pieces of experimental apparatus employed by Mr. Tesla in researches, extending to every department of electrical science.

Load Factor in New York Edison Stations.

In the discussion of Mr. H. Ward Leonard's paper at the February meeting of the American Institute of Electrical Engineers, Mr. John W. Lieb said that the load factor of the combined stations of the Edison Electric Illuminating Company, of New York, on the day of last year when the output was greatest (Dec. 10) was 34½ per cent. The load factor of the lower district supplied by the company, in which is included a large motor load, is somewhat less than 34 per cent.; the load factor of the upper district, which has only a small motor load, being slightly greater. The total kw hours of output of the combined London stations on Dec. 19 of last year, was 96,240. The combined output of the Edison stations in New York City on Dec. 10 was 60,633 kw hours. The maximum load carried at any one time was in the case of the combined London stations, 11,600 kw; combined Edison stations in New York, 7,354 kw. The connected installation in the case of the combined Edison stations in New York was: incandescent lamps, 234,494; arc lamps, 3,014; motors, 7,616 hp; or a total equivalent installed of 178,000 amperes. Mr. Lieb said it may seem strange that the load factor of such a district as the lower district of New York City, in which the motor capacity connected (in kw equivalents) represents 42 per cent. of the total connected installation, is not greater than in the case of the upper district, where the motor load represents only 16 per cent. of the installation. This is due to the fact that the lower district is eminently a business and industrial locality, and that after six o'clock the load curve drops off very rapidly to a minimum, while in the upper district is a business and residential locality where the day load is light, but the evening load keeps up well and falls off gradually.

Theories of Atmospheric Electricity.

According to Prof. Schuster, of London, there have been no less than 25 theories proposed for atmospheric electricity between 1753 and 1886, the most fruitful year having been 1884 when no less than five brand-new theories made their appearance.

Electrical Units.

The act of Congress, passed July 12, 1894, which established and defined certain units of electrical measure, required that the National Academy of Sciences should prescribe and publish specifications necessary for the practical applications of these units. A committee for this purpose was selected from members of the Academy, whose report was submitted to Congress on Feb. 19; the committee consisted of Prof. H. A. Rowland, chairman, and Profs. G. F. Barker, J. Trowbridge, E. S. Hastings and A. A. Michelson, Dr. C. Barns and Gen. H. L. Abbott.

The specifications prepared by the committee refer to the ampere and volt, and are as follows:

THE AMPERE.

In employing the silver voltameter to measure currents of about one ampere, the following arrangements shall be adopted:

The kathode on which the silver is to be deposited shall take the form of a platinum bowl not less than 10 centimetres in diameter, and from 4 to 5 centimetres in depth.

The anode shall be a disc or plate of pure silver some 30 square centimetres in area and 2 or 3 millimetres in thickness.

This shall be supported horizontally in the liquid near the top of the solution by a silver rod riveted through its centre. To prevent the disintegrated silver which is formed on the anode from falling upon the kathode, the anode shall be wrapped around with pure filter paper, secured at the back by suitable folding.

The liquid shall consist of a neutral solution of pure silver nitrate, containing about 15 parts by weight of the nitrate to 85 parts of water.

The resistance of the voltameter changes somewhat as the current passes. To prevent these changes having too great an effect on the current, some resistance besides that of the voltameter should be inserted in the circuit. The total metallic resistance of the circuit should not be less than 10 ohms.

Method of Making a Measurement.—The platinum bowl is to be washed consecutively with nitric acid, distilled water and absolute alcohol; it is then to be dried at 160° C., and left to cool in a desiccator. When thoroughly cool it is to be weighed carefully.

It is to be nearly filled with the solution and connected to the rest of the circuit by being placed on a clean insulated copper support to which a binding screw is attached.

The anode is then to be immersed in the solution so as to be well covered by it and supported in that position; the connections to the rest of the circuit are then to be made.

Contact is to be made at the key, noting the time. The current is to be allowed to pass for not less than half an hour, and the time of breaking contact observed.

The solution is now to be removed from the bowl and the deposit washed with distilled water and left to soak for at least six hours. It is then to be rinsed successively with distilled water and absolute alcohol and dried in a hot-air bath at a temperature of about 160° C. After cooling in a desiccator it is to be weighed again. The gain in mass gives the silver deposited.

To find the time average of the current in amperes, this mass, expressed in grams, must be divided by the number of seconds during which the current has passed and by 0.001118.

In determining the constant of an instrument by this method, the current should be kept as nearly uniform as possible and the readings of the instrument observed at frequent intervals of time. These observations give a curve from which the reading corresponding to the mean current (time average of the current) can be found. The current, as calculated from the voltameter results, corresponds to this reading.

The current used in this experiment must be obtained from a battery and not from a dynamo, especially when the instrument to be calibrated is an electrodynamometer.

THE VOLT.

Definition and Properties of the Cell.—The cell has for its positive electrode mercury, and for its negative electrode amalgamated zinc; the electrolyte consists of a saturated solution of zinc sulphate and mercurous sulphate. The electromotive force is 1.434 volts at 15° C., and between 10° C. and 25° C., by the increase of 1° C. in temperature, the electromotive force decreases by 0.00115 of a volt.

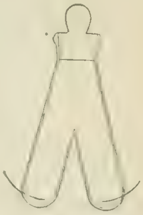
1. Preparation of the Mercury.—To secure purity it should be first treated with acid in the usual manner, and subsequently distilled *in vacuo*.

2. Preparation of the Zinc Amalgam.—The zinc designated in commerce as "commercially pure" can be used without further preparation. For the preparation of the amalgam one part by weight of zinc is to be added to nine (9) parts by weight of mercury and both are to be heated in a porcelain dish at 100° C. with moderate stirring until the zinc has been fully dissolved in the mercury.

3. *Preparation of the Mercurous Sulphate.*—Take mercurous sulphate, purchased as pure, mix with it a small quantity of pure mercury and wash the whole thoroughly with cold distilled water by agitation in a bottle; drain off the water and repeat the process at least twice. After the last washing drain off as much of the water as possible. (For further details of purification, see Note A.)

4. Preparation of the Zinc Sulphate Solution.—Prepare a neutral saturated solution of pure re-crystallized zinc sulphate, free from iron, by mixing distilled water with nearly twice its weight of crystals of pure zinc sulphate and adding zinc oxide in the proportion of about 2 per cent. by weight of the zinc sulphate crystals to neutralize any free acid. The crystals should be dissolved with the aid of gentle heat, but the temperature to which the solution is raised must not exceed 30° C. Mercurous sulphate, treated as described in 3, shall be added in the proportion of about 12 per cent. by weight of the zinc sulphate crystals to neutralize the free zinc oxide remaining, and then the solution filtered, while still warm, into a stock bottle. Crystals should form as it cools.

5. Preparation of the Mercurous Sulphate and Zinc Sulphate Paste.—For making the paste, two or three parts by weight of mercurous sulphate are to be added to one by weight of mercury. If the sulphate be dry, it is to be mixed with a paste consisting of zinc sulphate crystals and a concentrated zinc sulphate solution, so that the whole constitutes a stiff mass, which is permeated throughout by zinc sulphate crystals and globules of mercury. If the sulphate, however, be moist, only zinc sulphate crystals are to be added; care must, however, be taken that these occur in excess and are not dissolved after continued standing. The mercury must, in this case also, permeate the paste in little globules. It is advantageous to crush the zinc sulphate crystals before using, since the paste can then be better manipulated.



To Set Up the Cell.—The containing glass vessel, represented in the accompanying figure, shall consist of two limbs closed at bottom and joined above to a common neck fitted with a ground glass stopper. The diameter of the limbs should be at least 2 centimetres, and their length at least 3 centimetres. The neck should be not less than 1.5 centimetres in diameter. At the bottom of each limb a platinum wire of about 0.4 millimetre diameter is sealed though the glass.

To set up the cell, place in one limb pure mercury, and in the other hot liquid amalgam, containing 90 parts mercury and 10 parts zinc. The platinum wires at the bottom must be completely covered by the mercury and the amalgam respectively. On the mercury, place a layer one centimetre thick of the zinc and mercurous sulphate paste described in 5. Both this paste and the zinc amalgam must then be covered with a layer of the neutral zinc sulphate crystals one centimetre thick. The whole vessel must then be filled with the saturated zinc sulphate solution, and the stopper inserted so that it shall just touch it, leaving, however, a small bubble to guard against breakage when the temperature rises.

Before finally inserting the glass stopper it is to be brushed round its upper edge with a strong alcoholic solution of shellac and pressed firmly in place. (For details of filling the cell, see Note B.)

The following notes are appended to the specifications:

(A.) The Mercurous Sulphate.—The treatment of the mercurous sulphate has for its object the removal of any mercuric sulphate, which is often present as an impurity.

Mercuric sulphate decomposes in the presence of water into an acid and a basic sulphate. The latter is a yellow substance—turpeth mineral—practically insoluble in water; its presence at any rate in moderate quantities has no effect on the cell. If, however, it be formed, the acid sulphate is also formed. This is soluble in water and the acid produced affects the electromotive force. The object of the washings is to dissolve and remove this acid sulphate and for this purpose the three washings described in the specification will suffice in nearly all cases. If, however, much of the turpeth mineral be formed, it shows that there is a great deal of the acid sulphate present, and it will then be wiser to obtain a fresh sample of mercurous sulphate rather than to try by repeated washings to get rid of all the acid.

The free mercury helps in the process of removing the acid, for the acid mercuric sulphate attacks it, forming mercurous sulphate.

Pure mercurous sulphate, when quite free from acid, shows on repeated washing a faint yellow tinge, which is due to the formation of a basic mercurous salt distinct from the turpeth mineral, or basic mercuric sulphate. The appearance of this primrose-yellow tint may be taken as an indication that all the acid has been removed; the washing may with advantage be continued until this tint appears.

(*B.*) *Filling the Cell.*—After thoroughly cleaning and drying the glass vessel, place it in a hot water bath. Then pass through the neck of the vessel a thin glass tube reaching to the bottom to serve for the introduction of the amalgam. This tube should be as large as the glass vessel will admit. It serves to protect the upper part of the cell from being soiled with the amalgam. To fill in the amalgam, a clean dropping tube about 10 cms long, drawn out to a fine point, should be used. Its lower end is brought under the surface of the amalgam heated in a porcelain dish, and some of the amalgam is drawn into the tube by means of the rubber bulb. The point is then quickly cleaned of dross with filter paper, and is passed through the wider tube to the bottom and emptied by pressing the bulb. The point of the tube must be so fine that the amalgam will come out only on squeezing the bulb. This process is repeated until the limb contains the desired quantity of the amalgam. The vessel is then removed from the water bath. After cooling, the amalgam must adhere to the glass and must show a clean surface with a metallic lustre.

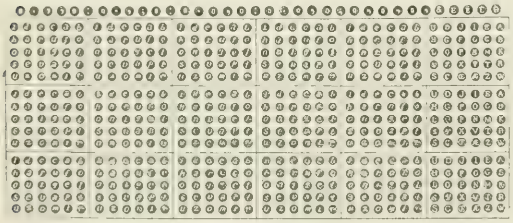
For insertion of the mercury, a dropping tube with a long stem will be found convenient. The paste may be poured in through a wide tube reaching nearly down to the mercury, and having a funnel-shaped top. If the paste does not move down freely it may be pushed down with a small glass rod. The paste and the amalgam are then both covered with the zinc sulphate crystals before the concentrated zinc sulphate solution is poured in. This should be added through a small funnel so as to leave the neck of the vessel clean and dry.

For convenience and security in handling the cell may be mounted in a suitable case so as to be at all times open to inspection.

In using the cell, sudden variations of temperature should as far as possible be avoided, since the changes in electromotive force lag behind those of temperature.

An Electrical Typesetting Machine.

A French journal recently described an electrical typesetting machine invented by a Dominican friar, Father Calendoli by name, which we illustrate in the accompanying engravings. As in all other typesetting machines, Father Calendoli makes use of a keyboard, but the one he used differs radically from those employed by other inventors in that the keys corresponding to all the letters in a word of reasonable length may be simultaneously depressed and the type will be set in proper order. The keyboard is shown below, and, as will be seen, consists of a number of keyboards assembled in one frame. There are fifteen similar alphabets of lower case letters to the left, three of upper case letters to the right, and a line of punctuation marks, etc., along the top. There are 30 keys; the vowels *a, e, i, o* on each are triplicated and the vowel *u* is duplicated, while each consonant has a key to itself. The letters have been arranged in order of their frequency of employment in the French language. Thus, *i* is repeated three times, first, as the first left-hand key on the upper row; second, as the third in the centre row, and third, as the next to the last to the right in the lowermost line. In composing a word the operator may select the *i*, for instance, which is most convenient to the position in which his fingers happen to be in. Thus, if he wished to set the word *roi* the *i* would naturally fall to the third finger of the left hand, while for the word *soi* the *i* on the lower line would be struck by the index finger of the same hand. It is claimed that with a little practice following an acquisition of a thorough knowledge of the keyboard, selections of the proper letters would be made almost instinctively.



Keyboard.

The letters forming a word are, in practice, struck simultaneously, and the sequence in which the letters are arranged depends upon the order in which the respective keys are released. Thus, in setting the word *roi*, the three keys corresponding to the letters of the word would be depressed at one blow, and the *r* key released first, the *o* key next and lastly the *i*.

The types are contained in vertical tubes at the back of the keyboard, resembling the pipes of an organ. At the bottom of each tube is a releasing bolt actuated by an electromagnet, which is in turn controlled by its respective keys. Depressing the key puts the type in position to be dropped into place, and releasing the key drops the type in the chute leading to the galley. The body of the type is much shorter than is commonly the case and has a deep groove in the lower end. From the magazine tubes the types pass along an inclined chute to the galley where they are automatically threaded on line rods.

ELEC WORLD N.Y.

Inventor Operating His Machine.

The feature claimed for the machine is its rapidity of operation, the manipulator being able to simultaneously depress as many keys as his fingers can conveniently reach. The duplication of keyboards is intended to facilitate the operation by having any letter in the alphabet within convenient reach at all times irrespective of the position of the operator's hands. It is said that the speed attainable by practiced operators is four or five times as great as that possible with other typesetting machines now in use.

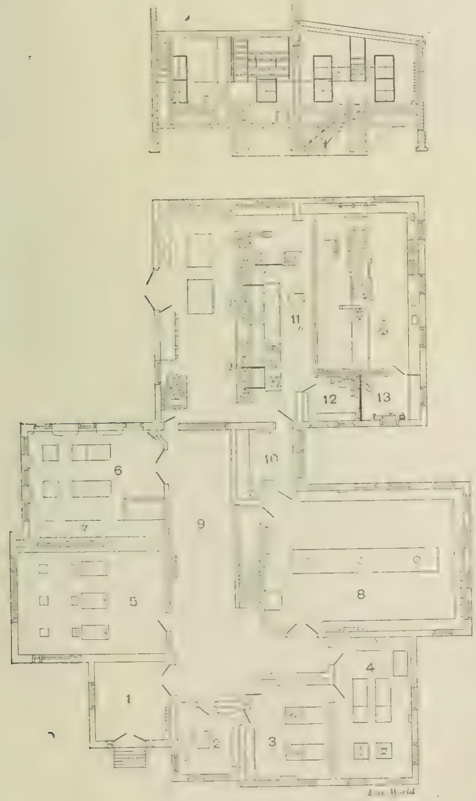
The American Association for the Advancement of Science.

The next meeting of the American Association for the Advancement of Science has been appointed for Springfield, Mass., August 19–September 4, 1895. Meetings of affiliated societies begin on Monday, August 26. It was expected when the Brooklyn meeting adjourned that the meeting this year would be held at San Francisco, and that liberal rail rates would be granted, which hope could not be realized.

Electrical Engineering at Purdue University.

PURDUE University, pleasantly located at La Fayette, Ind., is the engineering school of the State and owes its existence and support to gifts from John Purdue, Amos Heavilon, State appropriation, and the Morrill bills, from which most of the State universities of the country receive a considerable portion of their income. While the university was established about twenty years ago, its growth was not rapid until within the past ten years, during which time, under the able management of President James H. Smart, it has rapidly developed, until it stands among the leading technical colleges of the country.

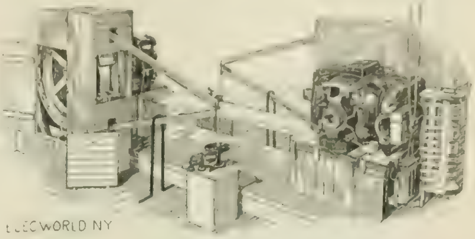
In the organization of the university there are five distinct schools; those of civil, mechanical and electrical engineering, of science and of agriculture; each provided with well appointed laboratories and separate faculties, but all available for the students of any one course, so far as the work of the other courses will be of advantage to the particular course considered. As this description has to do with the purely electrical work of the university, it will be confined to work done in the electrical building, a large brick structure with stone trimmings, which is given up to the uses of the department.



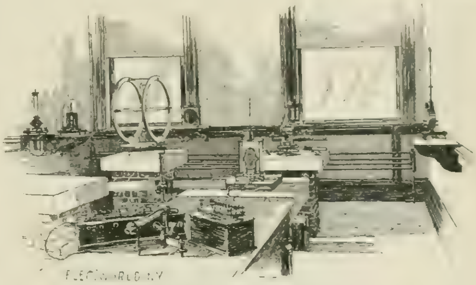
PLAN AND ELEVATION OF BUILDING.

The department of electrical engineering was established during the academic year of 1888–89 under the direction of Dr. Louis Bell, and, from a beginning with three students in that year, the department has grown until the present time, when the enrollment in electrical engineering is over two hundred.

The course in electrical engineering is, throughout the freshman and sophomore years, almost identical with that in civil and mechanical engineering and the students have the benefit of the thoroughly appointed courses in shop work, drawing and machine design provided in the school of mechanical engineering. In the junior year, the courses begin to diverge and the work is arranged so as to include instruction in the finely equipped mechanical laboratory, and other class and lecture work of the schools of civil and mechanical engineering, and, at the same time, make preparation for the senior work by providing instruction in the electrical laboratory, and class and lecture work on elementary electrical subjects, throughout the year. In the senior year, work in the mechanical laboratory is continued, but most of the time is spent in electrical engineering, which is arranged so as to give prominence to four distinct lines of study, as follows:



MOUNTING OF STREET RAILWAY MOTORS.



PIER ROOM NO. 4.

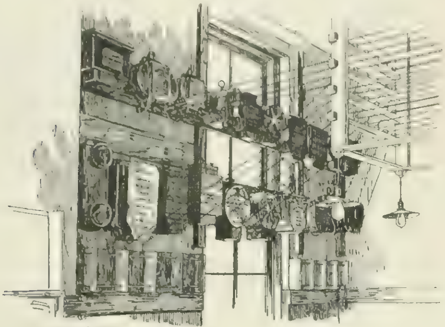
1. Experimental work in the electrical laboratory, involving the operation, testing and construction of the usual electrical machines and apparatus met with in practice; the study of direct currents incandescent, arc and power systems; of alternators, transformer, and multiphase machines; of methods of exact electrical measurement, and often the testing or installing of commercial systems under the conditions of actual engineering practice.

JUNIOR LABORATORY.

2. Lectures throughout the year on the general practice of electrical engineering, including the design, commercial operation and maintenance of electrical apparatus and machinery.

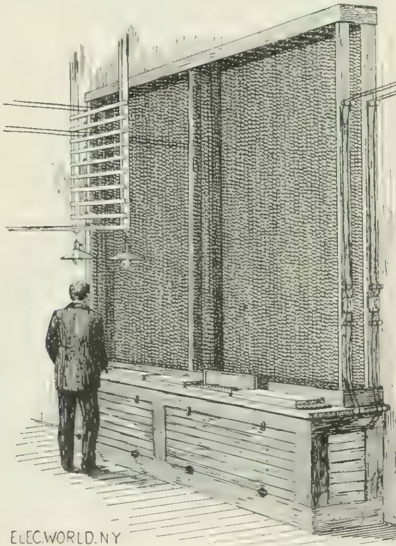
3. Work in the drawing room in the actual calculation and design of electromagnetic mechanisms, dynamos, alternators, transformers, electrical systems of power distribution and other special applications of electricity. Each student is required to carry out the design and make the drawings for at least a dynamo, transformer and two other designs selected from the other headings.

4. Lectures and recitations on the mathematical theory of electricity and magnetism. This course, while treating quite thoroughly the mathematical theories of electrostatic and magnetic fields, gives special prominence to the theory of alternating currents and its applications to alternate current working. It also embraces the theories of alternators, transformers, synchronous and polyphase motors, the measurement of power on alternate current circuits, and the general effects of inductance, distributed capacity, and of electrical resonance.


ELEC WORLD NY.

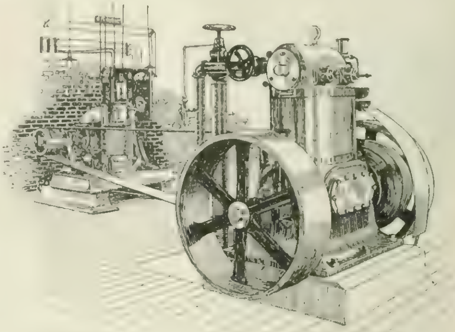
Bank of Transformers.

In addition to the above, the preparation of a well developed thesis and a trip of inspection to various electrical centres of industry is considered a part of the year's work.



German Silver Resistance.

An idea of the arrangement of the laboratories may be obtained from the ground plan of the electrical building. Rooms 3, 4, 5 and 6 are pier rooms, and 3 and 4 are provided with brass fittings, so as to do away with magnetic disturbances as much as possible, for the prosecution of the more delicate instrumental work which would be affected by varying magnetic fields of force. Seven is the photometer room, which is equipped with a Krüss Bunsen photometer and special appliances for photometric measurement, including a dynamo for the sole use of this room, which is regulated by the observer at the photometer. Eight is the general laboratory for junior work. Twelve is a carpenter and repair shop fitted with lathe, bench, etc. Thirteen is a room for the instrument maker of the department and supplied with necessary power tools. Ten is a supply and instrument room from which instruments or material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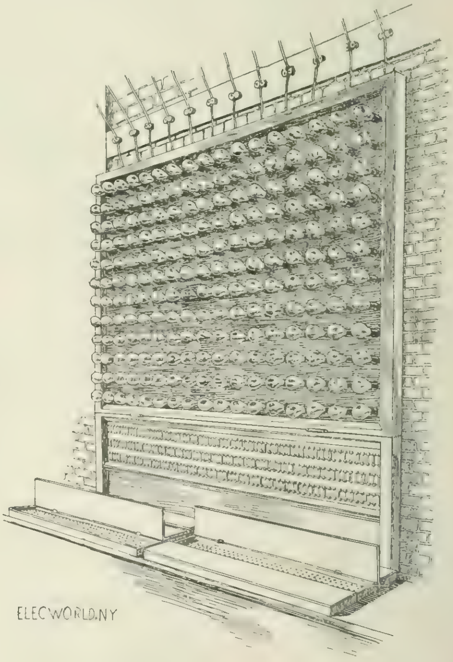
500-Volt Generator and Engine.

may be served to either the junior laboratory or the senior dynamo room, of which a general view is given and which is also indicated in plan at 11 and in sectional elevation just above. From this and the general view of the dynamo laboratory, it will be seen that all the larger machines are mounted on two heavy foundations extending the entire length of the room, and run from a jack shaft below the floor, each machine being provided with a friction clutch operated from the centre of the room. The jack shaft is driven by a motor with differential winding for constant speed and taking current from a 500-volt generator driven by an engine in the mechanical laboratory. This motor is provided with a tachometer and ammeter so that the exact condition of working of the entire laboratory can be readily ascertained. This method of driving the laboratory has, for the year that it has been in operation, proved itself



Adjustable Lamp Board.

o be exceptionally convenient and makes possible much work that could not otherwise be performed. The aggregate power of the machines, dynamos and motors connected with the work of this room is over 200 horse power.

The department is well supplied with apparatus and instruments for regular and special laboratory work, several of the more noticeable being illustrated.

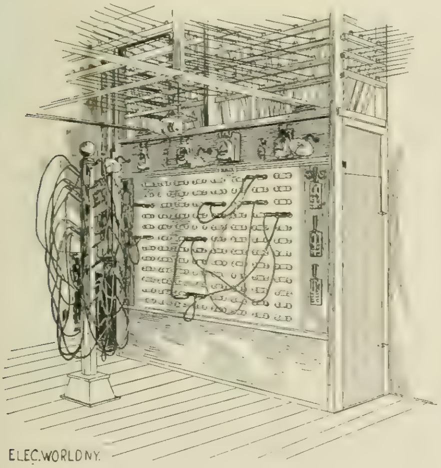
A set of German silver resistance coils are so arranged that any required resistance from .08 to 1,250 ohms can be readily obtained, and of sufficient capacity so that dynamo currents may be carried as high as 500 amperes for the lower resistances. For higher resistances a lamp board on which each lamp is provided with separate terminals gives a range in available resistance, for dynamo work, of any value from 1 to 40,000 ohms.

For alternate current working, there are alternators and multiphase machines and transformers of nearly every make, a portion of which are illustrated.

There are five street railway motors of different types, two of which are shown mounted for regular class work in the laboratory and on which a considerable amount of interesting data has been obtained.

All dynamos, motors, instruments, or other pieces of apparatus throughout the building can be connected to the general switchboard in the dynamo room, so that it is possible to secure at that point any combination of machinery, instruments and apparatus that may be desired for any piece of experimental work undertaken.

The instruments are of late design and from the best makers. For potential measurements, they include Kelvin electrostatic electrometers and voltmeters, Ayrton and Edelmann quadrant electrometers, twelve voltmeters of Weston and other types with multiplying coils, potential galvanometers, and other instruments. For current measurement are included two Kelvin balances, the deciampere and composite, ten ammeters of Weston and other types, four Siemens electrodynamometers, and a number of tangent, sine, Weidemann, Kelvin, D'Arsonval, Rosenthal and other galvanometers. There are also the following pieces of apparatus of importance; a Kew unifilar magnetometer, an Anthony standard resistance box, a standard subdivided microfarad condenser, an Ayrton secohmmeter and standard of self-induction, standard cells and other apparatus of less importance.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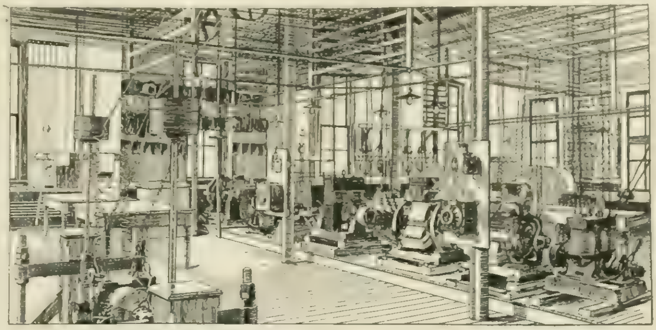
GENERAL SWITCHBOARD.

The department offers a line of graduate work leading to the degree of mechanical engineer, of which advantage is taken each year by several graduates of this and other institutions.

The city lighting and street railway companies have always made their plants available for special work, which, in addition to the equipment and training at the university, makes possible the preparation of young men for their life work in such a manner that each year they are called upon to fill positions of responsibility, and in such positions have made excellent records for themselves and the university.

The department is under the direction of Harold B. Smith, Professor of Electrical Engineering, and associated with him in the work of instruction in the department are W. E. Goldsborough, Associate Professor of Electrical Engineering; A. Wilmer Duff, Professor of Physics, and Edward E. Reynolds, Instructor in Electrical Engineering.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GENERAL VIEW OF DYNAMO LABORATORY.

Electrical Condition of Buried Conductors Due to Leakage Currents from Electric Railways—I.

BY W. STUART-SMITH.

Early in the year 1894 the gas and water companies of San Francisco found several places where corrosion of pipes had taken place, these being confined to the region within the influence of the San Francisco & San Mateo Electric Railway. This road was the first one electrically equipped in San Francisco, and the construction of the roadbed was of the poorest order. It was reported that the track had been in many places bonded to the gas or water pipes (or both) with the object of utilizing them as return circuits, and it was thought possible the cases of corrosion discovered might have been due primarily to the heavy current thus introduced into the pipes.

There was every reason to believe that the only other electric road then in operation, the Metropolitan, had not made connection with the pipes, and as the Market Street Railway Company was contemplating the construction and operation of an extensive system of electric roads covering all parts of the city, it was considered desirable that the electrical condition of the pipes along the two roads then in operation be compared in order to determine whether a good roadbed would prevent leakage to the pipes, or whether such leakage might be expected to become general when the new roads were put in operation; also what steps might be taken by the companies owning buried pipes in order to prevent general corrosion.

The San Francisco Gas Company was the first to take the matter in hand, and intrusted the work to the author, assisted by Mr. Frank P. Adams, electrician for the Stockton Electric Light Company. The instructions were to spare no pains to determine every possible fact. As it was uncertain to what extent the joints of services might vitiate the readings, it was determined to make use of the mains only, and a gang of six men was supplied to uncover the mains at every point where it was desired to make a test. Under these conditions, the tests were begun June 25, 1894, and continued uninterruptedly until Aug. 6, during which time the mains were uncovered at between 500 and 600 places, both along the line of the roads and in the outlying regions within which it was found the influence extended.

With the exception of the series of tests made and reported upon by Mr. I. H. Farnham, the author knew of no records covering, in a systematic manner, the entire area of influence of stray currents from electric roads, and even in the case of this one exception, the experiments were mainly made on telephone cables carried in subways, touching the ground only at widely separated points, and nowhere coming sufficiently close to the track to permit the passage of more than a very small current.

From this series of tests on an exceptionally placed conductor conclusions were drawn regarding the effect upon buried conductors in general, and the relation between two or more systems of conductors entirely buried in moist earth. The special tests made to prove that the corrosion was due to electric action, and the remedies proposed, are too well known to require mentioning.

Mr. Farnham's tests were made with a view to determining the potential relation between the conductor and the ground, this relation being assumed to determine the passage of current to or from the conductor. It was found that with the negative of the dynamos to the track (and ground) there was a region near the power house, of comparatively small extent, within the limits of which the conductor was positive to the ground, and hence dangerous, while in all outlying portions of the territory influenced by the electric road the ground was positive and the conductor safe.

It is not positively stated that buried conductors in general will be safe or dangerous within the same limits as the telephone cables experimented upon, but there was no *a priori* reason for supposing otherwise, and the author's tests were begun mainly with the idea of locating the limits of these areas, and, if possible, locating the points where the track and pipes had been wired together, with a view to the removal of such wires throughout the region where the track was positive. It was thought that generally the pipe systems would be neutral to each other, but both power houses were located outside the limits of the gas pipes, while the water pipes continued to and beyond them, and for this reason it was expected that near the limits of the gas pipes they would be found positive to the water pipes, as the current which leaked to the gas pipes along the lower reaches of the roads must pass to the water pipes in order to reach the power houses. It was also expected that near a point where the track was wired to the pipe that system to which the wire was connected would be positive to the other.

In order, however, that no possible condition might be missed, it was determined that at every point tested the potential relation between the gas pipes and every other conductor in the neighborhood should be actually tested, and hence at each point the data obtained gave the relation between both pipe systems and the track, between both systems and the ground, and between the two pipe systems.

For ground tests a bar was generally driven in the bottom of the hole made in uncovering the pipes. Contact was not made for a moment and then broken, under the assumption that all necessary information had been obtained, but it was maintained for considerable periods in each case, and the readings noted during the passage of four to six cars, careful note being made of the changes as the cars approached from considerable distances, when they started, when cars were bunched or none near, etc. By this means peculiarities were noted that would otherwise have been unsuspected.

In addition to the systematic series of tests by Mr. Farnham, the local and technical papers have published many articles based upon tests made by various electricians, most of which consist of voltmeter and ammeter readings taken at points widely separated, and hence of no practical value. With regard to the ammeter readings, as usually published, they cannot be otherwise than very misleading. We read in one case that the iron framework of a building *contained* ½ ampere at 3 volts, in another case 20 amperes were passing from a hydrant to the rail, etc. These ammeter readings are favorites with most of those who undertake to make so-called tests of pipe systems, and the results are made the basis of sensational newspaper articles in which it is gravely stated that the current in the pipes is sufficient to light so many lamps (usually a large number), no account being taken of the fact that the pressure is very low. Electricians who ought to know better (and do) permit reporters to publish such statements.

Besides the bad impression produced in the minds of the public by the publication of such figures, the data obtained are valueless, from an electrical point of view, except in certain cases, for the following reasons: An ammeter is purposely made of low resistance so that when inserted in a circuit it will not appreciably alter the conditions that existed before it was inserted. This being the case, if pipes carrying current were opened, and an ammeter inserted in the break, or if the rails had been purposely connected to the pipe by a wire, with intent of making the pipes a portion of the circuit, and this wire be cut, and an ammeter inserted, then in either case the reading obtained would show the passage of current at the points as it actually occurs in practice, but these correct readings are precisely the ones which are never taken.

Where, without making any other changes, an ammeter is inserted between pipes and rails, a temporary path of very low resistance is made, where normally the resistance is high, with the result that there is a heavy momentary rush of current to the point. This passes through the ammeter, is recorded, and published to the world as the ordinary state of affairs, whereas normally the passage of current at that point may be so small that it can only be recorded by very sensitive instruments. The removal of the ammeter restores the normal path of high resistance. It is argued that even if that current does not normally flow between pipe and rail, it at least flows in the pipe, else it could not pass when the ammeter is inserted; but even this is not true, because in every city there is a network of conductors beneath the surface, which either touch each other or come within short distances, and the current is normally divided between them in proportion to their relation, conductivities and facilities for receiving current, and the current in any one may be small. Also as each system of conductors is continued on every street, there will be a greater or less subdivision of current at every street corner, except in certain localities where the tendency is for the current to concentrate in the system.

When the temporary path of low resistance is inserted between one conductor and the track, the current in that conductor rushes to that point from all sides, and the other systems pass current to the one connected, so that the volume of current in the pipe itself is locally very greatly increased.

For these reasons it was determined to entirely exclude the use of an ammeter and obtain voltmeter readings only, making the record show the tendency to passage of current. The fact was not overlooked that this would give no indication of the actual passage of current at any point, but it was considered better to have no information on this point than so-called information that was all wrong, and resistance measurements could be made if a point was found where the knowledge of current flow was imperative.

The map shows the three electric systems as they were at the time of the second series of tests. During the first series the Market Street Companies' lines were not in operation. Starting that system introduced some very important changes which will be noticed when considering the second series, made after the winter rains began. The first series was made during the dry season when leakage through the ground would be at a minimum.

The location of the S. F. and S. M. power house far to the south will be noted. The positive of the generators is to the overhead line, and as should be the case, the track on all the lower reaches of the road was generally positive to the pipes, the reverse relation taking place at about 30th street and Chennery. Throughout this region the track varied from about 1 to 15 volts positive to the pipe, depending upon the location of cars with reference to test point, whether test was near or on heavy grades, etc. The variations of potential were very rapid, but generally there were no peculiarities that might not readily have been foreseen. As far as the track was concerned, the regions along the roads were generally divided into safe districts of large extent, and smaller danger regions near the power houses.

With regard to the pipe systems, however, it was very soon found that conditions existed of which published accounts of tests had given no hint. Beginning at Market and Stewart streets, tests were made on every street crossing, and the pipes were found to be neutral to each other. This portion of the track is level, and there are never more than two cars on it at a time, generally but one. Turning into Harrison the track is level for one block, to Spear, then heavy grades begin and continue to First. From First to Stanley place there is a slight rise, with a similar fall from Stanley place to Second on Harrison. From Second to Third there is a very heavy fall, down which cars go on brakes with plenty of sand. This grade is too steep for cars to ascend, and hence from Stanley place to Eighth the road is divided, as shown, the up track being on Harrison and the down track on Bryant. From Second to Valencia street the road is practically level. The down track has a moderate grade on Bryant, from Third to Second, and from Bryant to Harrison on Stanley place the grade is pretty steep. From 14th street to the power house there are many steep grades in both directions.

Along the lower portion of the road the track was found to be heavily wired to the water pipes at Harrison and Fremont, Harrison and Fourth, Bryant and Fourth, and Harrison, between Eighth and Ninth.

After the road turns into Harrison the pipes were seldom found to be neutral to each other. At Spear and Harrison the gas pipes varied from about $\frac{1}{100}$ to $\frac{1}{10}$ + to water, but never became —. One block further away, at Beale, water was + to gas, and continued so with varying potentials to First, when the pipe systems were practically neutral. The following from the test records will show about how the potential varied from Spear to First: Harrison and Main: water pipes varied from $\frac{1}{10}$ to $\frac{3}{5}$ volt + to gas, between Main and Beale water was $\frac{1}{2}$ volt + to gas when car started up grade, dropped to $\frac{1}{3}$ + as car passed test point, and pipes became neutral as car passed over crest and ceased using current. Harrison and Beale water was $\frac{1}{10}$ + to gas.

Between Beale and Fremont water was [illegible] + to gas, when car was on level near foot of Harrison, and became $\frac{3}{4}$ + when car started up grade. With car between Beale and Premont water was $\frac{1}{2}$ volt + to gas and $\frac{7}{8}$ volt + when car was between Fremont and First. The potential rapidly fell as car passed First. At Harrison and Fremont water rose to but $\frac{1}{4}$ + to gas, and at First and Harrison the pipes were practically neutral. It is worth noting at Fremont when the track was found to be heavily wired to the water pipe, this pipe only became $\frac{1}{4}$ volt + to gas, while a half block below it became $\frac{7}{8}$ volt +, and one block above the pipes were neutral. This will be referred to again, and an explanation given. Between First and Fremont the record is as follows: With no cars moving near the gas and water pipes were practically neutral, water being very slightly +. With cars on level near foot of Harrison street, water was $\frac{1}{3}$ + to gas, slowly increasing to $1\frac{1}{2}$ volt + when car reached Fremont, and holding as car passed Fremont. When car started at First water became $1\frac{3}{4}$ volt + to gas, which quickly fell to 1 volt as car gathered speed, and rapidly to zero as car reached the crest of the grade.

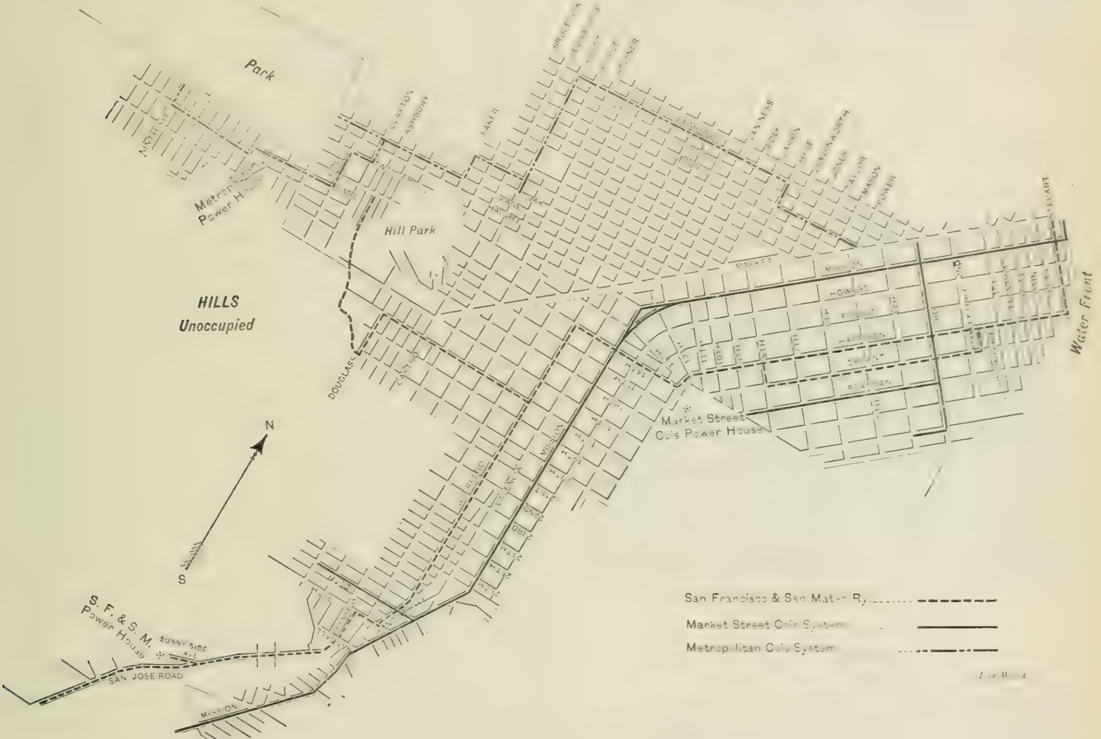
It will be noted that the block from Fremont to First is very short, and yet while half way between Fremont and First water pipes reached $1\frac{3}{4}$ volt + to gas, yet at First water at no time became +, showing within what short distances there may be great variations in the potential relations between pipe systems. As far as the author knows, this fact has not before been recognized. The block from First to Second is divided into three parts by small streets, Rincon place and Stanley place, as shown. At Rincon place the record of tests show the following: With no car near gas pipes were steadily $\frac{1}{10}$ volt + to water, and became $\frac{1}{15}$ to $\frac{1}{10}$ + to water when car was coming up Harrison grades (note that gas pipes are + to water, though but a short distance below, at Fremont, the track was heavily wired to water pipes. At no place was the track wired to the gas pipes). With car coming up Stanley place grade gas was steadily $\frac{1}{10}$ + to water, and became $\frac{1}{5}$ to $\frac{1}{3}$ volt + when car turned from Stanley place into Harrison.

Harrison and Stanley place pipes were practically neutral. On Harrison, from Stanley place to Fourth, the pipes were practically neutral. The track was wired to the water pipe at Fourth and water became $\frac{3}{5}$ volt + to gas. Within half a block above Fourth the systems became practically neutral again, and continued so to a point between Seventh and Eighth, when water became $\frac{1}{10}$ + to gas and continued + with varying amounts to Ninth street. As noted above, track was wired to water pipe between Eighth and Ninth. Beyond Ninth the systems were seldom neutral, but rapidly varied in potential relations, first one being + then the other, these changes occurring from block to block, and sometimes two or three times in a block. The amounts of the readings were generally from about $\frac{1}{10}$ to $\frac{1}{4}$ volt.

Returning to Stanley place and the Bryant street track, a test on Stanley place between Harrison and Bryant (middle of steep grade) showed the gas very slightly + to water when car was on Bryant and approaching Stanley place. When the car was climbing the grade and neared Harrison gas became $\frac{1}{4}$ to $\frac{1}{3}$ volt + to water.

At Bryant and Second the pipes were neutral, at Bryant and Third gas averaged $\frac{1}{5}$ volt + to water rising considerably above this value for short periods. Between Third and Fourth the pipes were practically neutral, gas being slightly + at times. At Fourth gas varied from $\frac{2}{5}$ + to $\frac{1}{5}$ — to water, the water being + when a car was very near test point.

The track was wired to water pipes here. Between Fourth and Fifth gas was normally $\frac{1}{10}$ volt + to water when no cars were near. As car approached Fifth it became $\frac{2}{5}$ + to water. If car crossed Fifth without stopping it became $\frac{3}{5}$ + to water, gradually falling to $\frac{1}{10}$ +



Map Showing Street Railway Systems.

[illegible] car approached Fourth. If car started at Fourth gas became [illegible] to [illegible] + to water, and [illegible] + if car started at Fifth. This, notwithstanding the fact that track was wired to water pipe at Fourth. Water pipe did not become + to gas at any time. It was thought certain that the track must be wired to the gas pipe near this test point.

At Bryant and Fifth gas varied from $\frac{1}{8}$ to $\frac{3}{8}$ + to water. Between Fifth and Sixth gas and water were neutral, and at Sixth water was $\frac{1}{10}$ + to gas. Between Sixth and Seventh the pipes were again neutral, and continued practically neutral to Eighth, at which street the down track returns to Harrison street.

The pipes along the line of the Metropolitan road were tested first, and before beginning them the dead ends of the gas pipes were located, and it was considered certain that in the region where the gas pipes terminated they would be found generally positive to water, the readings being comparatively high if the pipes along the lower reaches of the road were receiving any considerable quantity of current. It was expected that generally along the lower portion of the road the pipes would be neutral to each other if neither was wired to the track, as there was reason to believe was the condition along the Metropolitan road. The generally neutral condition of pipes was found as expected, also the gas pipes near the dead ends were positive to the water, but instead of the readings having comparatively high values, they were very small, being barely perceptible in many cases. From this it was inferred that during the summer when the ground became dry the pipes only received a very small quantity of current, but when measurements were made between track and water pipes just beyond the terminal points for the gas pipes, and it was found that more than half a mile from the power house the pipe became positive to the track, the potential increasing rapidly from block to block, the fact was recognized that though but little current could leak to pipes at any one point, yet the accumulated current amounted to a very considerable volume.

As the pipes were neutral to each other at all points except at the extreme limits of the gas pipes, there must be a comparatively equal distribution of current between the two systems. This was to be expected since, in general, over any considerable area the two systems are practically the same distance from the rails, and will receive practically the same amount of current. It was supposed that with the volume of current in the pipes the conductivity of both systems would be practically the same.

As the accumulated current in the gas pipes near the terminals would be a considerable amount, the reason for the small potential readings between the two systems near these terminals was not clear, and it was supposed that points existed where the passage of currents was high, and that at such points corrosion would be likely to take place. Knowledge gained by further experience made it evident that such points cannot be expected to exist.

(To be continued.)

Electrical Power Transmission.—XVII.

BY LOUIS BELL, PH.D.

In cases where continuous insulation is employed, it is for one of two purposes. First, to prevent interference with the circuit by such accidents as twigs or wires falling across the line, and either short circuiting the lines or grounding them. Aside from this, the only other object in insulation is to lessen the danger to persons accidentally touching the wires.

With moderate voltages both these ends can be reached with a fair degree of success. With high voltages it is very difficult, and in many cases well nigh impossible.

Nearly all materials which are available for insulation deteriorate to a very marked extent when exposed to the weather. Those substances which are the best insulators, such as porcelain, glass, mica, and the like, cannot be used for continuous insulation, and, in fact, our best insulators which are substances of comparatively simple chemical composition are mechanically so bad as to be impracticable. There is a large class of insulators which are complicated in chemical constitution, but are mechanically good; these are the plastic or semi-plastic substances like gutta-percha India rubber, bitumen, paraffin and heavy oils. All of these are subject to more or less decomposition, more particularly those which are, through good mechanical qualities, desirable for insulation. All which have been mentioned are sufficiently good insulators to answer every practical requirement, if they do not deteriorate.

Gutta-percha and India rubber are decidedly the best of these; but gutta-percha is too plastic at anything excepting low temperatures to be mechanically good. Gutta-percha fills, however, an unique place on account of its remarkable ability to withstand the action of salt water, and it is the most reliable insulator for submarine work. For overhead work it is nearly useless, as the heat of the sun softens it so as to endanger itscontinuity, and even a moderate increase in temperature may decrease its specific resistance to a tenth of its ordinary value.

India rubber is, by all odds, the best all around insulator for overhead lines. In its pure state it deteriorates with very great rapidity; but when vulcanized by the addition of a small amount of sulphur, its chemical character is so changed as to resist both spontaneous changes and those due to the atmosphere to a very considerable extent without injury to its insulating properties. It is however, costly, and is eventually effected by the weather. To cheapen the manufacture of insulated wire a large variety of rubber compounds are employed, consisting of mixtures of rubbers with various other substances intended to give the material good mechanical and insulating qualities at less expense. These rubber compounds are inferior to pure vulcanized rubber in point of specific resistance, but make a good and substantial covering for ordinary purposes. They are very often employed for commercial work.

Insulated wires for overhead work may be divided into two classes. First, those which in places are so prepared as to withstand the weather to a considerable extent and to retain good insulating properties even in bad weather. Such wires are covered with a pure or nearly pure vulcanized rubber, generally protected outside with a braiding of cotton saturated with some insulating compound and serving to protect the main insulation from mechanical injury.

The second class of wires are those in which no solid insulating material is used, but which are thoroughly protected by a covering of fibrous material saturated with compounds of rubber, bitumen, or the like. These wires are those most extensively used; the insulation is good in dry weather, and fair under most ordinary circumstances, but generally inferior to those wires which are given a coating of rubber.

So far as protection of the wire from accidental contacts is concerned, either class of insulation is tolerably effective until the covering becomes worn or weathered by long or hard usage.

As regards danger in touching such wires, at moderate voltages both kinds of insulation afford a fair degree of protection. At high voltages neither can be trusted, in spite of their apparently high insulation resistance. There is good reason to believe that any insulation employed on wires is greatly affected by the strain of high voltage. Tests made with the ordinary Wheatstone bridge give us no useful information as to the action of the same insulation under stresses of five or ten thousand volts. Tests made with pressures ranging up to even 500 volts show generally a noticeable, although very irregular, falling off in resistance, and the higher the voltage is carried the more likelihood of complete breaking down of the insulation and the more irregular the results.

It is improbable that even the most careful insulation with vulcanized rubber of any reasonable thickness would give a wire which under a pressure of 10,000 volts could be depended on to remove from accidental contact all danger to persons. Even if entirely safe at first it would be unlikely to remain so for any great length of time. So serious is the difficulty of continuous insulation of high pressures that it is probably best not to place dependence upon it; but either to fall back upon bare wire with complete insulation at the supports, or if insulated wire be employed to use an insulation intended only to lessen the danger of short circuits from falling objects, and to treat it so far as personal contact goes precisely as though it were bare wire.

Information regarding the insulation of lines, whether of bare or insulated wire, under high voltage is very scarce; but all such lines should be treated as if they were grounded, in spite of any tests of the insulation that may have been made. Theoretically, one should be able to touch a completely insulated circuit without danger save from static charge; but, practically, it is unsafe so to treat any high voltage circuit.

The writer calls to mind one case in which a man was instantly killed while standing on a dry concrete floor by contact with a 10 000 volt circuit. He probably touched a bare portion of the wire, but so far from the insulation of the circuit saving him, the current which he received was sufficient to burn into the concrete floor the print of the nails in one of his shoes. The ordinary tests on the line, with magneto and bridge made shortly afterward showed no particular ground, nor was there any reason to believe that one existed at the time of the accident. Other accidents, under similar conditions, have occurred with arc light circuits of lesser voltage on which there was a similar absence of perceptible ground. It is advisable, therefore, that high voltage circuits should be treated as dangerous, so far as contact is concerned, at all times, and if insulation tests are to be made upon them to determine the resistance to grounds, these tests should be made with, at least, the full voltage of the circuit. It is quite as well not to place too much reliance on insulation of any kind; but to regard a high voltage electrical circuit as dangerous, and to be treated with the same respect as is due to other useful, but dangerous, agents, like high pressure steam and dynamite, neither of which is likely to be abandoned on account of the danger that comes from careless use. The precautions taken, either with these or with high voltage currents, should be in the direction of preventing such carelessness as might result disastrously.

An electrical circuit should be so installed that no material risk will be run by any person who is not indulging in wilful interference with the line, and in such case, if an accident occurs, the victim is deserving of no more sympathy than one who should deliberately stand in front of an express train.

If the circuit is of bare wire, there can be no doubt in the mind of any one as to its dangerous character, whereas, if insulated wire is employed, there is likely to be established a certain false sense of security. There is no good reason, therefore, for advising the extensive use of insulated wire for high voltage lines.

The ideal overhead circuit is one in which the conductor is thoroughly insulated as regards leakage, carefully protected from danger of wires or branches falling across it, and placed out of the reach of anything except deliberate interference of human beings. There may be places at various points along the line where insulation would be desirable, in order to avoid extensive cutting away of trees, branches of which might fall upon the line, or where local regulations require the use of insulated wire. Except under these circumstances, insulation increases the cost and maintenance of the line without giving any adequate returns in security. On rare occasions, portions of the high voltage circuit may have to be placed underground. Here only the very best quality of insulation should be employed, preferably high grade rubber covered wire thoroughly protected by an outside braiding or metallic sheathing against the effects of moisture, and installed in clean, dry and accessible conduits. The character and amount of the precautions to be taken depend on the voltage of the circuit, and there has not yet been enough experience, at pressures above those which must be classified as moderate (that is, from one to three thousand volts), to get sufficent data to enable one to say absolutely what are sufficient precautions. The best course to follow is, knowing the voltage at which the transmission is to be made, to select a cable which cannot be experimentally broken down by the voltage in question, and to install it with every precaution against deterioration. If any great work is to be done, the necessary expense is so considerable as to make it well worth while to enter into a careful investigation as to the particular voltage in hand. For a transmission at 10,000 volts, for example, the writer would not consider any insulation less than one-half inch in thickness of the best rubber compound obtainable, and even this should be subjected to a very careful test. This suggestion is only given to point out the general magnitude of the problem of installing cables of such voltages.

Wherever underground cables are employed they should be subjected to a daily insulation test, and the greatest care should be taken with the joints, which are, in almost every case, the weakest point in the insulation.

From what has been said, it should be understood that while the problem of installing high voltage lines is unquestionably a difficult one, we have not yet had sufficient experience to be able to say definitely how difficult it may be. It is very certain that much more can be done than has yet been accomplished. It seems probable that so far as overhead work is concerned, it will be practical to employ voltages several times greater than those now in use. Before any limit can be set to the progress in this direction we need ample experimental data, not only on the behavior of insulation at a very high pressure, but on the maximum voltage which is likely to be encountered when a certain affective voltage is to be employed. This opens up a wide field for investigation, involving the conditions of unknown seriousness connected especially with the electrical peculiarities of alternating currents, which there is every reason to believe will be employed almost exclusively on high voltage work.

(To be continued.)

Electrodynamic Machinery—XXVIII.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

Drum Armatures.

144. The drum armature was first introduced into electrical engineering in the shape of the shuttle armature by Siemens, and was modified by Hefner-Alteneck in 1873. The drum armature was subsequently modified in this country by Weston, who employed a laminated iron armature core consisting of discs of soft iron, called *core discs*, provided with radial teeth or projections. This armature core, when assembled, had space provided between the teeth for the reception of the armature loops on its surface, a completed armature showing, when wound, alternate spaces of iron and insulated wire. Edison introduced the smooth core drum armature, that is, a drum armature composed of similar core discs in which the teeth were absent, so that the completed armature had its external surface completely covered with loops of insulated wire. Fig. 126 shows a common type of toothed cored armature in various stages of construction. The laminated iron core is shown at *A*, as assembled on the armature shaft ready to receive its winding of conducting loops in the spaces between the radially projecting teeth. At *B* is shown the same core provided with windings of insulated wire. At *C* is shown a completed armature. The detailed construction of a laminated armature core is illustrated in Fig. 127, which shows a portion of a drum armature core already assembled by securing to the driving shaft a number of stamped toothed sheet iron core-discs assembled by the aid of large bolts *BB*, passing through holes *h*, *h*, *h*, in the core-discs. On the right are other core-discs ready to be placed in position on the shaft.

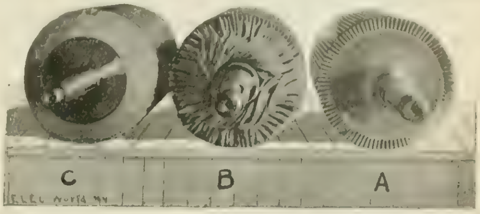


Fig. 126.—Tooth-Cored Armature in Various Stages of Construction.

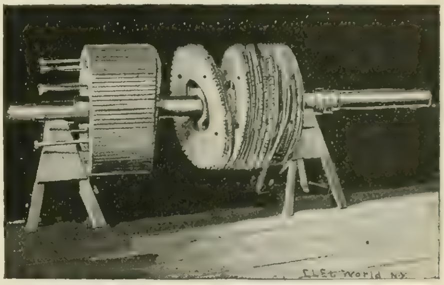


Fig. 127.—Assemblage of Laminated Armature Core Discs.

145. Fig. 128 shows a laminated armature body of the smooth cored type. Here the separate core-discs are formed of sheet iron rings assembled on the armature shaft as shown. These discs, after

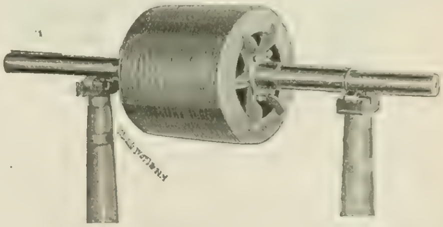


Fig. 128.—Smooth Core Armature Body.

being assembled, are pressed together hydraulically. The end rings are heavy bronze spiders, held together internally by six bolts shown in the figure. When the armature body is subjected to compression, these bolts are tightened up on the spiders, which are firmly keyed to the shaft, so that on release of the hydraulic pressure, the laminated iron core forms one piece mechanically. Fig. 129 shows the same armature completely wound.

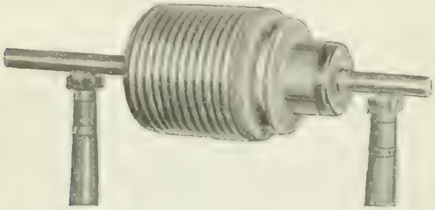


FIG. 129.—COMPLETED ARMATURE, SMOOTH CORE TYPE.

146. In the drum armature the conducting wire is entirely confined to the outer surface, and does not pass through the interior of the core. In this respect, therefore, it differs from the Gramme ring armature already described, in which the winding is carried through the interior of the core, lying, therefore, partly on the interior and partly on the exterior. The armature core or body of a Gramme ring machine differs markedly in appearance from the armature body of a drum machine when both are in small sizes, since then the drum core is practically solid, having no hollow space, so that it would be impossible to wind it after the Gramme method. Such a drum-wound armature is shown in Fig. 130. When, however, the drum armature is increased in size, so as to be employed in multipolar fields, the form of the core or body passes from a solid cylinder to that of an open cylinder or ring, as is shown in Figs 128 and 131, so that it would be possible to place a conducting wire on such a core either after the drum or Gramme type of winding. The tendency, however, in modern electrical engineering is toward the production of drum-wound generators rather than Gramme-wound generators. This tendency has arisen probably more from mechanical and commercial reasons than from any inherent electrical objections to armatures of the Gramme-ring type.

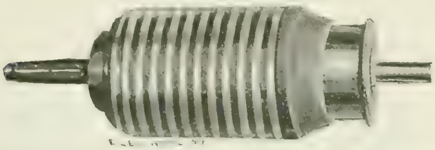


FIG. 130.—TYPICAL FORM OF SMALL SIZE DRUM ARMATURE.

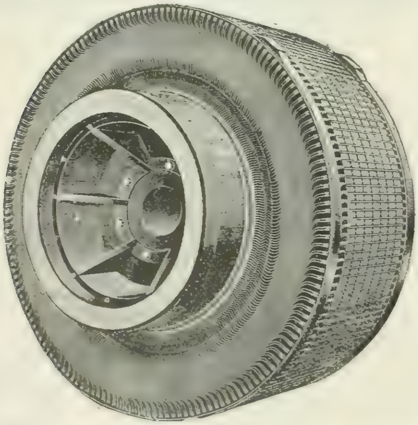


FIG. 131.—LARGE DRUM ARMATURE FOR MULTIPOLAR FIELD.

147. The windings of drum armatures are numerous and complicated in detail, but all may be embraced under two typical classes; namely, *lap-winding*, and *wave-winding*. In lap-winding, the wire is arranged upon the surface of the armature in conducting loops, the successive loops overlapping each other, hence the term; while in wave-winding, the conducting wire makes successive passages across the surface of the armature while being advanced around its periphery in the same direction.

148. Lap-winding is applicable particularly to bipolar armatures, while wave-winding is applicable only to multipolar armatures.

The simplest form of lap winding is shown in Fig. 132, where the separate paths taken by the turns *a*, *b*, *c*, *d*, and *e*, *f*, *g*, *h*, across the outside of the bipolar armature core, and their connections to the commutator are represented as shown. If the entire winding of the armature be completed, it is evident that any attempt to represent the winding graphically by the method adopted in this figure would lead to great complexity. For this reason it is customary to represent the armature surface as unrolled, or developed upon the plane of the paper, as shown in Fig. 134. For example, the winding already shown in Fig. 132 becomes on this development represented as in Fig. 134. Here it is clear that each loop overlaps its predecessor, and, consequently, it is evident that the simplest form of drum winding is a lap winding.

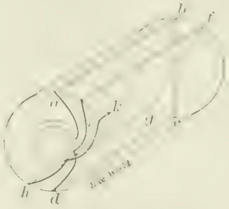


FIG. 132.—SIMPLE BIPOLAR DRUM WINDING.

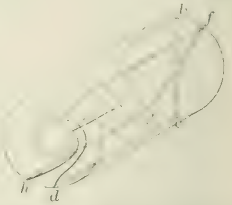


FIG. 133.—SIMPLE BIPOLAR DRUM WINDING WITH LEAD IN COMMUTATOR CONNECTIONS.

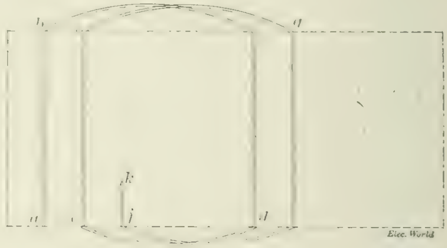


FIG. 134.—DEVELOPMENT OF LAP WINDING IN FIGS. 132 AND 133.

Fig. 133 represents the same winding as Fig. 132, except that the connections with the commutator are given a lead of 90 degrees, requiring a correspondingly altered position of the brushes of the machine.

Fig. 135 in a similar manner represents a number of conductors, *ab*, *cd*, *ef*, *gh*, etc., wound on the external surface of a drum core in the winding of the wave type. Here it will be seen that the conducting wire, after crossing over from one side of the armature core to the other, advances progressively over its surface in the form of a rectangular wave. The corresponding development is shown in

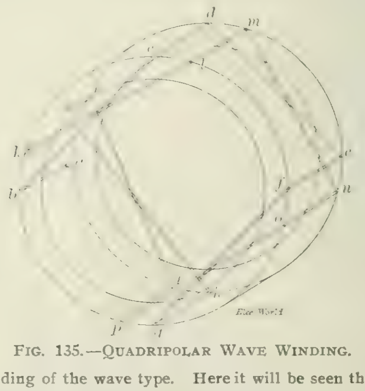
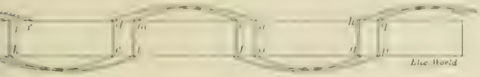


FIG. 135.—QUADRIPOLAR WAVE WINDING.

136. The winding shown is applicable only to quadripolar s. For an inspection of this particular arrangement of wave ing will show that when conducting wires, *ab* and *ef*, are pass- orth poles, the conducting wires *cd* and *gh* are passing south , and the direction of the induced E.M.F. while opposite in



G. 136.—Development of Quadripolar Wave Winding.

essive conductors as regards the separate conductors *ab*, *cd*, *ef* *h*, is nevertheless, unidirectional, so far as the entire circuit *a*, *b*, *e*, *f*, *g*, *h*, *i*, *j*, *k*, is concerned. In the same manner a wave ing for an octopolar machine is required to be spaced in rdance with the successive distances between alternate poles. boratory of Houston and Kennelly, Philadelphia.

(To be continued).

Practical Notes on Dynamo Calculation—XXX.

BY ALFRED E. WIENER.

Chapter 49.—Dimensioning of Magnet Cores (Continued).

Relative Position of Magnet Cores.

e majority of types having two or more magnets, the ive position of the magnet cores is next to be considered. great number of forms, having the magnets arranged metrically with reference to the armature circumference, exact relative position of the magnet cores is given by the e of the field magnet frame; in other types, however, ng parallel magnets on the same side of the armature, etrically or axially, the shape of the frame does not fix relative position, and the *distance* between them is to be erly determined.

is is done by limiting the magnetic leakage across the cores certain amount, according to the size of the machine, ely, from about 33 per cent. of the useful flux, in small hines, to 8 per cent., in large dynamos.

e relative amount of the leakage across the magnet cores is rmined by the ratio of the permeance between the cores to ermeance of the useful path, and the percentage of the core age is kept within the limits given above, if the average eance of the space between the magnet cores does not ed one-third of the permeance of the gap space in small hines, and one-twelfth of the gap permeance in large amos or if the reluctance across the core is at least three to ve times, respectively, that of the gaps.

e area of the cross section and the length of the cores being n, the reluctance of the space between them depends upon hape of their cross section and upon the distance between . In case of *round* cores the shape is given by the area of cross section, and the reluctance of the path from core to , in consequence, only depends upon their distance apart, ctly increasing with the same. The reluctance of the air is determined by the diameter and length of the armature, e percentage of polar embrace, and by the radial length of ap space, decreasing with the area of the gap and increas- ith its length. The cross section of the cores and the gap both depending upon the output of the machine, have a or less fixed relation to each other,—varying with the type, oltage, the speed, and the kind of armature—and the rela- between the reluctance across the cores to that of the air can approximately be expressed by the ratio of the average nce apart of the cores to the radial length of the gap space. ynamos with *smooth drum* armature this ratio is made from 16, in *smooth ring* machines from 8 to 20, and for *toothed* and *orated* armatures the distance apart of the cores is taken 3 to 6 times the maximum radial length of the gap e, *i. e.*, from 3 to 6 times the distance between pole and bottom of armature slot. The following Table, LXVIII., s the average distance between cylindrical magnet cores arious kinds and sizes of armatures, the ratio of this nce to the radial length of the gap space, and the cor- onding approximate leakage between the magnet cores, essed in per cent. of the useful flux.

case of *inclined* cylindrical magnets the figures given in le LXVIII. for the least distances apart are to be considered as the *mean* least distances, taken across the magnets midway between their ends. (Compare formula (131), chapter 39.)

TABLE LXVIII. DISTANCE BETWEEN CYLINDRICAL MAGNET CORES.

	Smooth core armature.								Toothed or Perforated armature			
	Drum.				Ring							
Diameter of armature. Inches.	Radial length of gap space.	Least distance between cores.	Ratio of distance apart to length of gap	Approx. leakage between cores, in p. c. of useful flux.	Radial length of gap space	Least distance between cores.	Ratio of distance apart to length of gap	Approx. leakage between cores, in p. c. of useful flux	Max. radial length of gap space.	Least distance between cores.	Ratio of distance apart to max. length of gap.	Approx. leakage between cores, in p. c. of useful flux.
2	11/32"	2 "	5.8	33%	..	..	..	..	..	..	..	.
3	[illegible]	2	6.3	30	..	..	..	..	..	..	..	..
4	7/16	3	6.9	25	5/16"	2½"	8.0	20%	11/16"	2 "	2.9	15%
6	½	3¾	7.5	22	11/32	3	8.7	18	13/16	2½	3.1	14
8	9/16	4½	8.0	20	3/8	3¾	10.0	16	15/16	3¼	3.5	13
10	5/8	5½	8.8	18	13/32	4¾	11.7	14	1 1/16	4	3.8	12
12	11/16	7	10.2	16	7/16	5¾	13.1	12	1 3/16	4¾	4.0	11
15	¾	8½	11.3	14	15/32	7	14.9	11	1 5/16	5½	4.2	10
18	13/16	10	12.3	12	½	8¼	16.5	10	1½	6½	4.3	10
21	7/8	12	13.5	10	9/16	9½	16.9	9½	1⅝	7½	4.6	9½
25	15/16	14	15	9	5/8	11	17.6	9	1¾	8½	4.9	9
30	1	16	16	8	11/16	13	18.9	8½	1⅞	10	5.3	8½
40	1⅛	18	16	8	¾	15	20	8	2	12	6.0	8

In dynamos with *rectangular* and *oval* cores the leakage across, for the same distance apart, is greater than in case of circular cores of equal sectional area, increasing in proportion to the ratio of the width of the cores to their breadth. For *rectangular* and *oval* cores, therefore, the distance apart is to be made greater than for round cores in order to limit the leakage between them to the same amount; and the distance must be the greater the wider the cores are in proportion to their thickness. The following table, LXIX., gives the minimum, average and maximum values of the ratio of the distance across rectangular and oval cores of various shapes of cross sections to the distance which, between round cores of equal sectional area, effects approximately the same leakage, in small, in medium-sized, and in large dynamos, respectively:

TABLE LXIX.—DISTANCE BETWEEN RECTANGULAR AND OVAL MAGNET CORES.

Ratio of thickness to width of cores.	Distance between rectangular and oval magnet cores, as compared with that between round cores of equal area causing approximately the same leakage across.		
	Minimum. (Small machines.)	Average.	Maximum. (Large machines.)
1 : 1	1.0	1.0	1.0
3 : 4	1.05	1.07	1.1
2 : 3	1.1	1.15	1.2
1 : 2	1.15	1.22	1.3
1 : 3	1.2	1.3	1.4
1 : 4	1.25	1.37	1.5
1 : 5	1.3	1.45	1.6
1 : 6	1.35	1.55	1.75
1 : 7	1.4	1.65	1.9
1 : 8	1.5	1.75	2.05
1 : 9	1.6	1.9	2.25
1 : 10	1.7	2.1	2.5

In order to determine the proper distance apart of rectangular and oval magnet cores, the corresponding distance between round cores of equal cross section is taken from Table LXVIII., in multiplying the radial length of the gap space by the ratio of distance apart to length of gap for the particular size of armature. The distance thus obtained is then multiplied by the respective figure found for the shape in question from Table LXIX.

Chapter 50.—Dimensioning of Yokes and Pole Pieces.

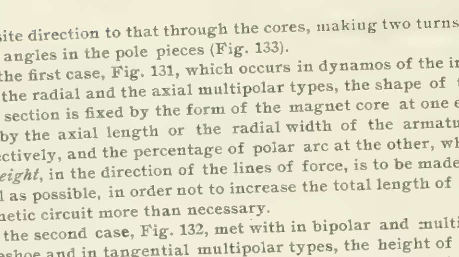
(*a*) —*Yokes.*

In *bipolar* types—the dimensions of the magnet cores being given by Tables LXIV., LXVI., or LXVII., Chapter 49, and their least distance apart by Table LXVIII., or LXIX., Chapter 49, thus fixing the length of the yoke, and the sectional area of the yokes being found from formula (137), chapter 47,—the dimensioning of the yoke consists in arranging its cross section with reference to the shape of the section of the cores, and, for the case that its material is different from that of the cores, in providing a sufficient contact area, conforming to the rules given in chapter 46.

In *multipolar* types the total cross section found for the frame from formula (137), chapter 47, is to be divided by the total number of magnetic circuits in the machine and multiplied by the number of circuits passing through any part of the yoke in order to obtain the sectional area required for that part of the yoke; otherwise the above rules also govern the dimensioning of the yokes for multipolar machines.

(*b.*) *Pole Pieces.*

In dimensioning the pole pieces three cases have to be considered: (1) the path of the lines of force leaving the pole pieces has the same direction as their path through the magnets (Fig. 131); (2) the path of the lines leaving the pole pieces makes a right angle to that through the cores (Fig. 132); and (3) the path of the lines leaving the pole pieces is parallel but of opposite direction to that through the cores, making two turns at right angles in the pole pieces (Fig. 133).



FIGS. 131 TO 135.

In the first case, Fig. 131, which occurs in dynamos of the iron clad, the radial and the axial multipolar types, the shape of the cross section is fixed by the form of the magnet core at one end and by the axial length or the radial width of the armature, respectively, and the percentage of polar arc at the other, while the *height*, in the direction of the lines of force, is to be made as small as possible, in order not to increase the total length of the magnetic circuit more than necessary.

In the second case, Fig. 132, met with in bipolar and multiple horseshoe and in tangential multipolar types, the height of the pole pieces is determined by the diameter, and the length of the pole piece by the length of the armature, while the area of the cross section, perpendicular to the flow of the lines, is to be made of the size obtained by formula (137) at the end next to the magnet core, and to be gradually decreased in amount from that end to the opposite end or to the centre of the pole piece, respectively, according to whether there is but one magnetic circuit, or whether two circuits are passing through the same pole piece. Since, in bipolar machines, the lines of force are supposed to divide equally between the two halves of the armature, only one-half of the total flux passes the centre of the pole pieces, in order to reach the half of the armature opposite the magnets, and the area in the centre of the pole piece, consequently, needs to be but one-half that at the end next to the core. In case the two circuits passing through each pole piece, Fig. 134, the same applies to the cross section of the pole piece, at one-quarter the height from either end. For ready use, in Table LXX. the dimensions of wrought and cast iron pole pieces for various sizes of bipolar horseshoe type dynamos are calculated for drum and ring armatures, by combining the respective data given in former tables.

TABLE LXX.—DIMENSIONS OF POLE PIECES FOR BIPOLAR HORSESHOE TYPE DYNAMOS.

	DRUM ARMATURE.						RING ARMATURE.				
			Dimensions of pole piece.						Dimensions of pole piece.		
					Thickness in centre. Inches.					Area in centre.	
Capacity in kilowatts.	Average total flux of bipolar horseshoe drum type. Webers.	Diameter of armature. Inches.	Height. Inches.	Length. (Length of armature.)	Wrought iron.	Cast iron.	Average total flux of bipolar horseshoe ring type. Webers.	Diameter of armature. Inches.	Height. Inches.	Wrought iron.	Cast iron.
.1	350,000	1¾	2¼	3½	½	1	175,000	4	4¾	⅞ sq. in.	1¾ sq. in.
.25	500,000	2¼	3	4½	9/16	1⅛	250,000	5	5¾	1¼	2½
.5	650,000	2¾	3½	5¼	⅝	1¼	325,000	6	6¾	1⅝	3¼
1	900,000	3¼	4	6	¾	1½	450,000	7	7¾	2¼	4½
2	1,400,000	3¾	4½	7	1	2	675,000	8	9	3¼	6½
3	1,800,000	4½	5	8¼	1⅛	2¼	900,000	9½	10½	4½	9
5	2,500,000	5¼	6¼	9½	1⅜	2¾	1,300,000	11	12	6½	13
10	3,500,000	6	7	10½	1½	3	2,100,000	14	15	10½	21
15	5,000,000	6¾	7¾	12	2⅛	4¼	2,800,000	15	16	14	28
20	6,000,000	7½	8½	13	2 5/16	4⅝	3,500,000	16	17	17½	35
25	7,000,000	8¼	9	14	2½	5	4,200,000	18	19	21	42
30	8,000,000	9	10¼	15	2¾	5½	4,800,000	20	21	24	48
50	12,500,000	10½	11½	18	3½	7	7,000,000	24	25	35	70
75	16,500,000	12½	13½	20	4⅛	8¼	9,500,000	28	29¼	47½	95
100	21,000,000	15	16½	22	4¾	9½	12,000,000	32	33½	60	120
150	30,000,000	18½	20¼	26	5¾	11½	17,000,000	36	37½	85	170
200	38,000,000	22½	24½	31	6⅛	12¼	21,500,000	40	42	107½	215
300	57,000,000	28	30½	38	7½	15	30,000,000	46	48	150	300

In the third case, Fig. 133, finally, which is found in single and double magnet types, the length of the magnetic circuit in the pole piece is determined by the diameter of the armature, by the cross section of the magnet core, and by the height of their winding space; the width, parallel to the armature shaft of the pole piece near the magnet, is given by the width of the magnet core, and that near the armature by the axial length of the latter. The heights, parallel to the axis of the magnet core, in case of a single circuit, are to be so chosen that all of the cross sections, up to that in line with the pole corner next to the magnet core, have an area at least equal in amount to that obtained by formula (137), and that the section in line with the armature centre has an area of one-half that amount. In case of two circuits meeting at the pole pieces, (consequent pole types), Fig. 135, the full area has to be provided from either end of the pole piece to the sections in line with the pole corners, half the full area at quarter distance from each pole-corner, that is, midway between each pole corner and the pole centre, and sufficient cross section for mechanical strength only is needed at the centre of the pole piece.

(To be continued.)

Electrical Difference of Potential.

To the Editor of The Electrical World:

SIR:—I find in your issue of March 2 a letter from Mr. A. W. K. Peirce, upon "Electrical Difference of Potential," in which this paragraph occurs: "But in the case of the inductor alone, the difference of potential between its ends is not due to any transference of any difference of potential from outside sources, but to the adding together of all the E.M.Fs. (infinite in number) which ar generated in the length of the inductor; there is, therefore, no flow of current required, and, consequently, no work done." I do no understand what is meant by transference of difference of potentia from outside sources, but if I know what electrical difference o potential is, it can never exist without a transference of somethin which we call electricity. I cannot conceive of an electrical differ ence of potential existing between the two ends of the "inductor referred to in the paragraph quoted, unless electricity is transferre along the inductor from one end toward the other. The paragrap seems to imply that the potential difference and the E.M.F. in th inductor are identical. They are numerically equal, but they are n at all the same thing. They act along the inductor in opposite dire tions, and exactly balance each other.

This is what I conceive to take place: When the motion of tl inductor begins, an E.M.F. is developed which causes a transfer electricity along the conductor charging one-half + and the other in such a way that there is a progressive increase of electrical densi from one end to the other, the middle point being neutral. It this varying density that causes the difference of potential, and t difference of potential tends to cause a backward flow to restore t uniform electrical density throughout the bar. After the potent difference is once established, all the E.M.F. does is to prevent tl return flow, which will take place in consequence of the differen of potential as soon as the E.M.F. ceases. If the inductor were c in two in the middle while still subject to the E.M.F. in the ma netic field, the two ends would, after being removed from the fie exhibit opposite charges. The quantity of electricity transferre and the amount of work done by a given E.M.F. in establishi the difference of potential between the two ends of the inductor, w depend upon the capacities of its two halves.

I may perhaps make my view clearer by supposing inductor to consist of a non-conducting bar. When such a moves across a uniform magnetic field, the E.M.F. is develop the same as before, but *no potential difference exists*, because electricity can be transferred. Suppose the bar to be not an ab lute non-conductor, but a very poor conductor. A potential dif ence equal to the E.M.F. would, after a time, be established, this potential difference would not immediately disappear when motion of the inductor ceased.

In short, electrical difference of potential can never be establis where it did not before exist, except by a transfer of electric and a transfer of electricity always involves work. This is jus true in the case of a bar wholly included in a uniform magnetic field as in any other conductor. WM. A. ANTHONY.

NEW YORK, N. Y.

Electric Shock from a Secondary Alternating Current.

To the Editor of The Electrical World:

SIR:—Referring to the communication in your paper of Jan. 19, concerning severe shock received by a man standing on damp earth while turning on a lamp supplied from 52-volt alternating secondary circuit, and also referring to your communications, three in number, under date of Feb. 16 on the same subject, I would say that some time ago we had almost an identical case just after a lightning storm.

The ground detector at the station showed a ground on the line, and upon examination we found two transformers burnt out. These were at once replaced with perfect ones and as it was late in the evening before the work was completed, no further search was made, especially as the ground detector indicated only slight evidence of ground above the usual leakage which is always shown.

The owner of a livery stable stepped out into one of his sheds where there was no floor, and as there had been a heavy rainfall the ground was damp, in fact, quite thoroughly soaked; as he reached up to turn on the light, which was above his head, he received a shock which killed him instantly. The other lights in the building went on burning as before, and nothing unusual was discovered except that the bulb of the lamp in the shed where the man was killed showed quite incandescent, very similar to a phosphorus light. Upon arrival at the scene of the accident very soon afterwards, I gave instructions that no one should in any manner touch any of the wires or switches until our man arrived in the morning, it being impossible to do any work that night. However, notwithstanding my caution, an employe of the stable in trying to explain to some one how the accident occurred, touched a snap switch used for turning on a bunch of lights in the barn, and the floor being damp from sprinkling, he received a shock which threw him for some distance and burned his hands quite badly.

An examination of the transformer showed a ground of one primary and one secondary wire on the case. Immediately I had every transformer on our line tested for ground between primary and secondary wires, and found two others in about the same condition, which of course were replaced with perfect ones. Since that time there have been two similar cases on our circuit, one of them being a servant girl in a private house. She went into the basement and stood in her slippers on a damp cement floor, and reaching up to turn on the light received a shock which knocked her down, senseless. The other was the boiler engineer in the Court House Block. He stood on a damp cement floor and received a severe shock while turning on the light.

These numerous cases have caused me a great deal of worry and anxiety, and I have done some corresponding to see if I could not learn what it is we have omitted in the way of practice or device which will obviate this trouble.

I have given much thought to the idea of grounding the secondary wire to earth, but as I have not heard of any one else doing this. I have not dared, as yet, to try it. I have noticed in the articles mentioned, that while all speak of the trouble, no one suggests a remedy. It is one which does not show itself until the accident occurs and it does seem as if some one should devise the means to obviate the trouble.

GREAT FALLS, Mont. W. D. DICKINSON.

Definition of Polyphase Systems.

To the Editor of The Electrical World:

SIR:—With great pleasure I see from your editorial in THE ELECTRICAL WORLD of March 9 that I have discovered a new definition of polyphase system. I am sorry, however, to be obliged to decline the honor since this definition is by no means new. In the *Transactions* of the American Institute of Electrical Engineers of February, 1892, it is referred to as the characteristic feature of a polyphase system that the flow of energy is constant, while in a single phase system it is pulsating, and it is stated that in this regard a certain similarity exists between the polyphase alternating current system and the direct current system.

I have given this matter considerable thought and found this the only consistent definition, since differences of phase of currents as well as of E. M. Fs. can be found in any single phase system, and thus cannot be the distinguishing characteristic between single phase and polyphase systems.

The definition mentioned in your editorial as the accepted one is hardly a definition at all because it is based on a logical fallacy. It is in other words: If an induction motor is supplied by a polyphase circuit, the action of the induction motor can—amongst other theories—be explained by the theory of the revolving field. Consequently, if the action of an induction motor can be explained by the theory of the revolving field, the induction motor must be a polyphase motor and the system polyphase. Obviously, a hypothesis, while useful in other respects, is not suitable as a definition, and the theory of the rotating field is a hypothesis only, which, besides, may be applied to the operation of an ordinary single phase induction motor also, that is, a motor consisting of a short circuited armature revolving in a straight single phase field.

Thus such a motor would be included in the definition, which I believe is a somewhat too excessive extension of the term "polyphase." C. P. STEINMETZ

SCHENECTADY, N. Y.

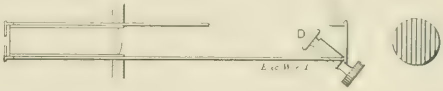
The New Illuminometer.

To the Editor of The Electrical World:

SIR:—I read with interest the article by Messrs. Houston and Kennelly in your issue of March 9.

Referring to the objections raised by Prof. Thomson in the discussion of the article I would suggest some changes in the construction of the illuminometer by which some of these objections might be overcome.

Instead of employing printed characters which are exposed to such an illumination as to make them just legible, I would use a small white disc with a number of black sharply defined lines across it, and the disc mounted so that it can be rotated by means of a milled head on the outside of the instrument. (See accompanying sketch.)



I would use the instrument as follows: Close the shutter entirely and then give the milled head carrying the disc a few turns so that the observer is unaware of the direction of the lines. Then look into the instrument and open the shutter till you can just see the lines.

By this means a person cannot be misled by his imagination, because he must actually see the lines in order to determine their direction, which of course will vary with each observation. The direction of the lines once noted in an obervation, and the reading taken on the shutter, it can be further verified by opening the shutter so that the lines can be seen easily.

CLEVELAND, O. CHAS. GOFFING.

A Correction.

To the Editor of The Electrical World

SIR:—In looking over my paper on the "Storage of Energy Essential to the Economy of Working Stations," read before the National Electric Light Association at Cleveland, I find an error that does injustice to Mr. Halpin's method of steam storage. The figures were correct in my original manuscript, but got changed in the haste in transcribing the printer's copy. In the printed copy the fixed investment charges are made to add up $994.39, whereas they add up only $788.39. This is so palpable an error that probably none but the casual reader would fail to detect it. It, however, places this method in a very wrong comparative light, and I will feel obliged if you will kindly call attention to the correction.

Making the change, the total fixed annual cost per electrical horse power becomes $67 instead of $87.60, and the total annual cost $97.24 instead of $117.84, with coal at $1.75, and the total annual cost with coal at $3.50 per ton becomes $114.27 instead of $134.77.

Substituting these figures in the final comparative statement it will read thus:

	Recapitulation.		Savings Effected.	
	Coal $1.75.	Coal $3.50.	Coal $1 75.	Coal $3.50
Present method; steady load......	$48.68	$65.62	——	——
" gas engine................	88.28	103.61	29 50	44 79
Combined feed and steam storage.	94.42	111 35	23 36	37.05
Feed storage......................	97.58	117.58	20.20	30 82
Without storage; load factor 25 per cent.........	117.78	148 40	——	——
Steam storage......................	97.24	114.27	20 54	34.13
Complete battery storage..........	123.13	145.74	—5 35	—2.66

NEW YORK, N. Y. NELSON W. PERRY.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions as far as the limited space will admit. Abstracts made by the authors, editors, or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 922 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears

DYNAMOS, MOTORS AND TRANSFORMERS.

Reversible Regenerative Armatures and Short Air Space Dynamos.—The Lond. "Elec. Rev.," March 1, reprints the recent paper of Mr. Sayers, with the illustrations, of which there are quite a number; the paper was abstracted in the Digest last week. The continuation of the discussion of the paper is published in the Lond. "Elec. Eng.," March 1. Dr. Preller discussed the subject of weight; it does not necessarily mean a reduction in the price and for traction purposes it is not advisable to make it too light; the 80-kw machine referred to weighs 100 lbs. per kw; Mr. Brown's 60 kw machines weigh 90 lbs. per kw, the Thury dynamos weigh about 110 lbs per kw; he doubts whether an efficiency of 96 per cent. can be obtained in practice. Mr. Evershed considers the arrangement admirable but rather complicated. Mr. Crompton thought there was a tendency to undervalue the author's invention on the ground that the plain slotted armature was sufficient. Mr. Sayers believes that if the proportions which he has given are carried out there will be no heating whatever of the pole pieces or any measurable loss of power; in reference to the comparative weights of the machines, he stated that if he made 4-pole machines their weight would be approximately half that mentioned in the paper; the main object is not "to get a regenerative action from the armature with a view to keeping up the voltage, but the chief advantage was that enough current could not be put on the armature to destroy the reversing field."

Alternators in Parallel.—A discussion, chiefly of local interest, regarding the Mordey alternators is continued in the Lond. "Elec.," March 1. Mr. Sayers relates a case in which the eccentric of an 100-kw engine broke, but notwithstanding, the alternator which was running in parallel with another kept perfectly in step driving the engine and taking a very few amperes; the momentary rise in voltage was only 1 per cent.

Motor-Alternator.—An illustrated description of the one designed for the electrical laboratories of the University College, by Dr. Fleming and worked out by Mr. Kapp, is published in the Lond. "Elec.," March 1; it is intended for producing alternating currents of various frequencies and for generating two-phase currents; it consists of four separate machines, two alternators and two continuous current motors coupled directly with them; the two pairs may furthermore be coupled directly with each other. An indicator in the form of a column of liquid, used in connection with these, is also described; it will indicate a change of speed of less than 1 per cent.

Application of Alternating Current Motors.—A paper by Mr. Fryer is reprinted with numerous illustrations in the Lond. "Elec. Eng.," March 1. In the first part he gives a somewhat elementary explanation of the action and in the latter part some descriptions of installations.

Alternating Current Motor.—In a lecture by Mr. Bradley, abstracted in "El'ty" and more briefly in the "Elec. Eng.," March 13, he describes a machine designed by himself, in which the armature is divided longitudinally into two parts, one being wound with German silver wire and the other with copper bars; the field is wide enough to span only one of these windings; for starting, the field is placed over the German silver winding, and when up to speed it is moved over until it surrounds that part containing the copper bars; he showed, by means of a lever and balance, that the starting torque was nearly three times greater with the German silver winding than with the copper; it also rises more rapidly at low frequencies; the efficiency was affected very little by the substitution of a solid core for a laminated one.

Testing Dynamos.—Messrs. Freedman and Osterberg have started a series of articles in "Elec. Power" for March in which they intend to discuss all the practical tests that must be performed on dynamos and motors. The first article, which is introductory, gives a short theoretical development of dynamo design.

The Electric Motor.—"Cassier's Mag." for March contains an article of a popular nature by Prof. Crocker.

LIGHTS AND LIGHTING.

The Electric Arc.—The article by Mrs. Ayrton (see Digest March 9) is continued in Lond. "Elec.," March 1. A curve is given showing clearly and with certainty that the core of the positive carbon is responsible for a very low potential difference on starting the arc. The influence of a flat negative carbon is discussed and it is shown that the shape of the negative carbon plays a very small part in the change of voltage that takes place on starting the arc, but this is not the case with the flat positive carbon. A curve is given showing the differences in the change of voltage after starting the arc with differently shaped carbons; the changes that take place in the voltage of the arc just after starting are due in order of importance: to the core of the positive, to the shape of its tip, to the shape of the tip of the negative, and very slightly to the temperature of the carbons before starting. She discusses the effect of changing the length of the arc, on the time during which the voltage remained variable; also how the varying of the current affected this time; with flat carbons the time is longer the shorter the arc and the smaller the current. The results of the experiments are given, made to find what change took place in the voltage when the current was suddenly increased or diminished, the length of arc being kept constant; quite contrary to what occurs with wires, the sudden rise of current in an arc is accompanied by a sudden fall of voltage and a fall of current by a rise of voltage. With a sudden change of current the sudden change of voltage is greater with a cored than with a solid positive carbon, the subsequent slow rise or fall of voltage is greater with the cored than with the solid positive carbon, and the time during which this slow change of voltage takes place is greater with a cored than with a solid positive carbon. The time the voltage takes to reach its steady value after a sudden change of current is less with a longer than with a shorter arc; the sudden exaggerated changes of voltage probably depends on the difference between the shapes of the carbons and craters with small and large currents. The shapes of the carbons show that with a large current both are burned away much farther down, making the lengths of the pointed parts shorter the smaller the currents. The voltage necessary to maintain a large current through a given length of arc will be less when the carbons are normal for a small current than when they are normal for a large one and the reverse.

Alternating Current Arc Lamp.—A new form is described and fully illustrated in the "Elek. Zeit.," Feb. 28; instead of there being an intermittent movement in the feeding of the carbons, it is continuous in this lamp; the regulation is effected by an electromagnet, having a piece on one of its poles extending to one side, forming a sort of polar extension to one side only; opposite to this is a pivoted copper disc; when an alternating current flows through the coil, the copper disc will revolve, owing to the unsymmetrical character of the pole piece opposite to it, the magnetic waves traveling from the core out toward the end of the extension; the rotation is opposed by the weight of the carbon holder and a turning of the disc feeds the carbon. Several modifications, as also some of the necessary conditions, are described and illustrated.

Cost of Manufacture of Incandescent Lamps.—A detailed table of costs of the manufacture of lamps in Germany, on the authority of Mr. Krueger, is given in "L'Ind. Elec.," Feb. 25; the totals are about as follows: materials 4.4c., labor 3.1c., general expenses 1.1c.; in addition he allows for a breakage of finished lamps of 10 per cent.

Lantern Projection.—In the "Elec. Eng.," March 13, Mr. Van Dycke describes a device for orienting the crater; a semi-circular electromagnet with a radius of about three inches is placed so that the arc is about at its centre of curvature; this produces a flaming arc and the crater remains always on one side, is oval in shape and makes an angle of about 50 degrees with the axis of the carbon; the carbons burn away considerably faster and the regulation is less perfect, but he believes he obtains about 50 per cent. more light.

Novel Tower Lighting.—An illustrated description of the novel system to be used on a new building in Chicago is illustrated and described in "Elec. Ind." for March; the outside corner of a building consists of a long vertical shaft, on which are placed, at regular intervals, 2,868 incandescent lamps; diagrams are given showing the method of connection.

POWER AND HEAT.

Large Transmission Plant.—A compilation of the competitive propositions for the plant at Locle (see Digest March 9) is published in "L'Ind. Elec.,' Feb. 25; all the different systems are represented.

Elastic Couplings for Gas Engines.—The discussion on this subject is continued in a communication by Mr. Bablon in "L'Ind. Elec.," Feb. 25.

Transmission Plant.—In "Cassier's Mag." for March Mr. Leggett gives an illustrated description of the plant at Bodie, Cal., which is said to be one of the most extended transmission plants now in operation in this country. The generator is a Westinghouse 120 kw constant potential, 12-pole alternator, coupled directly with the water wheels, the governor for which is described at some length; the voltage is 3,530; the line is made of No. 1. B. & S. gauge, soft drawn, bare, copper wire, which, however, is insulated near the supports before being attached; the line has given no trouble whatsoever; the distance is 12.5; the motor is a synchronous constant potential machine of 120-hp which is started by a 10-hp Tesla motor; it is claimed that there is but very little lag in the phase of the current delivered to the motor and therefore the apparent efficiencies of these machines is for all practical purposes the true electrical efficiency; the daily saving over the use of the steam plant is said to be $35 to $40 per day; the line is equipped with the Wurz system of spark gap arresters and choking coils.

Long Distance Transmission.—According to "Elec. Rev.," March 13, it is rumored that one of the largest power plants in the world is to be erected on the Susquehanna River to supply Philadelphia, Wilmington and Baltimore with light and power.

Niagara Falls Plant.—The "Elec. Rev.," March 13, gives some illustrations of the tunnel, subway and sectional elevation of the power house.

New Sources of Electric Power.—The "Jour. Teleg.," Feb. 20, concludes the reprint of the recent article by Mr. Thwaite from the "Nineteenth Century," discussing the problem of developing power at the coal mines and transmitting it electrically to industrial centres.

Power Losses in Transmission Machinery of Central Stations.—A paper by Mr. Aldrich, read at the Montreal meeting (June, 1894) of the Am. Soc. Mec. Eng., is published in the transactions of that society, vol. 15, 1894; it contains some interesting results of tests.

Electric Power in Southern Cotton Mills.—The "Eng. Mag." for March contains an article by Mr. McKissick in which he gives the advantages gained by electric transmission of power for cotton mills and describes briefly the electric plant at the Columbia cotton mills (see Digest Feb. 23) and the mills at Pelzer. He reprints the table of Mr. Flather giving the power required to drive the shafting in a number of large factories, showing that it varies from 15 to 80 per cent., the average being 38.6.

Electric Elevators.—In an article by Mr. Fay in the "Elec. Age," March 9, he discusses the question of the power required for elevators, giving practical formulas and a convenient diagram from which the horse power required for any velocity in feet and any weight can be determined without calculation; the diagram is based on an efficiency (useful weight divided by total weight) of 60 per cent.; the lines on the diagram are all diagonals, laid out on the basis that it takes 100 hp for 10 tons at a velocity of 100 feet per minute. The issue of that journal, March 16, contains an illustration of an Otis Double Screw Electric Elevator.

Power from Railway Circuits.—In the Elec. Eng.," March 13, Mr. Guy describes some of the industrial uses of motors in Los Angeles, taking their power from street railway circuits; the company supplies in this way 240 hp, the greater part of it being for elevators and for cold storage plants; a number of other applications are illustrated and described.

Gas Engine-Dynamo.—The "Prog. Age.," March 1, abstracts a report by Prof. Kennedy of some tests; it includes a table giving the results for a number of different loads.

Electric Cooking and Heating.—"Cassier's Mag." for March contains an illustrated article of a popular nature by Mr. Perry.

TRACTION.

Electric Cable Railways.—Dr. Preller's article is continued in Lond. "Engineering," March 1. A well illustrated description of the Stanserhorn road is given.

Waterloo & City Electric Railway.—A brief description of the civil engineering features of the tunnel for this railway is published in the Lond. "Elec. Eng.," March 1.

Rail Bonding and Its Bearing on Electrolytic Corrosion.—The communication by Mr. Low (see Digest last week) is concluded in the "St. Ry. Gaz.," March 9. It is devoted largely to a description, with illustrations of the direct bonding system of Mr. Newberry, which he favors. He gives a large number of the advantages of direct bonding; he shows the inconsistency of bonding a wire to the web of the rail on the grounds that the carrying capacity of the rail surface exposed to the bond wire is insufficient and that under the general prevailing conditions the carrying capacity of such bonding is overestimated by about 20 per cent.; to enable the copper to take a current up to its full capacity, its surface contact with the rail should be about six times the area of the wire, from which it is obvious that the web is not the proper place to attach the bond wires. In conclusion, he believes that the problem of eliminating electrolytic corrosion is simply one of judicious bonding.

Canal Boat Haulage.—The Lamb electric cable system is described and illustrated in the "Elec. Eng.," March 13. Results of recent experiments are said to have demonstrated that the system is entirely feasible; a motor travels along a suspended cable, exerting a pull on another similar cable, the boat being connected with the motor by means of a hawser; it has been shown that the motor can pull a boat around the sharpest curves. The system requires no changes in the present methods, as the electric motor simply takes the place of the mules; the speed is said to be doubled; the cost per boat per mile for horses is given as 18 to 25 cents, while that for the electric system is said to be 10 to 15 cents.

Test of a Small Railway Plant.—A paper by Mr. Smith, read at the Montreal meeting (June, 1894) of the Am. Soc. Mec. Eng., is published in the transactions of that society, vol. 15, 1894. He gives the tabulated results in considerable detail, including indicator diagrams of a test made on a railway in Detroit in October, 1893.

Storage Battery Railway and Lighting Plant.—A description of the Merrill plant (see Digest, Feb. 9) by Mr. Condict, is given in the "Eng. and Min. Jour.," March 9. Some additional information, including some load diagrams, is given in the "Elec. Eng.," March 13.

Accumulators in Power Stations.—A description of the plant in Zurich, in which accumulators are used to equalize the load on the machines, is given in the "Eng. News," March 14; an abstract of the original article was given in the Digest July 28.

Electric Locomotives.—The "St. Ry. Gaz.," March 9, reprints from "Lippincott's Magazine" for March an article by Mr. Varney describing briefly the electric locomotives that have been constructed in this country.

New York Trolley Rules.—The recommendations of the State Board of Railway Commissioners are given in the "Elec. Rev.," March 13.

Beecher Single Rail System.—Some additional information regarding this system is given in the "Elec. Eng.," March 13, including illustrations of the cars. Each motor car will carry about four tons of accumulators and will have a 30 hp motor with a 40-in. driving wheel, the speed is intended to be 60 miles an hour for five hours, with one charge of the battery.

Monte Salvatore Electric Cable Railway.—The "St. Ry. Gaz.," March 9, abstracts a recent article from Lond. "Engineering" including two of the illustrations.

Electric Railway Over Niagara Falls.—According to "Eng. News," March 14, a cable tramway located 30 feet above the crest of Niagara Falls has been projected; towers will be erected on each side of the river and a double set of cables will be run across the Horseshoe Falls, from which an electrically operated passenger car will be suspended.

Binghamton.—An illustrated description of the railway system is given in "Elec. Ind." for March.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electricity in Mining.—The article of Mr. Corlett mentioned in the Digest March 9 is reprinted with the discussion in the Lond. "Elec. Eng.," March 1. The question brought up regarding the lighting of pit tops and bottoms is discussed by Mr. Snell in the "Lond Elec.," March 1; he gives some general hints regarding the mains.

Generator Gas Installation in Switzerland.—A few generator gas installations are briefly described in the "Elec. Zeit.," Feb. 28. One firm has recently installed several of over 100-hp each; a gain in the ratio of 2 to 3 is claimed as compared with steam.

Profitable Plants for Small Towns.—A translation in abstract of the article mentioned in the Digest last week is given in the Lond. "Elec. Eng.," March 1.

Rules and Regulations for Installation.—The "Elek. Zeit.," Feb. 28, gives the proposed rules prepared by the committee of the German Union of Electricians; they are also discussed editorially.

Municipal Electric Lighting of Paris.—"L'Ind. Elec.," Feb. 25, reprints some large tables and detailed data of the expenses for the year 1893 taken from a recent report by Mr. Tavernier.

London.—The Lond. "Elec." March 1, gives the capital and output of a number of the London stations, all of which show an increased output and a decrease in the ratio of working expenses to revenue; all are paying a satisfactory dividend.

Blackburn.—A brief description of the station is published in the Lond. "Elec. Rev.," March 1; the low pressure three-wire system is used.

Statistics of Boston.—Some statistics from a recent report are given in "Elec. Eng.," March 13.

Test and Operation of Electric Plants.—The serial by Mr. Armstrong is continued in "Elec. Ind." for March.

WIRES, WIRING AND CONDUITS.

Explosions.—The English journals, March 1, continue to record explosions in electric conduits. The Lond. "Elec.," March 1, editorially calls attention to a somewhat remarkable explanation which was found for the presence of the spark in districts where stoneware insulators are used; verdigris was found on the copper mains and a whitish salt on the insulators which was found to be nearly pure caustic soda; when water was thrown on it flames shot out, showing that pure metallic sodium was electrolytically produced which in the presence of water turns into caustic soda; under conditions which may, and do exist, particles of metallic sodium remain which, in contact with water will produce the flame. The remedy is to abandon that material for the insulators and to adopt glass instead as is done in many other places in which plenty of gas was found but where no explosions have occurred; the film of moisture on the glass insulator can do no more damage than slightly lower the insulation while the other material when moist becomes an electrolyte.

Underground Wires in Paris. Mr. Monmerque's article is concluded in "L'Eclairage Elec.," Feb. 9 and 16. In his conclusions he expresses the belief that in large cities where underground wires are required there will soon be a return to the use of armored cables for a double electrical and mechanical protection and placed directly in the earth; if conduits must be used he recommends glazed earthenware; he does not favor metallic conduits, but if they are obligatory the cables used should be of the same kind as those which are intended to be placed directly in the earth; great attention must be given to ventilation of the conduits.

Electric Wiring and the Fire Hazard. The "Eng. Mag." for March contains an article by Mr. Cabot, in which he discusses the causes of electric fires and the means of their prevention; he believes that all the dangers which have arisen from the use of electricity on metallic circuits can be overcome; one of the chief dangers arises from the employment of unskilled and incompetent workmen.

ELECTRO-PHYSICS AND MAGNETISM.

Atmospheric Electricity.—A Royal Institution lecture by Prof. Schuster is abstracted at some length in the Lond. "Elec. Rev.," March 1, including some of the illustrations of the apparatus and curves. To explain the modern theory of electric discharge he stretched a piece of elastic; the two ends then seemed to be attracted to each other due to a stress between them; he states that it is better to consider that electricity is not a something itself but the manifestation of a something between the charged bodies which exhibits results of a nature of a stress; when the rubber breaks the analogy with a spark is complete; that which breaks down cannot be the ether because without air no spark would pass. He showed experiments, the apparatus for which is illustrated, to prove that heated air conducts and that electrified air discharges a charged body. He discusses the question where the lines of force end; balloon and kite experiments have been made to heights up to 10,000 and 20,000 feet; electrification apparently vanishes at 12,000 feet; diurnal variations are uniform over the earth; atmospheric electrification appears to be connected with, not the amount of watery vapor, but the aqueous vapor pressure; he gives a curve connecting the volts per cm with the pressure; he intimates that some connection may exist between the ultra-violet solar radiation and the amount of moisture in the air. Lines of force seem to find their anchorage on small masses of matter and dust storms exercise an influence, thus a dust storm in upper Egypt seems to reverse the electrical effects in the centre of Germany; waterfalls cause a redistribution for many miles; we do not know where the lines of force end in their upper extremities. He defines two kinds of thunderstorms; oaks are frequently struck but beeches very seldom, owing probably to the oily matter; the safest course for a human being in a thunderstorm is to get thoroughly wet; "Franklin has recorded that he could kill a rat when dry by a lightning discharge, but when wet never." Theories of atmospheric electricity are briefly discussed as also the aurora borealis; he shows the importance of observations of atmospheric electricity in polar expeditions.

Experiments with Alternating Currents.—The "Phil. Mag." for March contains a paper by Mr. Griffiths. If an alternating current and a constant current combined go through the coils of a galvanometer, the defection of the needle is greater than that produced by the constant current alone; he discusses this phenomenon and describes experiments made to investigate it; the action of the needle will vary approximately as the square of the alternating current. He offers a hypothesis for the phenomenon noticed by Lenard, namely: the resistance of bismuth in a strong magnetic field, when measured with an alternating current and a telephone, is greater than when measured with a steady current and a galvanometer; he describes experiments with bismuth and spirals, all of which gave negative results; he describes a convenient and satisfactory arrangement for diminishing the spark on breaking a current. He gives a discussion of the behavior of the method of differential winding for diminishing the spark on breaking a circuit; also a theoretical treatment of the working of the interrupter for high frequencies; he also describes the method adopted to compare self-inductions.

Production of Cathode Rays.—A paper by Mr. Kowalski from the "Comptes Rendus," vol. 120, page 82, is reprinted in "L'Eclairage Elec.," Feb. 9. He describes experiments to investigate the statement of Mr. Goldstein that the rays produced at the cathode form three distinct radiations and that the so-called cathode rays are produced in the dark spaces of Crookes. His experiments show that cathode rays have the following properties: their production is not limited to the discharge of metallic electrodes through rarefied gases; they are produced wherever the primary glimmer reaches a considerable intensity, or, in other words, wherever the density of the lines of current is sufficiently great; the direction of their propagation is that of the lines of current in the part where the rays are produced, in the direction from the negative to the positive pole.

Kation.—Mr. Waddell in the Lond. "Elec.," March 1, protests against spelling the word "kathion"; the error arose by a false analogy with "kathode."

Potential and Current in a Wire Moving in a Field.—A paper from the Italian by Mr. Lombardi on the variation of the potential and the intensity of the current in an open circuit moving in a uniform magnetic field is abstracted in "L'Eclairage Elec.," Feb. 16; it is of a mathematical nature.

Electrostatics.—An article by Mr. Pellat of a mathematical nature on "Electrostatics Not Founded on the Law of Coulomb and the Electric Force Acting on the Surface of Separation of Two Dielectrics" is begun in "L'Eclairage Elec.," Feb. 16.

Transmission of Energy between the Source and the Conductor.—An Academy paper by Mr. Vaschy of a mathematical nature on "The Loss of Transmission of the Energy between the Source and the Conductor in the Case of a Permanent Current" is abstracted in "L'Eclairage Elec.," Feb. 9.

Multiple Resonance of Electric Oscillations.—An article by Mr. Strindberg is abstracted briefly in "L'Ind. Elec.," Feb. 25.

Electric Properties of Pure Sulphur.—A Royal Society (London) paper by Messrs. Threlfall, Brearley and Allen is abstracted in "L'Eclairage Elec.," Feb. 9.

Slow Changes in the Permeability of Iron.—The paper of Mr. Mordey (see Digest last week) is concluded in the Lond. "Elec." and "Elec. Rev.," March 1. The iron of some transformers which showed this increase did not return to its original condition after a period of repose, if, therefore, repose in some cases prevents the rise, he believes it is because the time of use is not long enough to allow of much increase in temperature; if only slightly warmed even when caused by magnetization, its permeability remains unaffected; it is possible that continued moderate cold may bring the iron back to its original condition or even permanently increase its permeability, a point which he intends to investigate; these slow changes of the hysteresis must not be classed with the immediate effect produced by moderate heating of the iron; the increase in hysteresis may have an important influence in the reliability of measuring instruments having iron portions magnetized by alternating currents, as the constants may gradually fall. He gives the conclusions of his tests, all of which were given in full in the Digest Jan. 12, in which, however, an error appeared. No. 5 should read, "it is not produced when the iron is not allowed to rise more than a few degrees above the ordinary temperature." In an appendix he shows the effects of pressure without heat; the loss in a transformer was measured after which it was subjected to a pressure of about 1,500 pounds per sq. in. perpendicular to the laminæ, when the loss was found to have increased 21 per cent.; after 30 days' continued subjection to this pressure the loss remained practically unchanged; on removing the pressure the loss was the same as before the pressure was applied; without heat, therefore, pressures up to this limit produced no permanent effect; the decrease in permeability due to continued heating is not to be accounted for by hardening produced by pressure; the hardening which takes place at these low temperatures is apparently similar to that which takes place in iron when heated and suddenly cooled. Tests are being made to find the effect of heat combined with pressure. In another appendix he gives the results of a test with a transformer heated in an oven, showing a considerable increase in hysteresis loss.

Propagation of Magnetization.—The paper by Messrs. Hopkinson and Wilson which was abstracted in the Digest last week is concluded in the Lond. "Elec.," March 1, consisting almost entirely of numerous large tables, curves and illustrations of the apparatus. It deals with alternating currents of periodic times varying from 4 to 80 seconds; it does not admit of being abstracted. In summarizing their results they point out the marked effect of a change of frequency on the average induction per unit area of the innermost coil when dealing with comparatively small maximum inductions; the maximum force per linear cm. due to the currents in the coil is 4.8, but the average induction per sq. cm. of the innermost coil was reduced from 7,690 to 1,630 by a change of frequency from $\frac{1}{80}$ to $\frac{1}{20}$; but this was not the case on the higher portion of the induction curve; with 500 periods per second only the outside layers of the 1 mm wire were really useful; the ergs dissipated per cycle per cb. cm. were 26,000 by induced currents and about 17,000 by magnetic hysteresis, which shows that when the wires in armature cores are of an order of 1 mm or 2 mm diameter the loss by induced currents would be but small as compared with the loss by hysteresis, assuming the wires to be perfectly insulated. They infer that the ordinary practice of making transformer plates about ½ mm. thick and plates of armature cores 1 mm thick is not far wrong; not much is lost by local currents and the plates could not be made much thicker without loss.

Electromagnetic Stress.—The "Phil. Mag." for March contains a paper by Mr. Jones in which he describes experiments to determine the true relation between electromagnetic stress, or lifting power per unit area of magnets, and magnetization; he reviews the numerous experiments made by others and describes in detail those made by himself; they were made to realize as closely as possible the conditions under which the results could best be compared with Maxwell's theory; the iron was in the form of an ellipsoid of revolution cut into two halves; the results are given in tables and curves and agree with Maxwell's theory to ½ per cent. for inductions up to 19,000 units; the curve connecting the induction with the square root of the number of grammes supported is a straight line; the present method is said to have great advantages over the ballistic, in which the weights for the same induction sometimes differ 20 per cent.; he concludes that any apparatus of the Thompson permeameter type may therefore be used for accurate measurements of magnetic induction in uniformly magnetized bars, the essential conditions being that the contact surfaces are plane, that the upper bar can be accurately adjusted and rigidly fixed and that the contact surfaces are as nearly as possible flush with the end of the magnetizing coils; the lower bar must also be guided.

Influence of Temperature on the Pull of Permanent Magnets.—An abstract, including the table of values of the tests of Mr. Pictet, mentioned in the Digest last week, is published in the Lond. "Elec. Eng.," March 1.

Magnetization Curves.—In Lond. "Engineering," March 1, Mr. Jenkin calls attention to a supposed error in the Hadfield curves mentioned in the Digest last week and gives some others (now somewhat old) for Crewe cast steel.

Magnetism and Chemical Reactions, E. M. F. of Magnetization.—A paper by Mr. Hurmuzescu is published in "L'Eclairage Elec.," Feb. 9 and 16; he gives a history of the subject and the results of some recent experiments. "L'Ind. Elec.," Feb. 25, contains some remarks of Mr. Janet regarding the paper of this author which was abstracted in the Digest, Jan. 19.

Magnetic Permeability for Rapid Electrical Oscillation.—In the "Phil. Mag." for March Mr. St. John gives a correction of an error in his recent article abstracted from the Digest Nov. 24.

Multiple Resonance.—A paper by Mr. Bjerknes from the "Ann. Phys. u. Chem.," No. 1, 1895, is briefly abstracted in the "Amer. Jour. Sci." for March. In connection with the subject of the apparent diffraction of electric waves, he points out that there is an important difference between interferences of light waves and that of electrical waves; what may seem to be spectral dispersion may be only the multiple resonance of the instrument.

Animal Electricity.—The third and concluding part of a long article by Prof. Thurston, published in the "Jour. Frank. Inst." for March, on "The Animal as a Prime Mover," is devoted largely to the subject of electricity in animals, and its generation; he refers also to the very efficient production of light by animals. The statement in the Digest last week, under the heading, "The Animal as a Machine," appears to be due to this writer.

Action at a Distance.—"Elec. Power" for March contains a short, popular article by Mr. Osterberg in which he shows how the theory of action at a distance developed and how Faraday, Maxwell and Hertz disproved the same.

Minimum Temperature of Visibility.—The recent paper of Mr. Gray is abstracted at some length in the "Amer. Jour. Sci." for March.

Hysteresis.—The discussion on the subject, by Mr. Harrison, is continued in the "Elec. Age," March 9 and 16.

Argon.—An editorial from the "Lond. Elec. Rev.," on this new constituent of the atmosphere, is reprinted in the "Elec. Rev.," March 13.

ELECTRO-CHEMISTRY AND BATTERIES.

Borchers' Battery.—The Lond. "Elec.," March 1, contains a communication by Mr. Rhodin. He claims that proof is not needed to show that the energy cannot be derived from the oxidation of carbon monoxide; the positive or energy developing elements must have the character of the cathion of an electrically decomposed electrolyte; the most characteristic property of a cathion is that it is able to combine with hydroxyle to a basic hydrate or replace hydrogen in a negative hydrogen combination forming a salt; carbon monoxide does not enter directly in combination with water but can be made to do so indirectly, the result being formic acid HOCOH. It is also certain that a compound cathion must be of a chemically unstable character and in most cases of only a hypothetical existence; carbon monoxide, CO, has all the properties of an exceedingly well balanced chemical compound; it has the characteristic of negative radicals generally and whenever it enters a positive radical the properties of these radicals depend upon another element than carbon, generally nitrogen; the only other class of CO compounds known are non-electrolytes; CO has the characteristic of an anion and it therefore cannot be used directly as a current developer, but this does not exclude the possibility of utilizing its reducing power for reviving the cathode. According to his opinion the energy in the Borchers cell is due to the oxidation of copper; the cathode is constantly supplied with fresh copper by the reduction of the oxychloride of copper by means of the compound of cuprous chloride and carbon monoxide; the difference between the combination heats; under these conditions the copper cathode might even increase in weight.

Compressing and Shaping Electrolytically Deposited Metals.—The Lond. "Elec. Rev.," March 1, abstracts a recent article by Mr. Langbein from the "Zeit. f. Elect. u. Electrochem.," 1894, page 161. It is for the purpose of producing articles on surfaces of revolution; the core is made of clay, shaped to any required form, after which it is baked and rolled under pressure; after rendering the surface conducting it is placed in the bath where it is kept rolling, pressure being applied to it to any desired extent. It is stated that the metal thus obtained is exceedingly tough and resisting; the process is claimed to have superior advantages over the somewhat similar Elmore process, one of which is that much more work can be done in the same space and the objects may have any profile.

Accumulators with Powdered Lead.—A translation of the article, mentioned in the Digest last week, is given with the illustrations and data in the Lond. "Elec. Eng.," March 1.

Diaphragm.—According to "L'Eclairage Elec.," Feb. 9, Mr. Kellner uses soap as a porous diaphragm in the electrolysis of alkaline chloride.

Metallurgy of Gold.—The "Prog. Age," Feb. 15, describes what is termed a very promising process, which has recently been introduced and which is claimed to avoid the great waste that often takes place, especially in obtaining the finer particles of gold; it appears that the material is treated with a solution of cyanide of potassium, the solution being treated in an electrolytic cell having a positive plate of lead and a negative plate of mercury, the gold being gathered on strips of copper connected with the mercury; the extraction is not complete and the solution is used over and over again; it is stated that by this process a capacity of handling 10,000 tons of pulp per month will cost but two dollars per ton. (In this connection, attention may be called to an article in the "Eng. and Min. Jour.," Feb. 23, pointing out an advantage in using bromide of cyanogen.)

Nickeling Baths.—"Elec. Ind." for March publishes the formulas of a number of good baths, from a German journal.

Storage Batteries and Their Construction.—A serial by Mr. Pumpelly is begun in "Elec. Ind." for March; the present portion is introductory.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Electrostatic Capacity of Coils.—An Academy paper by Mr. Cauro is abstracted in "L'Ind. Elec.," Feb. 25; he discusses the electrostatic capacities of coils and their influence in the measurement of coefficients of induction by means of the Wheatstone bridge. Coils with bifilar windings have a negligible self-induction but a capacity which increases rapidly with the length of the wire and which in some cases may be considerable; he suggests a method for reducing this capacity and has obtained excellent results; it consists in winding the layers alternately, always starting from the same end by bringing the wire back, longitudinally, for each layer; this gives better results than the winding proposed by Chaperon; as ordinarily wound the capacity became considerable and as the measurement really gives the difference between the self-induction and the capacity, one can obtain a negative self-induction; the effects of the capacity are negligible in measurements made with the ordinary Wheatstone bridge, but they are of importance in measuring coils having small inductance with high resistance.

Instrument for Measuring Inductances, Capacities and Polarizing Resistances.—A description of the present improved form of Profs. Ayrton and Perry's secohmmeter, as now made by Nalder, is published in the Lond. "Elec." and "Elec. Rev.," March 1, the former containing also a diagram of the connections.

The Clark Cell When Producing a Current.—Mr. Threlfall, in a communication to the "Phil. Mag." for March, takes exception to some of the statements made by Mr. Skinner in the article which was abstracted in the Digest Oct. 20; he considers that Mr. Skinner's unconditioned statement of his conclusion appears somewhat inadequate.

Differential Electrometer.—The paper from the Italian by Mr. Arno on the use of the quadrant electrometer as a differential instrument is abstracted with an illustration showing the connections, in "L'Eclairage Elec.," Feb. 16.

Idiostatic Electrometer.—A new and very sensitive type by Mr. Righi is described and illustrated in "L'Eclairage Elec.," Feb. 9.

Demonstration Apparatus for Thermo-Electric Currents.—An illustrated description of the apparatus of Mr. Guillaume which was described in the Digest Dec. 22 is reprinted from "La Nature" in the Lond. "Elec. Rev.," Feb. 22.

Electrochemical Curve Tracer.—A reprint of the greater part of the article mentioned in the Digest March 9 is published in "L'Eclairage Elec.," Feb. 9.

Measurement of the Magnetic Properties of Iron.—A Royal Society (London) paper by Mr. Gray is abstracted in "L'Eclairage Elec.," Feb. 9.

Measuring the Armature Loss and Efficiency of Motors and Generators.—The "Elec. Zeit.," Feb. 28, contains a long reply by Mr. Grau in reply to a recent criticism of Mr. Lenz (see Digest, March 9). He claims that the statements are not correct; the error in his formula is not more than 1 per cent.

Measuring the Specific Resistance of Pure Copper.—A Royal Society (London) paper of Messrs. Swan and Rhodin is abstracted in "L'Eclairage Elec.," Feb. 9.

Measuring Eddy Current and Hysteresis Losses in Direct Current Armatures.—"El'ty.," March 13, contains an article by Mr. Peirce, in which he describes a method in which the common sources of error do not exist and which has other advantages. The machine to be measured is driven directly by a motor, a series motor being preferred; the E. M. F. applied to the driving motor is varied until the speed of the driven armature is steady and the desired amount, the magnetization of the driven machine being zero; the current and voltage of the motor are then measured; a current is then sent through the magnetizing coils of the driven machine and an E. M. F. is applied to the armature of the driven machine slightly greater than and opposite to the E. M. F. generated by it until the current through the armature drives it as a motor and exerts just torque enough to balance the hysteresis and eddy current losses, leaving the driving motor to furnish the balance of the power, which will then evidently be exactly the same as in the first test; under these conditions the input into the driven armature is equal to the eddy current and hysteresis losses, plus the resistance loss in the armature windings, which latter can readily be subtracted. The process is repeated for any other degrees of magnetization; in this method the loads and speeds are the same in all the tests and therefore the other losses of all descriptions are constant. A few hints are added, one of which is that a direct reading tachometer or other centrifugal indicator should be used instead of a speed counter, as it is important to know the speed at any instant; the machine must be running steadily at that speed and the measurements must therefore not be made while the speed is increasing or diminishing. It is sometimes of an advantage to increase the E. M. F. of the supply circuit to the motor and insert a resistance in the armature circuit, so that the drop in this resistance is about the same as that through the motor; under these conditions the difference between the applied and the counter E. M. Fs. is considerable and slight variations in the former have a correspondingly slight effect on the current. (He appears to assume that the friction loss is constant with and without excitation, the correctness of which assumption may be questionable; it appears that any change in the friction loss would, in this method, be credited to the losses which are being measured.)

Calculation and Measure of Small Inductances.—The "Amer. Jour. Sc." for February calls attention to a paper by Mr. Wien in the "Ann. Phys. u. Chem.," No. 13, 1894, in which he discusses the calculation and the experimental determination of the induction coefficients of oscillators and resonators, such as are used in the study of electric waves.

Influence Machine.—A large illustration of the Morton-Wimshurst-Holtz machine for therapeutical use is given in the "Elec. Age," March 16.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Portable Telephone Apparatus.—A brief description is given in the Lond. "Elec. Eng.," March 1, of the apparatus of Mr. Berliner consisting of a portable telephone set used in Germany, intended to be connected with telegraph wires on open tracks in order that conversation may be had with the next railway station; telephonic communication is carried on without disturbing the Morse signals.

Electric Light Signals in War.—"L'Eclairage Elec.," Feb. 9, contains an article by Mr. Marcillac.

Signaling Weather Predictions by Search Light.—The system to be used from the tower of the Auditorium in Chicago is described in the "West. El.," March 16, illustrations being given of the tower, search light and the switchboard; the tower is 280 feet above the pavement and it is believed that the signals can be conveyed over the area of a circle forty miles in radius, the population within which is 3,000,000; a solid beam of white light will indicate a cold wave, or frost in spring or fall; a solid red beam will give a warning of a marine storm; a beam half white and half red will indicate a storm with high westerly winds; the beam will travel slowly around the horizon.

International Cable Code.—The new code of the International Telegraph Convention is discussed briefly in the "Teleg. Age," March 1.

Telephone Service in Europe and America.—Some remarks by Gen. Tracy made before the New York legislature are given in the "Elec. Rev.," March 13.

Base Ball Games.—A method of reproducing a game at a distance electrically is described and illustrated in the "Elec. Age," March 9.

MISCELLANEOUS.

Electric Currents in the Living Body.—A London Institution paper by Prof. Horsley is reprinted in the Lond. "Elec. Rev.," March 1; it is well worth reading by those interested in this subject. He points out what is actually known concerning such currents, shows some experiments and points out the false ideas which are made the foundation of so much fraudulent quackery. The first part is somewhat elementary; he shows that there is no electrical difference between one part of an uninjured cord or muscle and another, but if injured by cutting, the injured part is negative to the uninjured, there being a constant difference of potential between the two surfaces which is commonly called the "resting difference" and it is always present where a portion of a living tissue is dead. A nerve impulse travels at the rate of about forty miles an hour, but beyond that, nothing more is known about nervous energy; when the nervous energy passes along a nerve or arrives at a muscle it causes a wave of contraction, both being accompanied by a change in the electrical state of the tissue, the small current produced having an opposite direction to that of the resting difference; nerve impulses are not electrical, to illustrate which he makes an analogy with the successive fall of a row of bricks. He points out the discovery of DuBois Raymond, discusses it, and describes some interesting experiments made by himself exemplifying among other things the method in which the brain sends out discharges in an epileptic convulsion. The claim made by quacks that electricity is life, he entitles as an "imposture promulgated for the purpose of extracting money from the ignorant;" he shows when currents do and do not exist in the body, stating that they cannot be influenced in any way by the passage of currents from the outside. He points out the legitimate use of electricity in medicine; in diagnosis, currents are used to find whether muscles and nerves are in their natural condition; regarding its use as a treatment very little is known; it is used to stimulate the function of activity of muscles or nerves and sometimes quite empirically and arbitrarily, with the intention of bringing about chemical changes in the tissues in order to encourage the natural chemical processes; there is no scientific evidence whatever proving that there is any quantitative acceleration or increase in the tissue changes in the manner indicated, although unquestionably improvement occurs; owing to the resistance of the skin currents of a certain strength must be used and they cannot possibly be developed from the so-called belts or other appliances of the charlatan.

Educational.—A communication by Prof. Foster on "Direct Reading Instruments and the Teaching of Physics" is contained in the Lond. "Elec.," March 1, forming part of the discussion which has been going on for some time in that journal. The purpose with which an experiment is performed should be the guide, it makes a great difference whether the purpose is to add to the stock of existing scientific knowledge or to increase the private stock of knowledge of the student; the chief ground for criticism of the paper of Prof. Ayrton (see Digest Jan. 12, 26, Feb. 2, 16, March 2) is afforded by its title; he does not approve of calling it a "determination." In his laboratory the students continually make various absolute determinations in terms of the fundamental units, and he believes that even a rough result is of a greater educational value than a more accurate one obtained with the aid of direct reading instruments; students should rely on themselves rather than upon the accuracy of their instruments and he therefore believes that they should start as near to the foundation as practicable with a sparing allowance of "instrumental short cuts;" in most cases, getting them to make apparatus leads to nothing but waste of time and material.

Insulating Material.—The "L'Elec." of March 2 gives the following formula by Mr. Gentzch from the "Rev. Industrielle": ozokerite, 50 parts; yellow amber, 45 parts; asphalt, 5 parts; the mixture is heated to a temperature of 400 degrees C. until the volatile products cease to be disengaged. The residue will be black, having the consistency of wax and can be used alone or mixed with other insulating compounds, for forming the insulation of cables; it is sufficiently plastic for insulating wires.

India Rubber.—A recent paper by Mr. Dybowski on "Caoutchouc, Its Culture, Its Production, Its Diminution and Its Culture in Congo," is abstracted briefly in "L'Ind. Elec.," Feb. 25.

Coating for Acid Tanks.—Some formulas for coating the insides of tanks containing acids are given in "L'Elec.," March 2.

Titanium.—The process of Mr. Moissan for the preparation of this element in a nearly pure state with the aid of the electric furnace is described briefly in "Lond. Engineering," March 1; he obtains a carbide of titanium free from nitrogen which is then fused with titanic acid.

Calcic-Carbide and Acetylene.—A portion of the lecture by Prof. Lewes, abstracted in Digest Feb. 16, is published in the "Jour. Frank. Inst." for March.

Action of Electric Current on Fused Sulphurets.—The French Academy paper, by Mr. Garnier, abstracted in Digest March 9, is translated in the "Eng. and Min. Jour.," March 9.

Lightning Freaks.—The curious effect of a lightning stroke described in the Digest Dec. 22 is illustrated in the "Elec. Rev." of March 13.

New Books.

Physics for University Students. By Henry S. Carhart, LL.D., Professor of Physics in the University of Michigan. Part I. Mechanics, Sound and Light. Boston: Allyn & Bacon. — pages, — illustrations. Price, $1.50.

The aim and purpose of this work is well stated in the preface. It is intended to be used in conjunction with lecture courses, to furnish to the student close and accurate statements of principles, with the deductions, mathematical demonstrations, etc., which he finds difficulty in following when they are given in lectures only; detailed descriptions of apparatus and experiments are, therefore, omitted. Illustrations of apparatus, where given at all, are in diagrammatic form, and where experiments are introduced, only essential characteristics are described.

This is as it should be, as the student needs to have before him, where he can refer to and study them, the general principles of the science, while a clear idea of apparatus and a full appreciation of the teaching of experimental demonstrations can only be obtained by at least witnessing the performance of the experiments. The use of a textbook such as that under review will prove an invaluable aid both to the student and the instructor. The general purpose of the work is well carried out. The topics are well chosen and the space given to each is well proportioned. It may seem that too much space is given to harmonic motion, but, as the author well says in the preface, its importance in the study of several branches of physics renders a thorough knowledge of it imperative. In short, the reviewer finds in the work very much to commend and very little to criticise.

In Art. 18 the printer makes Motions, etc., "definite" instead of "directed" quantities. On page 63 the author seems to imply that there is an inherent difference between potential and kinetic energy as regards availability. In the best turbine wheels the potential energy of a head of water is first converted into kinetic energy of water at a high velocity, which is reconverted into mechanical energy with a loss of less than 10 per cent. in the double conversion, which is as well as could be done through an overshot wheel where the energy does not appear in the kinetic form at all. On page 155 it is stated that "for purposes of graphical illustration it may be supposed that the vibrations are at right angles to the motions of the wave, since in no other way can a curve be made to do duty in exhibiting the phenomenon of wave motion in sound." The reviewer had always considered that the co-ordinates of a curve merely represented the relation between the magnitudes of two dependent quantities without regard to direction, even if the quantities were directed quantities.

The reviewer does not see the propriety of combining the two equations as is done on the same page, 155; at least it is not clear what the resulting equation

$$y = a \sin \frac{2 \pi x}{\lambda}$$

represents. If it be assumed that the particle at the oxygen is at its position of equilibrium and moving in the positive direction, then a proper combination of the two equations will give

$$y = -a \sin \frac{2 \pi x}{\lambda}$$

as the displacement of a particle at distance x.

Teachers of physics will welcome the second part of the work.

GENERAL INFORMATION WITH REGARD TO ELECTRIC INSTALLATIONS. Berlin: Allgemeine Elektricitats Gesellschaft. 234 pages. Price $5.

The Allgemeine Elektricitats Gesellschaft, of Berlin, has issued a unique publication, consisting in part of a technical treatise and in part of a trade catalogue.

The book is 9x12 inches in size, beautifully printed on handsome paper, and elegantly bound in white celluloid, reminding the reader rather of an *edition de luxe* of some literary production than of a trade catalogue, or even an ambitious technical work.

The inside covers and facing pages give three fairly good maps: one of Germany and adjacent countries, one of Europe, and the third a double-page commercial chart of the world, all by Jul. Straube, the celebrated cartographer. Next following the title page is an elaborate frontispiece, lithographed in colors, showing the Allgemeine offices and principal works.

The technical portion of the book considers, under the head of "Synopsis of Electric Lighting Projects," methods and data for ascertaining the requisite illumination for rooms of different sizes and under various conditions. Sketches and suggestions are also presented for the guidance of the engineer in installing accumulators, boilers, engines, etc. The table giving the efficiency of a 60-cell accumulator battery is rather obscure. The term "Number of Cells" might be advantageously changed to "Cell Numbers" or "Type of Cell," since it refers to the identification number given each cell, and not to the total number of cells in use, as would at first appear. The arrangement of steam and gas engines shown in plan and elevation does not radically differ from the American practice, and would not be found particularly instructive by the average electric light engineer of this country.

Under the succeeding head of "Directions for Preparing Approximate Estimates" is presented a schedule giving the approximate cost of boilers, steam and gas engines, dynamos, motors, accumulators, etc. The prices given on the electrical equipment seem rather lower than current figures on this side, while, on the other hand, prices of boilers and engines are higher than in America.

Following this are estimates of the cost of installing and operating electrical plants, a synopsis of practical units, sinking fund, and interest tables, and a schedule of freight rates between Hamburg and all the principal ports of America, Europe, Australia, Asia and Africa.

The catalogue portion of the book is exceedingly comprehensive in its scope, embracing almost every device used in electric lighting. A commendable feature is a preface to every subject, presenting information regarding the function and principle of each piece of apparatus. This elevates the catalogue section to the dignity of at least an elementary technical treatise, and is thoroughly novel in a book of the kind. The illustrations are copious and well executed.

AMERICAN STREET RAILWAY INVESTMENTS. Published annually for the use of Bankers, Brokers, Capitalists, Investors and Street Railway Companies. New York: The Street Railway Publishing Company. 216 pages, including 24 maps. Price, $5.00.

The aim of this compilation is to furnish some basis for calculating the market value of the stocks and bonds of street railway companies. The rapid development of the street railway in the last ten years, and the demand for money to construct and operate the large plants used in connection with the more important street railway systems, have given rise to the necessity for having at hand the physical details of the cities in which the street railways are located, as well as the latest information regarding the condition of the properties themselves. This work presents all these details in a classified form for nearly or quite 1,000 different street railway companies. The more important systems are accompanied by maps. Considering that the work is the first of its special character in the field, and the difficulty of obtaining information of this kind which has always been more or less carefully withheld from the public, this book contains an immense amount of valuable information, and should prove very useful to investors in street railway securities. It is the intention to issue the work annually on the 15th of March.

The Electrical Industries of St. Louis.

The annual report of the secretary of the Merchants' Exchange, of St. Louis, contains an interesting account of the electrical industries of that city by Mr. William H. Bryan, from which we extract the following:

The arc lighting of St. Louis is done by four companies, who operate about 4,500 lights of a nominal capacity of 2,000 candles each. The incandescent lighting is done by three companies, which now have approximately 175,000 lights connected. The electrical equipment of these several stations aggregate 20,000 hp. The service extends over the entire city and as far west as Kirkwood. The year 1895 will see extensive enlargements made, both to the plants and distribution systems. The most important advancement to be expected in the immediate future is the placing of the major part of the wiring under ground, which consummation it is expected will be reached within the next twelvemonth.

Three companies distribute an aggregate of about 4,000 hp throughout the city. Electricity has displaced steam in hundreds of small manufacturing establishments, and has recently come into quite extensive use for elevator service in tall buildings.

It is in connection with street railways, however, that electricity has met its widest field of work in St. Louis. Nine companies, capitalized at about $17,000,000, operate some 275 miles of single track, running 500 motor cars, with 20,000 hp of electrical equipment, and 600 trailers. There are eight power houses, with a total electrical equipment of about 23,000 hp These lines carried 65,000,000 in 1894, a gain of about 8 per cent. over 1893. During 1894 steam and electrical apparatus of 8,500 hp, valued at $800,000, and 33 miles of single track have been added. The electric railway companies employ about 4,000 men regularly. Considerable extensions will be made during the coming year, and a number of suburban electric roads, connecting with existing downtown lines, will probably be built.

St. Louis has always been a centre of the carbon industry, while the manufacture of incandescent lamps has also grown to be large and important. Recently the manufacture of alternating current motors, fans and converters has been taken up, and is being actively pushed. Five large supply houses furnish electrical material and equipment. The capital invested is in the neighborhood of $125,000, and they did a gross business of about $500,000 during 1894, being just about the same as was done in 1893. These companies carry a stock valued at about $125,000, and the territory covered includes the entire Southwest.

Electric Lighting in London.

The recent financial returns of the companies supplying electricity in London exhibit the same marked improvement as the records of previous years. Dividends are being paid where none had been paid before, and in other cases have been increased, and with a growing output there is an equally healthy decline in the cost per Board of Trade unit sold.

New "Iron-Clad" Ammeters and Voltmeters.

Recognizing the demand that exists for a moderate priced, well made, and fairly accurate line of ammeters and voltmeters of neat appearance for switchboard use, Messrs. Elmer G. Willyoung & Company, of Philadelphia, have brought out the instrument illustrated in the accompanying figures. Work on this instrument has been going on for a number of months and a large number of experiments have been made in order that the best results might be secured.

These instruments are of the circular pattern with faces 6 inches in diameter, and the working parts are enclosed in handsome nickel plated cases of bold design. They are of the soft iron type, controlled by gravity—no springs or permanent magnets being used; the indications are thus permanently reliable and unchanging. The proportions of the soft iron parts have been carefully worked out experimentally so that the error due to "residual" magnetism is exceedingly slight. The scales are drawn upon white enameled metal and each instrument is individually calibrated by comparison with an accurate standard. In the ammeters the scale divisions begin at about 10 per cent. of the maximum range and are, for the rest of the scale, practically uniform throughout. In the voltmeters the first half of the scale is entirely suppressed, while the remaining divisions are spread out so as to have as large a value as possible at and about the normal voltage.

The cases being of iron the instruments are not affected by neighboring magnetic fields and currents, but are "iron clad" in the best sense of the word, and it is claimed that two instruments can be mounted very close to each other upon a switchboard without one disturbing the indications of the other. These cases are made with very tight joints which are closed on the inside with a composition cement so that the instruments are practically dust proof and water proof.

The connections, as shown in Fig. 2, are all made at the back of the switchboard, there being absolutely no projections of any kind on the front of the instrument to mar its symmetrical appearance. In the case of voltmeters these back lugs are brass spindles with double nuts for clamping the connecting wires. In the ammeters the lugs are very massive and carry at their ends similarly massive terminal lugs clamped on by heavy nuts, and bored out to receive the main leads, which are soldered in.

These instruments are made for both direct and alternating currents, the alternating current instruments being calibrated for the particular frequency desired. The indications are guaranteed accurate within less than 2 per cent. maximum error.

Preparations are now being made for the manufacture of this same style of instrument with cases 9 inches in diameter for use in large central stations; it is expected that these 9-inch instruments will be ready about the middle of April.

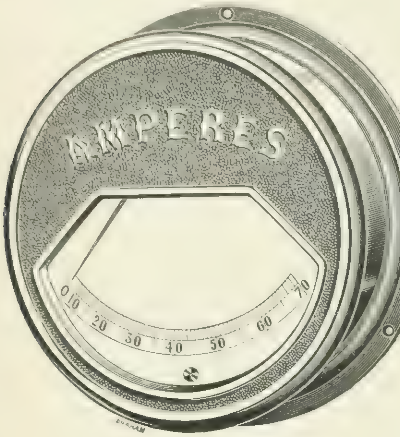


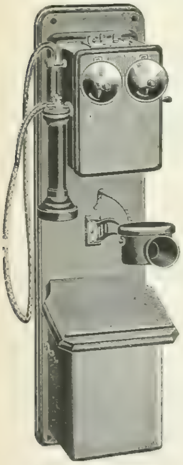
Fig. 1.—Ammeter.

An especially noteworthy feature of the "iron-clad" instruments is the exceedingly high insulation which has been attained. This is accomplished by the use of plenty of hard rubber, and the instruments are guaranteed perfectly satisfactory on circuits of two and three thousand volts.

The Acme Telephone.

The accompanying cut illustrates the Acme telephone, now being placed upon the market by S. L. Simpson, 44 Broadway, New York, for which the claim is made of great simplicity united with high efficiency and perfect workmanship. The contacts are controlled by gravity, thereby doing away with adjusting screws and insuring reliable action at all times. The electrodes are mounted on an arm which can be simply adjusted by the user at his convenience.

The automatic switch consists of a plug or pin attached to the small end of the receiver, which, when inserted in an appropriate opening in the magneto case, cuts out the transmitter and cuts in the bell; when the plug is removed in taking down the receiver the reverse contacts are made. No spiral springs or pivoted parts to be bridged form part of the mechanism.



"Acme" Telephone.

The transmitter is of the battery type, and the efficiency of this and the receiver can be judged from the fact that a whisper is audible over a 1,000-mile line, and ordinary speech can be heard distinctly three feet from the mouthpiece of the receiver.

Steam Separator.

The steam separator we illustrate below, made by Charles D. Mosher, 1 Broadway, New York, is based upon the principle of separating the moisture from the steam by centrifugal motion. As will be seen by reference to the cut, the separator consists of a section of the main steam pipe, having secured within it a helical surface, situated above a chamber into which the entrained water is thrown by centrifugal action. The bottom of the steam conduit is of spiral form with one lip below the other as shown in the cut on the left, thus forming a slot through which any water carried by the steam is thrown into the chamber below, as indicated by the arrows.

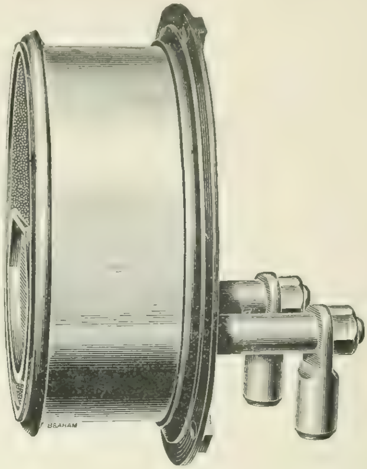
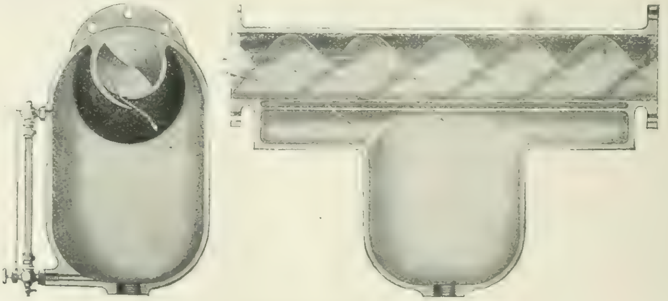


Fig. 2.—Showing Back Connections.

It will be seen that the steam is acted on many times in passing the length of the helix, as at each convolution the entire mass of steam and water passes over the slot, and being in rotary motion, any water present tends to separate, and is delivered into the chamber; the steam is thus not only continuously being acted upon, but at each convolution the outer layer of moisture of the revolving cylinder of steam is shaved off by the projecting lip and deposited in the chamber, where it is positively isolated from the currents of steam. The final separation does not occur in the body of the chamber through which the steam passes on its way to the engine, and as the steam current is never again brought into contact with the moisture from the moment of separation, there is no possibility of it being again picked up and carried onward to the engine.

This separator is also constructed without the large receiving chamber shown, in which form it is especially convenient for the separation of oil from exhaust steam, occupying no more space than the exhaust pipe and its flanges. On account of its compact form it lends itself admirably for use as the connecting pipe between the various receivers of compound, triple or multiple expansion engines in general, thereby enabling a notable increase in the working efficiency of the steam to be secured.



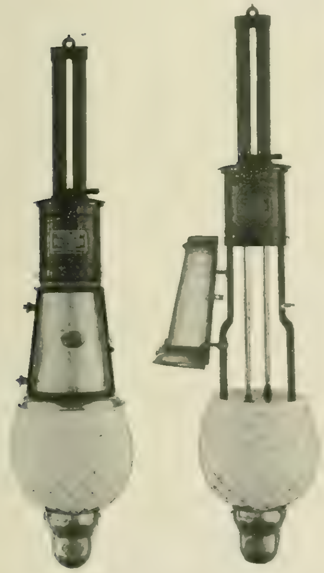
Steam Separator.

One of the special uses to which this separator has been applied with unusually satisfactory results is that of separating oil from ammonia in refrigerating plants, which is considered to be one of the most difficult problems of separation.

A valuable feature of this form of separator, and one which has a particular bearing on electric street railway work in which the power fluctuates between very wide limits thereby tending to cause boilers to foam, is that, on account of its unlimited separating capacity, it cannot be overworked to such an extent as to impair its efficiency, provided the chamber is kept drained.

Arc Lamp Spark Arrester.

The accompanying illustration shows a recently patented spark arrester, manufactured by the Philadelphia Electrical & Manufacturing Company, 20th and Jones streets, Philadelphia, Pa., which is very substantial in design and construction. The arrester is rigidly clamped to the frame of the lamp and the two halves are readily swung out of the way for the renewal of carbons, etc. The body is made of perforated tin with brass finish, riveted to a malleable iron frame. The bottom of the arrester is finished with a polished bronze rim which fits down closely over the top of the globe. This device, made in strict conformity with the rules of the International Fire Underwriters' Association, has been approved by that body.



SPARK ARRESTER.

A Novel Tree Insulator.

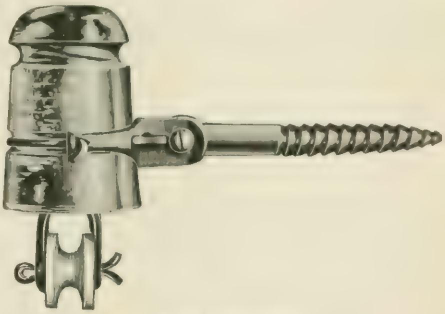
It is safe to say that a large proportion of the troubles on overhead electric circuits is due to grounds, leaks and broken wires caused by imperfect insulation and support of the conductors where they pass among trees. In order to provide more effective means for the insulation and support of wires under these and other unfavorable conditions, the Brodie Electric Company, of Manchester, N. H., has brought out a line of special insulators, one form of which is shown in the accompanying illustration.

It will be noticed that insulation is secured by the use of a petticoat glass insulator supported by a malleable iron collar which is attached to the lag screw in such a way that the collar and the screw are adjustable with respect to each other, so that no matter what the inclination of the tree limb to which it is attached the insulator may always remain in a vertical position and its insulating surfaces dry. The wire is carried on a porcelain pulley held by a bifurcated metallic pin which screws into the thread in the glass and is cemented in place. The pulley not only furnishes additional insulation to the wire but allows it to move freely so that the strain on the conductor is equalized and the liability to trouble from broken wires minimized.

Another form of the device is provided with a cleat with two screw holes instead of the lag screw, and adjustable like it. This form is especially designed for use upon smaller tree branches and on buildings and cross arms.

A third form is adapted to replace the rubber hook, the use of which is discouraged by the underwriters, attachment to the building or cross arm being made by a single screw. All three forms are made with a malleable iron hook of the usual form in place of the pin and porcelain pulley if so desired.

There is nothing combustible about these insulators and nothing likely to deteriorate by action of the weather; they are strong and durable and easily put in place, and it is claimed that they are capable of furnishing insulation to wires among trees equal to that of the other portions of the line, a result unattainable by the use of devices the insulating surfaces of which are unprotected from the rain.



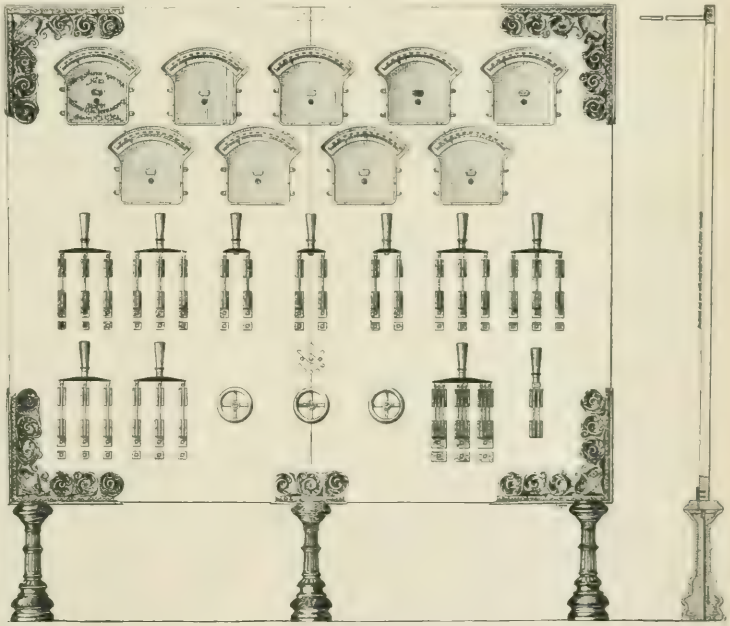
TREE INSULATOR.

A Handsome Switchboard.

The accompanying engraving shows a handsome switchboard made by T. J. Murphy & Co., 136 Liberty street, New York, for the Constable building on Fifth avenue. The board is 6 ft. 10 in. by 8 ft. in size, and made of specially selected "bon-pink" Tennessee marble, highly polished. It rests upon heavy solid brass pillars, and is secured to the wall at the top by steel braces, thus obviating the use of all iron behind the board, and practically all metal excepting the electrical connections. All posibility of disturbing magnetic influences upon the instruments is thus eliminated, together with the liability to crosses and inconveniences in making cross connections attendant upon the presence of a metallic framework.

The corners are protected and ornamented by handsome massive brasses, and all the apparatus used is of the highest grade obtainable.

A cross sectional view is given on the right of the illustration, which shows more plainly the details of construction.



SWITCHBOARD.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK March 16 1895

ELECTRICAL STOCKS displayed no particular activity this week beyond some trading in General Electric, which continues to monopolize what little interest is manifested. The old rumor was revived as to a consolidation of General Electric and Westinghouse interests, this time under the protecting wing of the Standard Oil Company Mr. Westinghouse promptly repudiated the suggestion and said positively that nothing of the sort was contemplated by his company. The Westinghouse Company has declared a quarterly dividend of 1¾ per cent. on its preferred stock, payable April 1.

EDISON ILLUMINATING, of New York has issued its statement for February, which shows an increase over February, 1894, of $19,529.93 in gross earnings and $1,923.47 in net earnings. The accrued interest on bonds is $17,966; surplus, $56,943

THERE was a bearish movement on Western Union due to the fact that the company barely earns its 5 per cent. dividend, and this is considered too close figuring for a telegraph stock Moreover, when business was good and there were accumulative surpluses, these were applied to the maintenance and improvement of the Western Union plant, and now that there is no surplus the question arises as to where the money comes from to keep up the plant. It is argued that the company will have to either reduce dividends or raise money on capital account unless business materially improves very soon The present strength of the stock would seem, therefore, to be largely due to the approach of the dividend period, the next quarterly dividend of 1¼ per cent. being due April 15.

ELECTRICAL STOCKS.	Par.	Bid.	Asked
Chicago Edison Company	100	128	130
Edison Electric Ill., New York	100	94	95½
" " " Brooklyn	100	..	108
" " " Boston	100	125	126
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	30⅝	31⅛
General Electric	100	29⅜	29½
General Electric, pref	100	64	67
Westinghouse Consolidated, com.	50	31	33
" " pref	50	50½	51½
BONDS.			
Edison Electric Ill., New York	100	105	106
Edison Electric Light of Europe	100	75	85
General Electric Co. deb. 5s	100	87½	..
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	192	193
American District Telegraph	100	..	45
American Telegraph & Cable	100	90	92
Central & South American Telegraph	100	117	120
Commercial Cables	100	130	140
Erie Telephone	100	50	50½
Gold & Stock Telegraph	100	105	
New England Telephone	100	68	68½
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63½	
Western Union Telegraph	100	87¾	88
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	.	14¾	14⅞
Binghamton RR. com	100	100	..
Brooklyn Traction	100	9	11
" " pref.	100	..	53
Buffalo St. Ry	100	66½	69
Cleveland City Ry.	100	68	70
Cleveland Electric Ry.	100	59	60
Chicago City Ry	100	303	317
Columbus St. Ry.	100	46	49
Consolidated Traction of N. J.		30	33
Electric Traction, Philadelphia	100	77½	78
Long Island Traction	100	5	5½
Louisville St. Ry. com.	100	37	39
" " " pref.	100	87	88
Metropolitan Traction, Philadelphia	100	96⅞	97¼
New Orleans Traction	100	14½	17
pref.	100	56	60
North Shore Traction	100	20	.
" " pref.	100	74	83
People's Traction	100	48¼	48½
Philadelphia Traction	100	87¾	88
Rochester St. Ry	.	38	..
Union Ry. (Huckleberry)	100	112	115
West End, Boston	100	69	61
" " pref	100	87	..
Worcester Traction	100	..	13
" " pref	100	77	80
BONDS.			
Buffalo St. Ry. 1st con. 5s	100	101	..
*Binghamton Railroad Co. 5s	100	99	100
*Columbus St. Ry. 1st 5s	100	93	..
Rochester St. Ry. 1st 5s	100	95	97
*Union Ry. 1st mtge 6s	100	105	108
*Westchester Electric 1st. mtge. 5s	100	98	101

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* With accrued interest.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 BROADWAY, NEW YORK, March 18, 1895

THE ELECTRICAL & MECHANICAL ENGINEERING & TRADING CO., of 39-41 Cortlandt street, has dropped from its name the words "and Trading," leaving the new name "The Electrical & Mechanical Engineering Company."

PROF. VANDER WEYDE. As THE ELECTRICAL WORLD goes to press the sad news is received of the death of Prof. P. H. Vander Weyde, at the age of 82 years. In adddition to his scientific attainments Prof. Vander Weyde was a musician and painter of no mean ability.

ACCUMULATORS ARE NOW USED by the Stock Quotation and Telegraph Company for the operation of its tickers This is the first instance of the application of storage batteries for this purpose, the nearest case being the use by the Western Union Company of accumulators in those of its offices where the service is not yet sufficient to justify the use of dynamos.

LECTURES WILL BE DELIVERED on Saturday evening March 23, at the club rooms of the Franklin Electrical Society, 239-241 East 57th street, by W. W. Ker and N. Harrison, E. E., on the subjects of "The Telephone; How it Works," and "Electrical Measurements and Tests." These lectures are of an elementary character, and all who are interested are cordially invited to attend.

R. B. COREY, who needs no further introduction, has made arrangements by which he becomes the exclusive selling agent for the product of the General Incandescent Arc Light Company. He has also arranged with this company to manufacture the entire line of Knight arc lamps, for which he is to also act as exclusive selling agent. In addition to this he will continue to handle a full line of imported carbons of the best make for all currents.

THE BROOKLYN BRIDGE CARS have been equipped with incandescent lights, current for which will be supplied from a stationary plant, the connection with the cars being effected by means of an overhead wire and trolley similar to that commonly used in connection with electrically propelled cars. There are ten 16-cp lamps in each car. The cost of equipping was about $16 000 and the annual saving as compared with gas is placed by Trustee Clarence Henriques at about $4,500, so that the equipment will pay for itself in a very few years.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, March 16, 1895.

MR. W. C. BRYANT, of the Bryant Electric Company, Bridgeport, Conn., was in Boston this week, as full of business as ever.

MR. W. H MANSFIELD, 71 Court street, New Haven, Conn., a prominent builder and dealer in machinery, is introducing new lathes for electrical, fine tool and model work that are commanding a great deal of attention because of their valuable and desirable features.

MR. E. W. LITTLE vice-president and general manager of the Interior Conduit and Insulator Company, favored Boston last week with his smiling countenance. His headquarters were of course at the Pettingell-Andrews Company, the New England agency of his company.

THE ASHTON VALVE COMPANY, Boston, recently shipped 40 4½-inch pop safety valves for the 8 500-hp steam plant of the Chicago West Side Street Railway Company, which was one of the several large orders received by the Ashton Company during the last few months through the Stirling Company, Barberton, O., the well known manufacturers of the Stirling water tube boiler.

MR. F. S. BILLINGS of the Billings & Spencer Company, Hartford, Conn., and his wife were sojourners for a few days this week in Boston, and during their brief visit were the recipients of many hospitalities and much kindly attention, notably a dinner in their honor at the Exchange Club—the new and handsome down town merchants club—last Friday afternoon, by Mr. D. A Andrews and wife, Mr. C. B. Price and Mr. F. X. Cicott at which it is needless to say business interests as between the Billings & Spencer Company and the Pettingell-Andrews Company were entirely forgotten and genuine enjoyment and pleasure reigned supreme.

THE LEAVITT MOTOR COMPANY, 124 Mitchell street, Providence, R. I., is busily engaged night and day in order to keep pace with its rapidly increasing business. It has recently received some excellent orders. Important changes have been made in its factory, new machinery has been introduced, notably a special line for the manufacture of larger sized motors, the office has been moved up stairs, and altogether the factory is a beehive of activity and industry. Mr. Leavitt has worked hard to secure these results and is deserving of congratulation for his push and enterprise. Small motors and fans are still made a specialty, in the manufacture of which Mr. Leavitt has earned an enviable reputation.

MR. ROBERT A. FALCONER, of the Falconer Mfg. Company, of Boston, and Miss Mary N. Sherburne of the same city, were united in marriage March 6, the wedding taking place at the residence of the bride's mother in Boston, many friends of the happy pair being present. Mr. Falconer is general manager of the company bearing his name, and is widely and favorably known to the electrical fraternity as a manufacturer of incandescent lamps and lamp sockets. It is generally understood that the success of his company is in no slight degree attributable to his indomitable pluck and perseverance. The bride is a charming young lady, well known in educational and social circles in Boston. We are sure the trade will join the WORLD in congratulating them and wishing them a long and happy future.

MR. GEORGE THOMPSON, president of the Thompson-Brown Electric Company, Boston, will sail for Europe next week from New York on the steamer Majestic, to be gone upward of five weeks. The object of his trip is to introduce abroad his varied and valuable line of street railway specialties, to capture possibly a handsome order from a Continental railway and to bring back some electrical specialties for introduction here. Mr. Thompson, as is well known, is a native of England, has hosts of friends there and commands respect and influence wherever he is known. London, Paris and Germany will be the particular centres to receive his attention this trip. During the absence of Mr. Thompson it goes without saying that genial Maybin W. Brown, treasurer, will look after matters on this side of the water in his usual "get there" manner.

THE ANSONIA ELECTRICAL COMPANY, Ansonia, Conn., an entirely new company, is the outcome of the recent sale of the plant of the old Ansonia Electric Company, and will virtually manufacture the same wire specialties—the Shield Brand moisture proof wire, fire and weather proof wire, weather proof line wire, all kinds of feeder wire, cable and solid, and to a large extent all kinds of magnet wire and office and annunciator wire. Notwithstanding the new company was only recently organized the factory is quite busy with orders. The officers of the company are Franklin Farrel, president; Thomas Wallace, Jr., vice-president and manager; Franklin B. Platt, secretary; and L. F. Anschutz, treasurer. Mr. Farrel is a prominent business man. Mr. Wallace needs no introduction because he is widely known and respected everywhere throughout the electrical field. Mr. Platt and Mr. Anschutz are both possessed of excellent business qualities, and under this management it is quite safe to predict a good business future for the new company.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, March 6, 1895.

ELECTRICITY SUPPLY IN LONDON.—The financial returns of the companies supplying electricity in the Metropolis are rapidly coming to hand, and exhibit the same marked improvement as the records of previous years. Dividends are being paid where none had been paid before, and in other cases have been increased, and with a growing output there is an equally healthy decline in the cost per Board of Trade unit sold.

THE SAYERS ARMATURE.—The discussion on Mr. Sayers' armature with its commutating coils and their consequences, sparkless brushes, small air space and regenerative action, came to a conclusion at the Institution of Electrical Engineers on Thursday evening last. The discussion, although long, was, it must be confessed, very disappointing. Although over 100 machines of this kind have been built and sold in this country since Mr. Sayers first brought out his invention two years ago, only two or three speakers spoke from experience, the remarks of the remainder being speculatively critical, and not over generous. Those who are both disinterested and competent, however, are warmly in favor of Mr. Sayers' device, and firmly believe that it is both effective and cheap.

THE PARALLEL RUNNING OF ALTERNATORS.—There has been a very lengthy and somewhat acrimonious discussion going on lately with regard to the parallel running of alternators in this country. The experience with machines made by the Brush Company has in many cases not been altogether satisfactory; at any rate, it has certainly not been uniform. In London, Sheffield and Coolbridge there is no denying the unsatisfactory performance of these alternators, when run in parallel, but at Bournemouth, Hastings and many other places their successful running in parallel is equally marked. The why and wherefore of their eccentric performances is not only of scientific and engineering interest, but a matter of considerable concern to the buyers of plant, and the engineering fraternity of this country is awaiting an authoritative explanation as to whether the disturbing cause is electrical or mechanical.

METALLIC SODIUM IN ELECTRIC CONDUITS.—Considerable light has been thrown upon the cause of the frequent electric conduit explosions in the network belonging to the St. Pancras Vestry by the discovery that among the components of the excrescent incrustations found upon the stoneware insulators supporting the bare copper strip there is a large proportion of metallic sodium. It would seem as if the constant pressure of 200 volts to earth had broken down some of these insulators, and that the metallic sodium is one of the results of their electrolytic decomposition. This discovery, which was made by an official of the Board of Trade, has been communicated to the vestry concerned, and an immediate and thorough overhauling of the insulators is promised. It is needless to say that the makers of stoneware insulators are not at all prepared to sit down quietly under the imputation that stoneware insulators in electric conduits are a grave public danger.

THE GOVERNMENT AND THE TELEPHONES.—On Friday evening last, an important debate took place in the House of Commons on the subject of the agreement which the Government proposes to enter into with the National Telephone Company taking over the telephone trunk wires of this country from that concern, and giving it in return some of its governmental privileges in the matter of way leaves, etc. It is now more than two years ago since Parliament first solemnly sanctioned this scheme and recommended that the details should be left for the Postmaster-General to settle. Notwithstanding this the draft agreement, ever since it has been placed in the hands of members of Parliament, has been subject to criticism. The discussion on Friday night was not different from previous ones in other places. Controverted arguments and exploded fallacies were brought forward once more with wearisome reiteration, and once more the great advantages accruing from this agreement to the country were set forth by the Postmaster-General. The honor of Parliament was in the end saved by the House agreeing not to call the agreement into question. This point was only gained at the expense of the appointment of a select committee, who are to have a roving commission to inquire into the whole telephone question.

General News.

NEW INCORPORATIONS.

THE INCANDESCENT LIGHT AND FUEL COMPANY, Carthage, Mo., capital stock $25,000, has been incorporated by S. E. Wetzel, J. L. Moore and C. Wright.

THE PEOPLES' ELECTRIC LIGHT AND POWER COMPANY, Calais, Me., capital stock $50,000, has been formed to furnish electric light and power. The promoters are Martin Cone, Geo. S. Murchie and Ashley St. Clair, Calais Me.

THE HAMBURG RAILWAY COMPANY, Buffalo, N. Y., capital stock $10,000, has been formed to build and operate a street surface railway one mile long. The promoters are Wm. Ellwood, S. H. Koopman and D. W. Allen, Buffalo, N. Y.

THE ALEXANDRIA TELEPHONE COMPANY, LIMITED, Alexandria, La., capital stock $2,500, has been incorporated with Thomas Clements, president; J. C. Ryan, vice-president; L. A. Stafford, secretary and treasurer, to construct a telephone system.

THE JOPLIN & GALENA ELECTRIC RAILWAY COMPANY, Webb City, Mo., capital stock $120,000, has been formed to build and operate street railways. The promoters are Galon Spencer, A. H. Waite, Joplin, and H. H. Harding, Carthage, Mo.

THE ATLANTA ELECTRIC POWER COMPANY, Atlanta Ga., capital stock $2,000,000, has been incorporated to build an electric and water power plant, by A. E. Thornton, and Evan P. Howell, of Atlanta, and Hugh R. Garden and J. H. Vail, of New York.

THE YANKTON ELECTRIC AND MANUFACTURING COMPANY, Yankton, S. D., capital stock $40,000, has been formed to own and operate an electric plant. The incorporators are John MacGregor, R. R. MacGregor and Otto R. Brandt, of Yankton, S. D.

THE FISHKILL ELECTRIC RAILWAY COMPANY, Matteawan, N. Y., capital stock $50,000, has been formed to build and operate a street surface road in Dutchess county. S. K. Phillips, Matteawan; J. F. Smith and John Place, Fishkill, N. Y., are interested.

THE TRUBE AUTOMATIC THERMO REGULATOR AND POWER EQUIPMENT COMPANY, Albany, N. Y., capital stock $25,000, has been incorporated by Jacob Haffelfinger, Emil Haffelfinger, John Trube and others to manufacture automatic regulators and other equipment.

THE IRONTON ELECTRIC RAILWAY LIGHT AND POWER COMPANY, Jersey City, N. J., capital stock $300,000, has been formed to erect, own and operate electric light, heat and power works. Address Lucius C. Ryce, Plainfield, N. J.; Mr. Geo. L. Shearer and T. Channon Press, New York.

THE CANAJOHARIE ELECTRIC LIGHT AND POWER COMPANY, Canajoharie, N. Y., capital stock $25,000, has been formed to generate and use electricity for light, heat and power. The promoters are Wm. J. Arkell, Bartlett Arkell, Canajoharie and A. L. McCre , Jr., Gouverneur, N. Y.

THE GENERAL ELECTRIC LIGHT AND POWER COMPANY, Le Sueur, Minn., capital stock $25,000, has been formed to construct and operate an electric light plant. Wm. H Patten, Wm. A. Patten, W. H Tomlinson, H. F. Weis, and E. H. McLeod, Le Sueur, Minn., are among the interested parties.

TELEGRAPH AND TELEPHONE.

MONROE, LA.—W. B. Reilly is forming a company to construct a telephone system.

MILLEDGEVILLE, GA.—William West has obtained a franchise for a telephone system.

WASHINGTON, D. C.—J. E. Keelyn and others are organizing a company to construct a new telephone system.

BENTON HARBOR, MICH.—The newly organized Board of Trade will arrange for better telegraphic facilities.

SALMON CITY, IDAHO.—The Salmon City Electric Light, Power and Water Company will erect a telephone line to Red Rock.

PARAGOULD, ARK.—A company has been organized by E. S. Bray, T. B. Kitchens and Fred Hoffman to operate a telephone exchange.

HAMPTON, VA.—The Hampton Telephone Company has been organized by W. E. Lawson and others and will construct a telephone system.

HARRIMAN, TENN.—A co-operative telephone company is being organized and a charter will be applied for. Address E. C. Drowne concerning same.

CHARLESTON, ILL.—A franchise has been granted for a telephone exchange, which will be immediately installed. Address F. A. Brooks, manager.

EASTON, MD.—M. M. Higgins, A. G. Passault and others will organize a company to establish a telephone system, and are in the market for the equipment.

MEANSVILLE, GA.—J. M. Means is putting up a telephone line from this place to Zebulon and will have connections with Barnesville, Milner, Griffin, Atlanta and other points.

PETERSBURG, VA.—The Mutual Telephone Company has been organized with W. B. McIlwaine, president, E. A. Hartley, vice-president, and R. D. Gilliam, secretary and treasurer. The capital stock is $10,000.

HOOSICK FALLS, N. Y.—The Hudson River Telephone Company will build a new telephone line between Hoosick Falls and the State line to connect with the line to be built by the New England Telephone Company.

ELECTRIC LIGHT AND POWER.

BRISTOL, R. I.—The Council has recommended an appropriation of $3,800 for lighting the streets by electricity.

WYTHEVILLE, VA.—J. A. Mebane and others have leased and will operate the municipal electric light plant.

LAKE CITY, MINN.—The citizens will vote April 2 on the question of issuing bonds to establish an electric light plant.

KNOXVILLE, TENN.—The city will advertise for bids for an electric light plant of a capacity of not less than 250 arc lamps.

WATER VALLEY, MISS.—Address G. D. Able, Mayor, regarding new machinery to be put in the city's electric light plant.

WINONA, MINN.—At the municipal election April 1 the electors will vote on the question of issuing $50,000 electric light bonds.

ALMON & SARGENT, of Boston, agents for the Belknap Motor Company, have removed from 620 Atlantic avenue to Room 106, No. 15 Federal street

NEBRASKA CITY, NEB.—The plans and specifications submitted to the city for an electric lighting plant to cost $18,200 were accepted and placed on file.

COLUMBIA, TENN.—The contract for electric lights will expire April 1, and the City Council will then be in a position to negotiate for a new contract.

LONDON, O.—The Council passed the ordinance authorizing the issuance of $20,000 worth of bonds to put in an electric light plant to be operated by the town.

WEBB CITY, MO.—The city has issued and sold $15,000 worth of bonds for the purpose of erecting an electric light plant, concerning which the Mayor may be addressed.

BRISTOL, TENN.—The Bristol-Goodson gas and electric plant has been purchased by S. C. Hurt & Son, of Lynchburg, Va., for $20,000, who will make improvements and operate it.

NORTHFIELD, VT.—At a town meeting it was voted to raise the amount necessary to defray the expense of building an electric light plant, which was judged to be in the vicinity of $20,000.

ST. LOUIS, MO.—The St. Louis Electric Light and Power Company has been granted a franchise for the erection of an electric plant. M. B. Greensfelder may be addressed for information concerning same.

ST. PAUL, MINN.—Kretz & Company New York Life Building, have prepared plans for the erection of an apartment house for Edward Feldhauser. The building will be lighted by an electric light plant of its own.

DUNNVILLE, ONT.—The Dunnville Electric Light Company proposes to erect a fireproof station building, and put in 200 hp in water power. An alternating plant of 1,200 16-cp lamps will be installed. The company's annual report shows it to be in excellent financial condition.

BUFFALO, N. Y.—It is reported that an electric railway will be built this spring from Buffalo to Hamburg by a company to be known as the Hamburg Electric Railway Company. Those interested are Jas. E. Curtiss, L. L. Long, R. E. Hanta and Wm. Elwood, of Buffalo; Thos. L. Bunting and H. S. Spencer, of Hamburg.

THE ELECTRIC RAILWAY.

AUSTIN, TEX.—O. F. Drake is in the market for an electric railway equipment.

MOHAWK, N. Y.—The officers of the new electric road have purchased lots on West Main street and will erect a power house.

GLOVERSVILLE, N. Y.—Work on the new electric road from Broadalbin to Gloversville will be commenced in a very short time.

BALLSTON, N. Y.—The State Railway Commission has authorized the Ballston Railway Company to operate its lines with electricity.

AUBURN, N. Y.—The Mayor will give information regarding the proposed construction of an electric road to Port Byron and Skaneateles.

CARBON, IND.—The City Council accepted the Fox Brothers' proposition to put an electric light plant in and furnish the town with electricity.

OCEAN VIEW, VA.—Chas H. Barrett, F. H. Treat and others of Philadelphia, will build a power plant for an electric railway at a cost of $30,000.

CHARLOTTESVILLE, VA.—The Piedmont Construction and Improvement Company contemplates extending its electric line to Locust Grove and Fry's Springs, suburbs.

VENICE, ILL.—The village board met in special session and granted a franchise to Frank McCambridge and C. H. Sharman to build and operate an electric road in this city.

BOWLING GREEN, KY.—Address Secretary Commercial Club regarding a power plant for an electric railway, which will include 150-hp boiler and engine, an 80-kw generator, etc.

COHOES, N. Y.—Urban Weldon, a prominent resident of Cohoes, is considering the advisability of building an electric railway from Cohoes to Dunbach's Ferry, a popular resort near Crescent.

WHITE PLAINS, N. Y.—The New York, Elmsford & White Plains Railway Company has accepted the franchise granted by the board of trustees to operate an electric street railway through the village.

ROCHESTER, N. Y.—The Grand View Beach railway was sold at auction to Mr. Harris for $31,000 and the new company will carry out the contract to light Charlotte with electricity, besides operating the railway.

KEY WEST, FLA.—The Key West Street Car Association has been sold to J. J. Philbrick, president of the Key West Gas & Electric Light Company. As soon as possible the road will be equipped electrically.

CORNING, N. Y.—A 50-year franchise has been granted to The Corning & Painted Post Street Railway Company. Theo. C. Bates, Worcester, Mass., is president, and W. H. Tylie, of the same city, is secretary.

WHEELING, W. VA.—The obstacles in the way of the Benwood & Southern electric railway have been removed, and a large force of men will be put to work immediately grading the roadbed and putting down the tracks.

ROCHESTER, N. Y.—The Grand View Beach Railroad was sold at auction to Edward Harris, representing a syndicate of capitalists, for $31,000. A new company is to be formed, with a capital stock of $60,000, and the road changed to electricity.

BALTIMORE, MD.—The extension of the right of way to lay tracks to connect the Baltimore, Middle River & Sparrows Point Railway with the Traction Company's lines has been granted and the road will be running within nine months.

NEW HAVEN, CONN.—The work of constructing the Middletown & Cromwell electric railway is to be commenced in a few weeks and the company, of which Israel A. Kelsey, of West Haven, is president, will expend about $50,000 in completing the road.

NORTH TONAWANDA, N. Y.—By request of Geo. P. Smith, action on the granting of francise extension to lay trolley tracks on the Ward road from Oliver street to the village limits was deferred until May 7, so that arrangements to connect with the Ely road could be made later.

BALTIMORE, MD.—Work on the electrical equipment of the Belt Line tunnel is progressing rapidly. The overhead conductor is being put up, and wires for the tunnel lamps are being strung. At the power house on South Howard street nearly the whole equipment of engines, boilers, generators and dynamos is in place. The large motors which will haul the trains through the tunnel have not yet arrived, but are expected shortly. Some parts of the equipment are so weighty as to require for their transportation the special car built to carry the great Krupp gun to the World's Fair, and this accounts in part for the delay.

Trade and Industrial Notes.

THE STEUBEN INCANDESCENT LAMP COMPANY, Canisteo, N. Y., which was closed up by injunction, is about to resume operations.

J. H. STEDMAN, transfer expert, of Rochester, N. Y., is distributing copies of an interesting pamphlet descriptive of a large variety of his street railway ticket and transfer forms, which are designed with a view to meeting any and all requirements.

WALLACE & SONS, 29 Chambers street, New York, have just issued a comprehensive catalogue and price list of their brass and copper product, which includes brush copper, hard and soft drawn copper wire, rail bonds, and various other articles used in electrical work.

THE STREET RAILWAY REVIEW, of Chicago, on account of damage done by a fire on March 10 in the Boylston building, has temporarily removed its quarters to the seventh floor of the Old Colony building, until its new offices on the eighth floor of that building are completed.

WILLARD S. ATKINSON & CO. is the style of a young firm at 1,020 Hunter street, Philadelphia, which has recently taken up the manufacture of switches, etc. Messrs. W. S. Atkinson and C. B. Crosby, Jr., constituting the firm, are progressive and energetic young men, and should find small difficulty in working up toward the front rank.

MR. TIMOTHY W. SPRAGUE, hitherto associated with the General Electric Company in its Power and Mining department, has opened offices at 53 State street, Boston, and 253 Broadway, New York, as consulting engineer. He will make a specialty of mining work, but is prepared to handle general engineering in a thoroughly satisfactory manner.

W. D. JAMESON & CO., 150 Broadway, New York, are sending out pamphlets containing some flattering testimonials concerning the Gerson telephone, which is controlled by them. A list of prominent business men is also given, and intending purchasers are invited to correspond with any of these parties with regard to the service obtained with Gerson instruments.

MR. ALEXANDER A. CARLISLE, representing the Bryan-Marsh Company, has just returned from a highly successful business trip through the States of New York and Vermont. The new Bryan-Marsh lamp, with the stem anchor holding the filament firmly in the centre of the bulb, met with hearty approval from all the central station men, and the company reports a very gratifying rush of lamp trade.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., reports the sale, through Messrs. H. B. Cobo & Co., Mail & Express Building, New York City, of one 250-light and one 350-light improved Mather ring type dynamos for the new lighting plant of the Portland apartment house, Washington, D. C. Messrs. Cobo & Co. were awarded the contract for the entire plant, including McIntosh & Seymour engines, piping, fittings, etc.

A MOST CONVENIENT TELEPHONE DIRECTORY is that in use by the City & Suburban Telegraph Association, of Cincinnati. The book is provided with a marginal alphabetical index, and also has a numerical index, enabling a subscriber to find any name or any number in about one-fourth the time required with the sort of list commonly used. An investigation of the merits of this directory should be beneficial to any telephone exchange.

H. E. COLLINS & COMPANY, Pittsburgh, Pa., sole agents for the Cahall vertical water tube boiler, report sales within the past ten days of 200-hp (second order) to the Inland Steel Company, Chicago Heights; 400-hp (fourth order) to the Shoenberger Steel Company, Pittsburgh; 500-hp to Michigan Alkali Company, Wyandotte, Mich. The 2,000-hp battery of Cahall boilers installed at the Carnegie Gas Pumping Plant, Bagdad, Pa., was started up a few days ago with entire satisfaction.

THE ELECTRIC ENGINEERING & SUPPLY COMPANY, of Syracuse, has on exhibition at its New York office, 136 Liberty street, the handsome switch board which attracted so much attention and excited such favorable comment at the Cleveland convention. Manager Hawkins reports business booming, and wears the complacent smile peculiar to those fortunates who find no trouble in placing their goods as fast as they can be gotten out.

THE BOUDREAUX DYNAMO BRUSH COMPANY, finding it necessary to open an eastern office in order to more satisfactorily handle the rapidly increasing demand for its well-known brush, has established headquarters in the Postal Telegraph Building, New York City Mr Benedix the general manager of the company, has been in New York for some time arranging details and making new friends and customers. He reports that business has largely increased and he anticipates as great a demand for the Boudreaux brush in America as in Europe, where something like 300,000 are now in daily use.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is entering upon an active campaign for lamp business with the original Packard lamp with platinum leading-in wires as it was originally made. The company is making some very strong claims regarding an improvement which has recently been achieved in the process of manufacture, by means of which the lamp is said to increase in candle power and efficiency during its life. The importance of such an improvement is obvious, as the comparative first cost of the lamp drops almost out of consideration, since a small increase in candle power and efficiency during its life will result in a saving of several times the original cost of the lamp.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has added to its long list of contracts the new power plant building for the Nassau Electric Company, at South Brooklyn, N. Y. The engine and dynamo room is 58 feet wide and 150 feet long, equipped with a 13-ton crane having a travel the full length of the building. This portion of the plant is covered with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron roof lining. The boiler room is 47 feet in width and of the same length as the engine and dynamo room, and is so arranged that 2 000 tons of coal can be stored in the pockets. The entire construction is of iron, and the buildings, when completed, will be fireproof.

THE MICA INSULATOR COMPANY, of 218 Water street, New York, is distributing among its numerous friends and customers samples of micanite insulation. Particular attention is directed to the plate from which commutator insulation is made, and which has been greatly improved recently. It is of a lighter hue than before, in fact, almost transparent, showing a smaller proportion of cement. This improvement is the result of much careful experimenting and is only practicable by the use of specially designed machinery. The company's business has grown steadily from the beginning, notwithstanding the recent depression, and now that trade is showing renewed activity the management finds it necessary to double the capacity of the works in order to keep up with the demand.

THE LAKON COMPANY will probably be substituted for the present name of the Hornberger Electric Manufacturing Company. The stock of the company has recently passed into the hands of Mr. John C. Boss, who, however, has been identified wth the Hornberger Company for a long time. Mr. Boss proposes to bring the company much more prominently before the electrical trade than has heretofore been the case. While the factory will continue at Elkhart, the main office of the Lakon Company will be in Chicago, with a branch office in New York, and probably one also in the South and another in Canada. Mr. Boss has the right kind of confidence in the goods his company manufactures, though not any more than those who have used them, or than they deserve We wish the Lakon Company success.

MISCELLANEOUS NOTES.

PHILADELPHIA, PA.—At the United States Engineers' Office, 1,428 Arch street, this city, sealed proposals for materials for an electrical plant at Fort Delaware, Del., will be received until 11 a. m., March 22. All information furnished on application.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS will hold its 95th meeting at 12 West 31st street, New York City, on Wednesday, March 20, at 8 p. m. A paper will be presented by Prof. Harris J. Ryan, of Cornell University, and Mr. Milton E. Thompson, entitled, "A Method for Preventing Armature Reaction." A meeting of Western members will be held the same evening, Wednesday, March 20, at 8 p. m., at Armour Institute, 33d street and Armour avenue, Chicago, where the above paper will be read by Prof. Fortenbaugh, of the University of Wisconsin.

Business Notices.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 12, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

Reissue 11,478. ELECTRICAL FIXTURE; L. Stieringer, Detroit, Mich. App. filed Dec. 21, 1894. An electric light fixture, with a hollow main stem, a distributing body and open section supported by two or more lamp carrying arms supported by said distributing body, of insulated main conducting wires passing through such hollow main stem and through said open section, a pair of insulated arm wires passing through each of said lamp carrying arms, said main and arm wires being directly connected together, and a central support from said open section for sustaining ornamental parts of the fixture.

535,345. CLOSED CONDUIT ELECTRIC RAILWAY; E. M. Bentley, Boston, Mass. App. filed Feb. 25, 1891. The combination of a conduit extending along an electric railway, an insulated conductor therein, a flexible cover for said conduit, a lifting device for said cover and a contact device connected to a vehicle on the railway and adapted to make contact with said conductor beneath the cover as it is raised by the lifting device.

535,363. ELECTRIC HEATING APPARATUS; M. W. Dewey, Syracuse, N. Y. App. filed March 12, 1894. An electric heater comprising a suitable plate or support, a resistance conductor wound on said plate or support, and an enclosing case provided with exterior fastening devices and with interior supports curving over the top and bottom of the plate, whereby the heater is supported with an air space surrounding the same, said case being perforated to allow free circulation of air and open at the back to permit said heater being secured in close proximity to a wall or support.

535,370. ELECTRIC CLOCK STRIKING MECHANISM; F. L. Gregory, Chicago, Ill. App. filed Jan. 30, 1894. A striking mechanism, the combination with the striker and means for imparting a reciprocatory movement to said striker of a stop wheel in operative connection with said striker, a hold back device in position and adapted for periodically engaging and arresting the movement of the stop wheel, a let-off cam in operative connection with and adapted for operating the hold back device to release the same from engagement with the stop wheel and an independent locking device in connection with the stop wheel, and in position and adapted for engagement with the hold back to prevent movement of said stop wheel after the release of the hold back from said stop wheel and until said hold back is let off by the let-off cam.

535,398. CONDUIT ELECTRIC RAILWAY; D. O'Flaherty, Kansas City, Mo. App. filed March 31, 1894. In an electric railway system the combination with a slotted conduit, having openings in one side and insulation rings fitting in said openings of said casings or boxes having their open ends fitting externally against one side of the slotted conduit and surrounding the openings and having oppositely disposed openings in their sides, an auxiliary conduit impervious to air and water comprising pipes connected by unions and extending through the openings of the casings or boxes and having apertures in its inner side within said casings and opposite the openings of the slotted conduit, a cable located in and insulated from the auxiliary conduit and exposed points within said casings and opposite the openings of the slotted conduit, insulation blocks fitting within said casings and provided with a longitudinal passage, a spring actuated contact rod fitting therein and projecting into the slotted roller and carried thereby.

535,484. ELECTRIC BURGLAR ALARM AND HOUSE CALL; H. L. Carpenter, Minneapolis, Minn. App. filed April 16, 1894. The combination with the clock mechanism of a dial revolved thereby and provided with a series of pin holes, pins or plugs adapted to be inserted therein and projecting through the dial, a series of circuits and switches, said switches being arranged in proximity to said dial and adapted to be operated by the pins or plugs inserted therein, a source of electricity translating devices included in said circuits, electromagnetic recording devices provided in said circuits and a time sheet upon which recording devices are adapted to operate, the strip or sheet being moved to correspond with the dial.

535,488. THERMO-ELECTRIC GENERATOR; H. B. Cox, Hartford, Conn App. filed March 8, 1893. A thermo-electric pile having its take-off connections connected with head and tail pieces, respectively from the hot and col ends of the opposite poles of the pile.

535,489. THERMO-ELECTRIC GENERATOR; H. B. Cox, Hartford, Conn App. filed March 8, 1893. A cylindrical thermo-electric pile, in combinatio with a bracket supporting the same, and a gas burner carried by th bracket at the open centre of the pile.

535,490 THERMO-ELECTRIC. GENERATOR H B. Cox, Hartford, Conn App. filed March 8, 1893. A thermo-electric pile provided with the outwardly projecting radiators from its outer surface independent of th elements of the thermo couples.

535,491. INDICATING SYSTEM FOR THERMO-ELECTRIC GENERATORS; H B. Cox, Hartford, Conn. App. filed Jan. 31, 1894. A thermo-electric generator having a cooling liquid jacket provided with the liquid supply and controlling valve, and an electric circuit including said generator and a alarm and controlled by the movements of said valve.

535,511. ELECTRICAL CONTROLLER. E. A. Sperry, Cleveland, Ohio. Ap filed Nov. 11, 1893. The combination with an electric motor of a variabl resistance, a brake switch so arranged that when the braking action i taking place the line circuit is open, means for controlling the polarity the residual magnetism of the field magnets, a local circuit, and an ele trically actuated device in said local circuit controlling the current in th field magnet coils and said circuit.

535,443. ELECTRIC LIGHTING SYSTEM; J. I. Conklin, Brooklyn, N. Y. Ap filed July 30, 1894. The combination dynamo, the driving shaft connecte with the dynamo and the car axle, and the battery connected with th dynamo of the governor mounted on the same shaft, the pivoted lever or end of which abuts against the movable collar of the governor, the oscilla ing disc formed of non-metallic and non-conducting material provided wit a pin which engages with the lower end of said lever, a spring connecte with said lever, metallic sections secured to said disc, and a contact sprin bearing against the disc and connected with a conductor leading to batter and a contact spring also bearing against said disc, and connected with conductor leading to the dynamo, the construction being such that whe the driving shaft is at rest the lever will oscillate the disc and throw th contact springs out of metallic connection and thereby open the circu between the dynamo and battery.

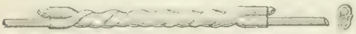
535,464. BATTERY; H. N. F. Schaeffer, Manchester, N. H. App. filed Jan. 9, 1893. A battery having its electrolyte composed of a salt of lactic acid and a mineral acid and an alkali.

535,524. CLAMP FOR TROLLEY WIRES; W. W. Annable, Grand Rapids, Mich. App. filed Nov. 25, 1894. The combination of opposing jaws consisting of plates having concave lower ends and inwardly projecting loops on one of said jaws, said lugs having laterally projecting pintles engaging said loops, one of the plates also having openings opposite the loops and lugs, and an inwardly bent portion to engage one of the lugs and prevent separation of said plates, and a screw adapted to close the concave jaws upon the conductor.

535,530. STARTING ALTERNATING MOTOR; O. Chytraeus, Pittsfield, Mass. App. filed Dec. 4, 1894. The combination with an electric current motor having field magnet poles, circularly shifted to one another about the armature, and means for changing some of the armature coils from being closed upon themselves, to being open, the remaining coils being in circuit with one another, said means consisting of electric conductors connecting the terminals of the first named coils, and adapted to move out of contact with the same.

535,5[illegible]3. ELECTRIC SWITCH; M. W. Dewey, Syracuse, N. Y. App. filed Jan. 11, 1895. The combination of a cylinder of insulating material, strips of metal secured in longitudinal rows across said cylinder and projecting beyond the surface thereof, a longitudinally movable bar within the cylinder connected to the latter by a spline and groove, a knife switch connected to one end of the said bar, an indicator carried by the same and rigidly secured to the same, a handle on one end of the bar to operate the same, and a series of contacts arranged in a row and adapted to engage the strips.

535,540. AUTOMATIC TELEPHONE SWITCH; N. H. Holland, Montreal, Canada. App. filed Aug. 10, 1894. The combination of flexibly jointed tubular ear pieces attached to the receiver by a single tube, suitable switch pieces or contacts mounted thereon and co-operating therewith by the movement of the ear pieces together.



No. 535,592.—Wire Joint.

535,541. METHOD OF CONSTRUCTING SECONDARY BATTERIES; A. Hough, San Francisco, Cal. App. filed Sept. 14, 1893. The method of constructing a plate for secondary batteries which consists in mixing dry monoxide of lead and a soluble material producing a paste of the resultant mixture with water and sulphate of ammonia or an aqueous solution of the latter and placing it on a support to set, and when set dissolving out the soluble material.

535,565. RAILWAY SIGNALING APPARATUS; W. H. Walsh, Albany, N. Y. In combination a main track separated into consecutive sections, a shunt track branching from one of said sections and insulated from the section at the point where one of its rails crosses it, the shunt track having its section adjacent to the main track insulated from an adjacent section, conductors extending along the main track and electrically connected with the rails of an adjacent section, connections between the rails of the shunt track and the conductors and a carriage adapted to move along the track and provided with brushes in position to engage the conductors, and in circuit with a battery and signal.

535,579. ARMATURE FOR DYNAMO-ELECTRIC MACHINES; H. Geisenhoner & C. Sandman, Schenectady, N. Y. App. filed Jan. 15, 1895. The combination of an armature or other conductor carrying electric currents, wound around spirally with twine or other suitable material, each successive convolution being spaced an appreciable distance apart from the preceding one, for the purpose of providing when conductors are arranged in groups or inserted in slots a space for the circulation of air around the conductors for the purpose of insulating and ventilating the same.

535,589. ELECTRIC ARC LAMP; J. C. Knight, New York, N.Y. App. filed March 2, 1894. In an electric arc lamp an automatic cut out in the shunt circuit thereof consisting of the movable carbon carrying rod provided with a notch, a pivoted counter balanced arm mounted on the frame of the lamp with its elevated end normally in engagement with said rod and means for holding said arm in engagement with said rod until the rod passes out of reach.

535,592. WIRE JOINT; Nathaniel W. Lillie, Somerville, Mass. App. filed Jan. 31, 1895. A coupling piece for uniting wires consisting of a metallic strip (S) shaped in cross section and thus having longitudinally open channels on opposite sides, in which channels the wires are adapted to be introduced, the said coupling piece and wires therein being adapted to be twisted to inclose and unite said wires. (See illustration.)

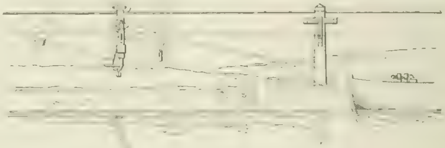
535,615. TELEPHONE; W. W. Dean, St. Louis, Mo. App. filed Sept. 24, 1894. A telephonic signaling device consisting of a suitable diaphragm, a magnet for vibrating the diaphragm, a spring for holding the diaphragm in its normal position and an adjustable screw for regulating the tension of the spring.

535,6[illegible]0. INSULATOR; W. J. Belcher, Hartford, Conn. App. filed Jan. 16, 1895. The combination with two tension members linked one through the other and each having a transverse stress exerting member and a pair of diverging longitudinal arms secured thereto, and each having also a pair of transverse openings in position and adapted for receiving the longitudinal tension member and non-contiguous to said arms; of an insulating member between and separating said stress exerting member in longitudinal direction, and having transverse openings corresponding in number with the longitudinal arms of the tension members and in position and adapted to receive said arms and to hold the tension members against rotative movement relatively to said insulating member.

535,679. SYSTEM AND APPARATUS FOR APPLYING BRAKES TO ELECTRIC CARS; C. E. Davis, Chicago, Ill. App. filed Dec. 29, 1893. In an electric device for a car a yielding connection between the axle and the car body, an electric circuit for the device, a current controlling the mechanism and an electric translating device for effecting the movement of a car in series with each other in said circuit, an operating connection for said controlling mechanism whereby the weight of said car body may control the current supply to said translating device.

535,692. CARBON HOLDER FOR ARC LIGHTS; A. W. France, Philadelphia, Pa. App. filed Nov. 10, 1894. A bracket provided with nipples and an adjustable socket having a threaded boss thereon, and a spring bearing against the movable jaw of said socket, said boss being fitted to said nipples and serving to connect the holder with the bracket and adjust the pressure of the spring.

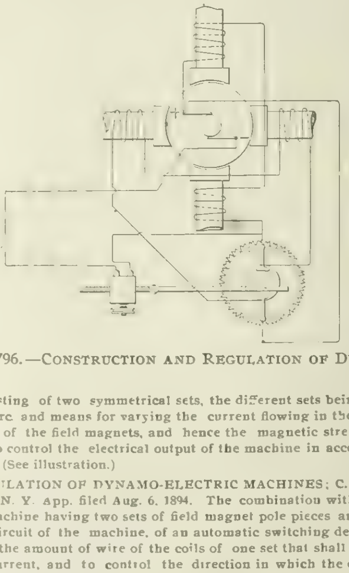
535,703. ELECTRIC CABLE WAY; R. Lamb, New York, N. Y. App. filed July 19, 1894. The combination of a supporting cable, a car supported on said cable, a motor carried by the car, a hauling cable anchored at both ends, and means independent of weight of the apparatus for causing tractional friction between the car and the hauling cable to haul the car on the supporting cable. (See illustration.)



No. 535,703.—Electric Cable Way.

535,745. TELEPHONE EXCHANGE APPARATUS; C. F. G. M. B. De La Touanne, Paris, France. App. filed Dec. 30, 1893. The combination with a telephone line comprising two limbs of a source of calling currents, a key to be depressed to connect said source of currents with one limb of said telephone line, and a second key adapted when depressed in addition to said key to connect said source of currents with said second limb; whereby when one of said keys is depressed one of said limbs is connected with said source of calling currents.

535,796. CONSTRUCTION AND REGULATION OF DYNAMO-ELECTRIC MACHINES; C. D. Haskins, Brooklyn, N. Y. App. filed Aug. 6, 1894. The combination with a dynamo-electric machine, of the external circuit with arc lamps or other translating devices included therein, the field of force magnets consisting of two symmetrical sets, the different sets being placed in multiple arc and means for varying the current flowing in the coils of one of the sets of the field magnets, and hence the magnetic strength of said magnets to control the electrical output of the machine in accordance with the load. (See illustration.)



No. 535,796.—Construction and Regulation of Dynamos.

535,797. REGULATION OF DYNAMO-ELECTRIC MACHINES; C. D. Haskins, Brooklyn, N. Y. App. filed Aug. 6, 1894. The combination with a dynamo-electric machine having two sets of field magnet pole pieces and connected with the circuit of the machine, of an automatic switching device adapted to control the amount of wire of the coils of one set that shall be traversed by the current, and to control the direction in which the current shall traverse the wire of said coils, or a portion thereof.

535,806. AUTOMATIC CENTRAL TELEPHONE SWITCH APPARATUS; F. Nissl, Vienna, Austria-Hungary. App. filed Feb. 17, 1894. An automatic telephone system comprising a main line including a central station, a plurality of branch lines converging to said main line, each including a subscriber's station, means at the point of convergence adapted to automatically and successively connect the subscribers' line with the main line for a definite period of time, and mechanism beyond the control of either the central or the subscribers' stations adapted to automatically interrupt such connection, in combination with a signaling circuit including the main and subscribers' lines, and means adapted to automatically indicate at all stations the particular subscriber's station connected with or about to be connected with the main line.

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ELECTROLYSIS BY TROLLEY CURRENTS.

In this issue we print the second part of Mr. W. Stuart-Smith's paper, based upon his recent experimental investigation at San Francisco on the distribution of the ground return flow of trolley currents. The investigation of the writer is the most extensive yet undertaken, as may be judged from the fact that between 500 and 600 excavations to uncover piping were made. As will be seen, it was found that some of the methods heretofore employed in similar work were far from giving true indications—for example, the one in which entire reliance was placed on voltmeter readings, whose manifest incorrectness, it may be remarked, was pointed out by Kennelly in the discussion of Mr. I. H. Farnham's Institute paper last year. The gas and water companies of San Francisco deserve much credit for furnishing the funds necessary to carry out this very extensive investigation, the result of which promises to finally establish several points of much importance.

ARMATURE REACTION.

The paper read by Prof. H. J. Ryan last week before the American Institute of Electrical Engineers on "A Method of Preventing Armature Reaction," resulted in the expression of a considerable difference of opinion as to the necessity of any special device for suppressing sparking. There seems to us to be considerable reason for the claim that such a device is superfluous as far as the suppression of sparking is concerned, as we are not aware that any difficulty has been experienced in producing dynamos of any size free of this trouble. A valuable point of the method discovered, however, is in the better regulating properties which it gives to a machine. The brushes may be moved without sparking, so as to over or under compound at will for large percentages While the heating limit in present machines is reached before the armature reaction becomes great enough to be taken into account, it may happen, as remarked by Mr. Kennelly, that means of ventilation may be devised to change this relation, in which case the method of Prof. Ryan will find a field of usefulness, and even at present there are probably special cases in which its employment would be advantageous, if not entirely necessary.

IMPORTANT IF TRUE.

For some days past a rumor has been in circulation to the effect that the General Electric and Westinghouse interests have been negotiating with a view to an agreement ending the present expensive patent litigation between the two companies. That such a negotiation is now under way we believe to be true, and at this writing it seems probable that an agreemnt will be arrived at. Whether the understanding will go beyond a *modus vivendi* with respect to patents alone, or include an amicable arrangement as to prices, can only be surmised at present, but it is improbable that its scope will extend to any general combination of interests. The case seems to be rather similar to that of the Westinghouse and Thomson-Houston companies some years ago; the latter had entered into an arrangement with the Sawyer-Man Company in regard to the manufacture and sale of incandescent lamps, which was continued when that company was merged in the Westinghouse interests notwithstanding the competition between the two rivals in other directions. As concerns the electrical industry at large, there can be no doubt of the wisdom of a course which will not only cut off enormous expenses for litigation, but give a great impetus to electrical development by removing from the minds of purchasers the fear of trouble from infringement suits. As to the effect on outside manufacturers, nothing can, of course, be known until the agreement, if completed, is divulged. In the meantime, we think it safe to assume that the unfortunate experience of the General Electric Company in its attempt to ride rough-shod over smaller concerns, and the consummate business acumen displayed in recent years by the Westinghouse management, both give assurance that no undue alarm need be felt on this score.

ELECTRICITY DIRECT FROM COAL.

We print elsewhere a translation of a comment in a German contemporary on a statement recently made in these columns in regard to the saving that would result if electricity could be obtained direct from coal instead of, as at present, through a secondary transformation with the consequent losses. The deduction made by us was based upon the cost per unit of energy produced of the generating plant, as well as the depreciation, remaining the same as at present. Since the case is a purely supposititious one, any assumption in regard to the cost of apparatus is wholly hypothetical, and the one criticised is no more so than that substituted by the writer in our contemporary. The basis of the latter is that the cost per unit of generating machinery, the depreciation, etc., in the unknown system will be less than that of the same factors in the present system; that is, the cost decreasing with the increase of the efficiency of transformation of the energy of coal into electricity, according to a rate determined by considerations that may be absent from the "coming system." The futility of this method of comparison would be shown if on the basis of the steam generation of electricity, the cost of generation by water power were calculated according to the manner proposed for the unknown system. In order that the cost of generating electricity direct from fuel with a high percentage of efficiency may notably decrease the price of electric energy, the cost of the generating apparatus, the depreciation and other factors entering will have to be considerably less per unit than at present. Until it can be shown that this necessarily follows, no claim can be accepted that such a system will produce any great saving. We do not see that the remarks in regard to cheapening through a greater output apply. Unless the unit cost is appreciably less, there will be no cause to increase the output.

THE BATE REFRIGERATING DECISION.

Owing to the vast amount of misinformation contained in the newspaper interpretations of the recent decision of the United States Supreme Court in the Bate refrigerating case, and, in scarcely a less degree, to the editorial remarks of some of our electrical contemporaries on the same subject, a very considerable misunderstanding exists in electrical circles in regard to the real significance of the decision. It is somewhat singular how the importance of this case has been magnified, and the unwarranted conclusions that have been based upon its final settlement. The Bate case, in short, may be considered as little more than a "bunco" game played upon credulous clients by their legal advisers, and the decision of the court has had absolutely no effect upon any patent whatever, either in the past, present or future. Section 4,887 of the revised statutes declares that a domestic patent expires with a foreign patent on the same invention if the date of the latter is prior to the date of issue of the domestic patent, and the attempt to substitute *application* for *issue* was so devoid of reason that it never had an iota of chance of favorable consideration by the Supreme Court, as was indicated by the unanimity of the lower courts in rejecting it, and by the fact that the case was only carried to the Supreme Court ten years or more after it could have been brought before it on appeal. The Supreme Court merely decided that the law must remain as it is, and since the pendency of the Bate case could not affect the action of that law, no patents were at any time affected. A statement, therefore, of the effect of the Bate case is that it affected nothing whatever—the decision merely registering the failure of an attempt to change existing law. The Edison telephone patents and the Edison lamp patent, for example, which expired in 1892 and 1894, respectively, were no less null before the decision than after it. The Bate case may, however, have an evil after effect through having taught that the public can be so easily bamboozled in legal matters, and, therefore, encourage owners of patents to get the benefit of a practical prolongation of the life of the same for a considerable period, by keeping in court a claim that their life still continues, no matter how absurd the grounds upon which the claim may be based.

MATHEMATICS AND PHYSICS.

It is a matter of common notoriety that of all the instruction received at colleges and technical schools that relating to mathematics is least permanent of retention. We doubt if, five years after graduation, there is one graduate in five able to follow with profit a mathematical demonstration which, when he was a junior or senior at school, would have presented no difficulty whatever. The reason for this unsatisfactory state of affairs we believe to lie largely in the present method of teaching mathematics in a separate course and with no direct reference to the manner in which it is to be applied by the student in that branch of science which he may have selected as the basis of his life work. The teaching of mathematics as a separate course has a tendency to train the mind of a student in a method of thought which, from its abstract nature, is rather that of a metaphysician than of the physicist or engineer, the latter dealing with physical entities whose consideration implies a habit of mind in which flexibility rather than rigidity is the desirable quality. No less injurious is the tendency of this method to suppress the imaginative faculty, for the rigorousness of mathematics leaves little field for its exercise. It may be said that this very quality of exactness furnishes a useful training for the mind, constraining it to form no conclusions not rigidly supported in fact; to this it may be answered that the study of science has the same effect, or that any lack in this respect is more than compensated for by a flexibility not possible in mathematical processes, and more in harmony with the workings of nature. The role of mathematics in the training of the engineer may be said to be two-fold; it furnishes a powerful aid in its character of symbolic logic to the understanding of the effects of physical phenomena, and supplies a tool for use in the after practice of his profession. Instead, however, of teaching its principles as mere abstractions, if imparted in connection with the class of phenomena whose understanding is the main object of the student's education, they would receive a significance that would tend to indelibly impress them on the mind; while all of the ideas involved in a given connection would thus be imparted in a natural order—the instruction in one department not having to be fitted to that in another. The drudgery of mathematics, including its elementary processes, might be left in the departments of mathematics as now organized, but when it comes to the conceptions of rates and higher space analysis—in fact, to the teaching of any of the ideas which are part of the physical phenomena to be studied—the instruction should be given with direct reference to the phenomena to which the ideas apply, and not divorced from the associations that enable their true significance to be grasped by the student. We therefore believe that the professor of mathematical physics or electricity should be one of the faculty of every school in which the science of electricity or electrical engineering is taught, and that until such a change is made in the constitution of these faculties the present unsatisfactory state of affairs referred to in our opening sentences will continue.

An Electrically Lighted and Heated Carriage.

Mr. Frank W. Hawley of the Cataract General Electric Company has had installed in his carriage an unique electrical equipment, consisting of a storage battery, incandescent lamps and an electric heater Five chloride storage cells of 150 ampere-hours capacity are contained in a box under the driver's seat, which supply the necessary current for the lamps and heater. In the interior of the carriage, over the rear seat, are two 8-cp incandescent battery lamps, and each of the carriage lanterns contains a lamp of the same candle power. Beneath the front carriage seat is an electric heater secured in a vertical position to the front of the seat box. This is believed to be the first time that an electric heater has been applied to this use, and it is the intention of Mr. Hawley to render the equipment still more complete by adding a dynamo to charge the cells, to be mounted on the rear axle and obtain its motion from one of the wheels.

Electricity Direct from Fuel.

In the article by Mr. C. I. Reed, on page 340 of our issue of March 16 there are two typographical errors in the chemical equation in the second column; there should be two molecules of water and of ammonium chloride, instead of one as indicated.

American Institute of Electrical Engineers.

At the ninety-fifth meeting of the American Institute of Electrical Engineers, held on Wednesday evening, March 20, Prof, Harris J. Ryan read a paper on "A Method for Preventing Armature Reaction," prepared by himself and Mr. Milton E. Thompson. The paper described a device, the fundamental principle of which was published in *Sibley Journal of Engineering* in 1892, but which has recently been considerably developed. It consists, in general, in surrounding the armature with a stationary winding which is similar in its magnetic effect to the armature winding, but is so connected in circuit as to exert an opposite influence, thus neutralizing the reactive effect of the armature upon the magnetic flux furnished by the field magnet.

The paper cited experiments made with several small machines in which curves were taken to show that with the extra winding in circuit there was absolutely no armature reaction and no sparking at the brushes, while the inductive efficiency of the armature winding was not impaired.

In the discussion following the reading of the paper, Mr. W. L. Bliss said that he could not see that there was any necessity for a device to prevent sparking or armature reaction. He had at first thought of using such adjunct, but an examination of patent records revealed the fact that about everything was tied up so that he had to do without these things. Afterward he found that in actual practice nothing of the sort was required. Mr. Bliss mentioned a constant potential dynamo which he had designed for lighting railway coaches, and, being belted to the car axle, had to run at speeds ranging from 60 to 1,500 revolutions per minute. This machine, he stated, was provided with a differential field winding to regulate the E. M. F., and its performance was entirely satisfactory, no sparking being observed, and no shifting of brushes required. He thought that the addition of the device described by the paper gave the dynamo an excessive weight for its output, and mentioned a machine he had built which gave a greater output per pound of material.

Mr. E. A. Merrill said that the device described in the paper certainly possessed the advantage of affording excellent regulation by reason of eliminating armature reaction.

Dr. Cary T. Hutchinson expressed the opinion that a device for curing armature reaction and suppressing sparking was superfluous in commercial practice, and thought it rather odd that two attempts are being made with this object in view—the one here described and that by Sayers in England. He said that the output of an armature is limited only by heating effects if the machine is properly designed, and mentioned a 30-kw machine which he knew to be running right along without any sparking or ill effects due to armature reaction.

Mr. C. S. Bradley said he had heard of machines which did not spark, but had never seen one, and would go quite a distance to see such a machine, whereupon Dr. Hutchinson invited Mr. Bradley to come to his office at any time and be taken around to inspect the 30-kw machine referred to.

Mr. C. O. Mailloux thought that the paper had undoubted merit, and the experiments described were of great interest, whatever the practical value of the invention. He said his experience had been that a great trouble was the lack of ventilation in many machines, which limited their output, and thought that this was an inherent disadvantage of the machine mentioned in Prof. Ryan's paper.

Mr. A. E. Kennelly expressed the opinion that the question at issue was not the number of kilowatts per pound of material, the primary and essential point being the output obtainable per dollar of investment. He said that in modern practice heating does limit the output, and not sparking, but this does not settle the question at all, because if sufficient ventilation is obtained to carry the heating limit beyond the sparking limit, then extra devices may be required to suppress the sparking. He did not think, however, that the device here described would be entirely advantageous.

Prof. Ryan briefly replied to some of the comments of Dr. Hutchinson, and the meeting then adjourned.

At a meeting of the Council of the Institute the same day, the following list of Council nominees for offices to be filled at the approaching annual elections was named:

For president, Dr. Louis Duncan, of Baltimore; for vice-presidents, Dr. M. I. Pupin, W. F. C. Hasson and Angus S. Hibbard; for managers, Carl Hering, Bion J. Arnold, Charles F. Scott and Dr. Cary T. Hutchinson; for treasurer, George M. Phelps.

Three vice-presidents and eight managers held over by the rules as follows: Vice-presidents, Prof. W. A. Anthony, Prof. Francis B Crocker and James Hamblet, of New York. Managers, Prof. Harris J. Ryan, Chas. Hewitt, A. E Kennelly, J. J. Carty, W. J. Hammer, W. D. Weaver, Chas. S. Bradley and W. B. Vansize.

The Commercial Aspect of the Direct Generation of Electrical Energy from Coal.*

THE ELECTRICAL WORLD† suggests the question whether the direct generation of electrical energy from the energy of coal can diminish appreciably the cost of its production, and it arrives at a negative conclusion. The arguments of this American journal rest on the well-known fact that in central stations for generating electricity the cost of coal is only about 10 per cent. of the total cost of operation and amortization, and that, therefore, there would be a maximum gain of only 10 per cent., if this factor of 10 per cent. were made negligibly small by direct generation from the coal.

But in this argument there is a false conclusion. The percentage value of the amortization in the cost of generation diminishes as the output of the installation is more completely utilized, while the cost of the fuel increases with it in the same proportion. The amortization, furthermore, will also diminish with the increase in size of the station, as soon as this exceeds a certain limit, as an installation for 100,000 hp or 500,000 hp does not cost 10 or 50 times, respectively, that of an installation for 10,000 hp. Meanwhile the direct cost for obtaining the energy always remains in the same increasing proportion to its production.

If we represent with P the cost of a unit of electrical energy, p the cost of the corresponding amount of fuel consumed, L the efficiency of the installation and q the "utilization factor" (load factor?) then

$$P = \alpha p \times \beta f(q \times L).$$

The function f diminishes with an increase of q and L, and, therefore, the first term increases in proportion to the second. At a certain value of q and L the first will no longer be 10 per cent., but will approach the value of 100 per cent. The factor p will, therefore, have an increasing influence on the quantity P, and the question then becomes of great importance, how many watt hours we can get from one kg of coal. If f were not a diminishing function and equal to the product of q L, though even the value of p is zero, it would have only a negligible effect on P, and the Niagara Falls installation in which $p = o$ would lose its importance in regard to economy, and the direct generation of the electrical energy from coal would then also remain without value.

It must be taken into consideration that the function f changes from time to time, due to the development of this branch of engineering, and, therefore, the second term in the value of P becomes smaller. Owing to this continual lowering of the costs due to amortization, etc., the importance of p will increase, and with this the question of what value to give p becomes more and more important.

Furthermore, the lowering of the value of p will have a still greater effect, in that it simplifies the construction of large installations, and, therefore, acts directly to diminish the second term. This is proved beyond question by cases in practice, as in the construction of large water power installations. The fact that these have made it posssible to cheapen the production of electrical energy can be used as a direct argument for the importance of the subject of the direct production of electrical energy from coal.

Prof. P. H. Vander Weyde.

The death, last week, of Prof. P. H. Vander Weyde removed from scientific and artistic circles a personality widely known and closely identified with their best interests. Prof. Vander Weyde was born in Nymegen, Holland, 82 years ago, and was a descendant of the famous 14th century troubadour, Walter Vander Vogel Weyde. He studied at Dusseldorf, and graduated from the Royal Academy at Delft. In 1849 he came to New York, and later on graduated from the New York University Medical College. In 1859 he was appointed professor of physics, chemistry and higher mathematics at the Cooper Institute, and in 1864 Girard College, Philadelphia, created the chair of Industrial Science expressly for him.

Prof. Vander Weyde was a prominent member of the New York Electrical Society, a prolific scientific writer, and had considerable standing as a musician and painter. He was organist for 20 years at the First Dutch Reformed Church, Brooklyn, and was a composer of decided merit.

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* Translated from the *Zeitschrift fuer Elektrotechnik und Elektrochemie*, Feb. 15.

† See ELECTRICAL WORLD, Dec. 22, 1894, page 636.

The Blackening of Incandescent Lamps.*

BY G. TOLOMEI.

The glass bulb of an incandescent lamp gradually blackens with usage, causing a diminution in the candle power, which may reach as high as 30 per cent. If we add the loss due to the disintegration of the filament, we see that the total candle power of the lamps may fall off as much as 50 per cent. of its initial value.

The blackening of the glass was attributed by Mr. Thomas to residual mercury vapors in the inside of the lamp, and by some others to the platinum particles thrown off from the leading-in wires. It is more probable, however, that carbon is the principal cause of the phenomenon, as the total amount of mercury which may remain in the inside of the lamp bulbs must be exceedingly small.

According to Mr. Sawyer, the phenomenon should be explained as follows: The inner space of the bulb always contains a very small quantity of oxygen, originating either from the residual air or from the water vapor which remains strongly adhering to the glass. This oxygen, together with that occluded in the filament, attacks the carbon, forming a carbonic oxide, which undergoes dissociation by coming in contact with the comparatively cold glass, depositing carbon and leaving the oxygen free for a repetition of the process. As the glass blackens, and its absorbing power increases, the dissociation is retarded by the higher temperature attained by the bulb, thus accounting for the more rapid blackening when the lamp is new.

The above explanation is based upon the existence of a carbonic oxide capable of dissociation at a low temperature, and until the possibility of such a phenomenon is demonstrated, Mr. Sawyer's theory may hardly be admitted. It is true that the presence of extremely rarified gases seems to alter the chemical laws observed at the usual atmospheric pressure, and we should therefore expect that, under such peculiar conditions as are present in the inside of an incandescent lamp, some compound may be originated the existence of which would be impossible elsewhere. But it is possible also, that incandescent carbon in a vacuum might undergo a sensible evaporation at a temperature far below its melting point, and the carbon vapor thus produced might deposit on the cool glass of the bulbs.

I wished to study the question somewhat more carefully than has been done heretofore, and the results which I have obtained seem to me to be worthy of consideration.

I examined the filament with a microscope of Reichert, and also one of Leiss, 850 times enlarged, and I observed that the filament of the new lamps presents a somewhat regularly undulated surface; on the contrary, the filament which has been used for some time has the whole surface covered with little humps, resembling, although very much smaller, those which appear on the carbons of electric arcs. It seems that such humps have been produced by some melted material, and have remained sticking to the surface of the filament after it has cooled.

Near the point of breaking, and often somewhere else, the surface of the filament presents to the naked eye a different appearance than the rest, and appears precisely as if it had been covered with lampblack. The filament, observed at this point with an enlargement of 850 diameters, appears to be furrowed by transverse cavities like craters, out of which rise some ramifications of lampblack, which have the appearance of volcanic jets. Around the breaking point the craters are deeper and the ramifications more frequent.

Furthermore, by examining a blackened lamp bulb, I noticed that the carbon deposit is much deeper just opposite the point of breakage of the filament than anywhere else. This shows that the cause of the breaking is the same which produces the blackening of the glass, and is connected with the development of some gaseous substance from the carbon. Sawyer's supposition is thus proved to be incorrect, for if the blackening were caused by the decomposition of a peculiar carbonic oxide, the surface of the filament could not present the appearance above described.

My observations also disprove the doubtful hypothesis according to which the carbon deposition should be attributed to a kind of sublimation, like that obtained by Moissan with the electric arc; such a phenomenon, indeed, could never give rise to the ramifications referred to.

The microscopic examination of the glass bulb shows that it is covered internally with a very thin layer of lampblack, in which it is easy to distinguish some larger grains, irregularly distributed. These grains are often assembled into strange shapes, and may be considered as true fragments thrown off from the filament, which have adhered to the glass. Among such fragments I have noticed the presence of some yellowish crystals, of very different sizes. Owing to the exceptional transparency of these crystals, it was impossible for me to measure the angles of their faces. All the crystals may be easily detached from the glass, and appear quite like those of olivine. I do not attempt to prove their identity with this compound, but am certain that they are formed of a substance produced in the filament, and sublimated, owing to the high temperature.

The presence of the craters observed on the surface of the filament is thus explained, and the production of the above described ramifications also. By the high temperature, some peculiar compounds are formed from the heterogeneous substances, a small amount of which is always mixed with the carbon in the filament of glow lamps. Owing to the evaporation of these compounds, the filament undergoes a gradual disintegration, and some very minute carbon particles are gradually thrown off on to the glass bulb. When the explosion from the little humps, present on the surface, is very violent, entire fragments are detached, and at those points where a detachment occurs more frequently, the filament is worn away so that a slight vibration is sufficient to cause it to break.

This interpretation of the phenomenon affords an explanation of the fact, generally observed in glow lamps, that blackening increases more rapidly in the first period of usage, and afterwards remains almost stationary.

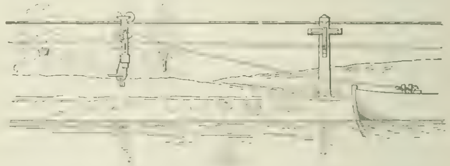
I have also undertaken a chemical examination of the filament and of the substance deposed on the bulbs; although this examination is by no means completed, it enables me to state that something other than carbon leaves the filament during the life of the lamps, and it constitutes the principal cause of its disintegration, and of the consequent blackening of the bulb. When my chemical examination is finished, I shall give the results in a later paper.

---

*Translated from *L'Elettricista* (Rome), March 1st.

Canal Boat Traction.

It is said that negotiations are under way to apply the Lamb system of electric towage to a two-mile section of the Erie Canal, with a view to its adoption along the entire line of the canal if successful results are obtained. The Lamb electric cable way, for which a patent was issued March 12, 1895, was described by the inventor in a paper read last year before the American Institute of Civil Engineers, and has been already tested on a large scale. As shown in the accompanying illustration, it consists of a supporting cable from which a car is suspended carrying a motor, with a hauling cable anchored at both ends of the car, and means independent of the weight of the apparatus for causing the necessary tractional friction between the car and the hauling cable to haul the car on the supporting cable.



Lamb's Electric Cable-way.

A Deserved Rebuke.

Under the caption of "Yankee Ways," the London *Electrical Review* prints the following: "We suppose our American friends would think us in a hurry if we dared expect the World's Fair exhibitors' awards to be delivered to the winners yet awhile. Scarcely eighteen months have passed since the exhibition doors were closed, and here we have impatient British exhibitors—who were advised twelve months or more ago that they are entitled to medals and other honors—wondering when their awards are coming! We would advise them not to be in too great a hurry; they will no doubt receive their dues by the date of opening the great 1900 Paris Exhibition. Much is said of the go-ahead spirit characteristic of our trans-Atlantic friends. May we regard this as a specimen?"

Americans Favor the Use of Teeth.

According to Dr. S. P. Thompson, of London, not 5 per cent. of the dynamos in the United States have smooth armatures.

Microscopical Research on the Electrostatic Discharge.

BY GEORGE T. HANCHETT.

Some writers on physics have gone so far as to describe the appearance of the disruptive discharge. The straight line for short distances, the forked or branched discharge for larger ones, and last of all, the zigzag for the maximum striking distance.

The fact of the matter is that the eyes have a severe defect which prevents us from seeing the true appearance of the discharge, namely, persistence of vision, and it may be added that the idea conveyed to the brain is by no means anything like the elaborate zigzags and tree-like forms which many writers are prone to describe.

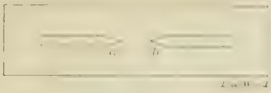
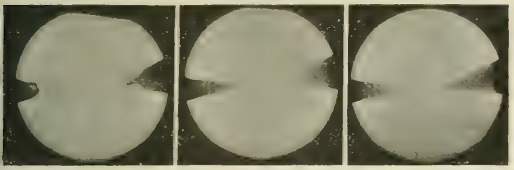


FIG. 1.

Photography, while even slower than the eye to record the appearance of the static discharge, has the faculty of remembering what it has seen and getting it on paper without drawing on its imagination, and although the events of the brief phenomenon are mixed up on the record, they are all there, and with skill and judgment can be deciphered and compared.

The writer has in a modest way endeavored to secure some photographic records of the static discharge, which he hopes will prove as interesting to others as he himself found them.



FIGS. 2, 3 AND 4.

The method of experimentation was briefly as follows: A particularly large glass slide was obtained, and on it were pasted strips of tin foil, after the manner of Fig. 1. The spark of an inductorium was discharged across the gap *a* *b*. One of the tin foil strips was connected to the microscope itself, and the other to the induction coil terminal. By grounding the other terminal on to the microscope the discharge was provided with a circuit, and disagreeable shocks from handling the screws of the instrument avoided. A common push button served to open and close the primary circuit at pleasure. The first thing that was noticed was that the tin foil terminals were rapidly diminished in size if the discharge was at all strong. This would naturally be expected, but it is interesting to note that the *negative* terminal is the one that wastes away most rapidly, the exact reverse of what occurs in the voltaic arc. The negative terminal is covered with purple light, and cannot be mistaken. This is well shown in the series of Figs. 2, 3 and 4. Fig. 2 shows a pair of freshly prepared terminals, no spark as yet having been passed. Fig. 3 shows the same terminals after a disruptive discharge had passed from right to left across the gap between them. The delicate point of the positive terminal is gone, but that of the negative terminal has been melted into a round knob, and is much further contracted. It is further to be remarked that the destruction of the negative terminal is apparently due to heat, while that of the positive seems to be of a mechanical nature, the particles being rather torn off than melted into a knob. This would augur that the luminous matter of the spark acted as the flame of a blow pipe and directed the most heat in the direction that it was propelled. The positive terminal, of course, had some heat, and as the particles softened they were torn off by the rushing current of luminous matter. Fig. 4 shows precisely the same effect with the same terminals, except that the current was reversed. The negative terminal is melted away as we should expect, but the positive or former negative terminal is more interesting. The solid ball of melted tin has better resisted the discharge, but, nevertheless, a fine cloud of particles has been torn away from its lower end.

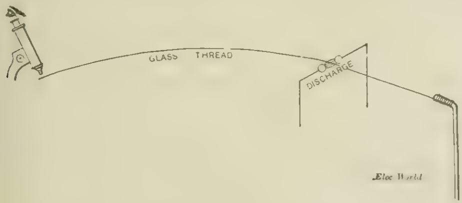
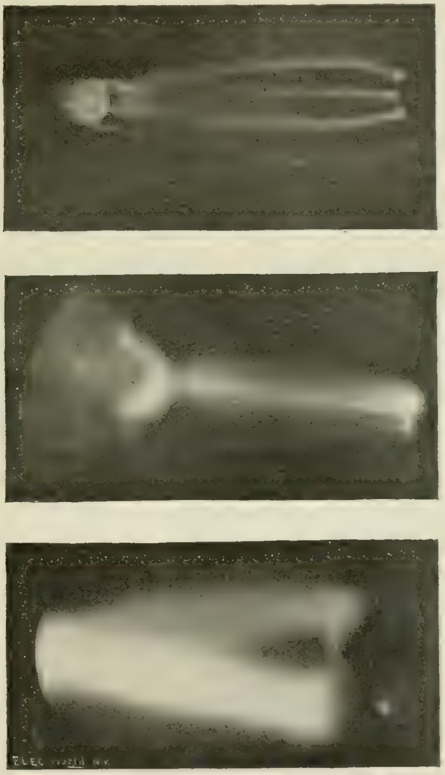


FIG. 5.

It appears as if the positive terminal was eaten away by the tearing off of particles, while the negative was contracted by being melted together.

These phenomena seem to the writer most important. In his opinion the only way in which electricians can determine definitely the direction of current flow is to carefully observe the phenomena of reversal and all pertaining to polarity. These facts seem to show that the uniform assumption that current flows from positive to negative is not in error.

If there is a flow of luminous matter from positive to negative it must be very minute in its mechanical power. The writer arranged apparatus as follows: A glass thread one-half a metre long was rigidly supported at one end. About two-thirds of the way from the support were placed the terminals of a powerful inductorium, so that the discharge completely enveloped the glass thread. The free end of the glass thread was subjected to observation under a microscope, using a ¼-inch objective. So delicate was this apparatus that the slightest motion of any one in the room would throw the index into vibration. The inductorium and the support for the needle were set on separate supports, and were damped by pads of cloth to avoid the vibration of the automatic circuit breaker. With this apparatus no deflection of the index that could be attributed to



FIGS. 6, 7 AND 8.

the spark was observed. The experiment was varied by attaching a minute piece of tin foil to the thread at the place where the discharge took place, thus making the deflecting portion a conductor, but as far as could be seen, no deflection took place. The apparatus is shown in diagram in Fig. 5.

Further than this the amount of metal torn off from the positive pole must be extremely small. Two pieces of tin foil as small as could be conveniently handled were carefully weighed and subjected to the discharge till the negative piece was almost melted into a ball. They were then reweighed and showed no change in weight. Unfortunately, the balance attainable was not sensitive to less than $\frac{1}{50}$ mg, and, therefore, the result is not as satisfactory as if the apparatus had been more delicate.

The spectroscope reveals to us that some particles are torn off from both poles, for on viewing a spark passed between poles of different metals spectra of both metals are seen, but this gives us no data as to how much is lost from either one in comparison with that lost by its mate, and spectroscopic quantities are far beyond the range of our best balances.

Of course, there could be a loss due to the oxidation of the hot terminals, but this could not be attributed to the static discharge.

We must, therefore, attribute the diminished size of pole piece, as seen under the microscope, almost entirely to the melting of the metal by the heat of the discharge. The negative terminal being melted much more than the positive in a given time it is fair to assume that it is the hotter of the two.

It is further interesting to observe that the mechanical effects of strong static discharges baffle the seeker after direction of flow. The pierced card is burred on both sides, and the block of wood is torn to splinters without the slightest clew as to the direction of the blow.

The appearance of the static discharge itself under the microscope presents many interesting features, aside from its being an object of great beauty. Fig. 6 shows a spark viewed at a power of some 75 diameters. The current of the primary was reduced till the minute distance was little less than the maximum striking distance of the coil. The right-hand side is the positive. The spark at the positive terminal is especially noticeable from the fact that the discharges are tipped with white knobs. These, as seen, are yellowish red. A pinkish haze surrounds the spark, but stops short before it reaches the negative terminal. A minute examination of the discharge suggest the presence of fine subdivisions, but these the writer attributes to the fact that the spark was in a state of vibration when being photographed. The negative terminal itself is bathed in purple light and brilliantly tipped with a fringe of brighter light. In the object itself there are scintillations of the terminal continually coming and going, and so numerous that the terminal appears to be covered with brilliant spots. These the writer would attribute to the discharge occasionally striking the terminal directly in the line of vision, and not horizontally across it. The fact that the scintillations follow the spark in its vibration up and down the negative terminal seems to verify this supposition. These scintillations are blurred together and do not show in the photograph.

Figs. 9 and 10.

Fig. 7 shows the discharge with a much stronger primary current. The spark is now more positive, straighter and less vibrating. The white knobs are strongly marked, even on the lower faint discharge. The pinkish glow stops short before it reaches the negative terminal. The bright trimming of the negative terminal is enlarged, as is also the purple glow beyond. One thing of interest is the bright dot beyond the negative crescent. It is one of the scintillating spots spoken of in Fig. 6, but occurred so frequently in that identical spot that it was recorded on the plate. If the writer's theory is correct the spark, or, more probably, a portion of it, must have frequently passed beyond the nearer terminal and turned sharply, striking end on at that point. One other thing of interest is that the knob on the positive pole is not in direct line with the spark, but a little above it, while a smaller knob in direct line seems more properly to belong to the discharge. In the writer's opinion these knobs are simply hot portions of the terminal, and the upper knob might owe its brightness to the fact that it was a small, almost isolated piece of metal, and, therefore, the heat was not rapidly conducted away by the terminal proper. These isolated knobs appear dark on the positive terminal when viewed in a light field, and remain for a few instants and then melt into the terminal itself.

Fig. 8 shows the positive terminal of the same discharge with a condenser shunted across the secondary terminals of the coil. It is a heavy blur, and the only thing noticeable is the white knob.

An interesting feature is the viewing of the sparks of Figs. 7 and 8 through dark glass. It was found that the spark of Fig. 7 was drawn down to a fine line, while it is quite impossible to so draw down the spark of Fig. 8. The spark of Fig. 7 is the simple discharge of the coil, and we know it to be a unidirectional pulsating discharge. The spark of the Leyden jar is one involving oscillations, and many hundreds of them take place in the brief interval of the spark. It may be, then, that this rapidly reversing discharge is a bunch of lines blurred together by the camera and by the persistence of vision, and not a hazy glow around a single line of discharge. The hazy glow can be removed by smoked glass. The bundle of bright lines could not be sensibly diminished in diameter by such means. The ozone of the electric discharge is generated most copiously at the negative terminal. To prove this the writer devised the following experiment. A pool of a mixture of starch and potassium iodide was spread upon paper and the sparks from both terminals of the inductorium allowed to discharge therein. That opposite the positive terminal blackened the mixture the most in a given time. This seems contradictory, but it must be remembered that the starch itself is the negative terminal. The spark from the other terminal blackens some, but not so abundantly. The mixture acts by the ozone liberating free iodine, which colors the starch. That this is not electrolytic action may be proven by immersing both terminals in the pool of prepared starch, instead of allowing them to discharge into it. The current will be found too feeble to electrolyze the mixture. Moreover, in the electrolysis of this mixture it is the positive terminal that blackens.

Fig. 9 shows the positive end of the discharge when it was striking over one-half an inch. It is easy to see that it was in rapid motion striking in every direction. The absence of the white button or knob is to be noted. This, together with the fact that the terminal is much less melted than when the same discharge is allowed to strike at short distance, shows that there is much less heat generated at the source of the discharge when the latter is striking its maximum.

Fig. 10 is the same terminal, but with the discharge reversed in direction. This photograph is very deceptive. The spark was dodging about and was recorded in many different positions. As we should expect, the negative pole is very much cooler than with the shorter spark of greater volume. The dark band just back of the terminal is very misleading. It would lead one to think that the pinkish glow surrounding the spark had over-traveled the negative terminal and then stopped short. Such is not the case. The band is due to a narrow neck on the terminal, the true gap between pink and purple being masked by the vibrating spark.

It is interesting to note that as the terminals are approached the blue discharge lines thin down, and the pink haze brightens and assumes the form of a brush, the line of demarcation between the brush and the negative purple being a wide band of black, and very strongly marked. As the terminals approach this pink brush contracts and brightens, a single blue line of discharge being all that actually crosses. When approached to within $\frac{1}{100}$ of an inch or less the brush contracts into a brilliant yellow spark, and the next instant the light goes out as the two terminals touch each other. To the writer this black band appears closely akin to the striæ of the Giessler tube.

Best Protection Against Lightning.

According to a recent lecture of Prof. Schuster, of London, the safest course for a human being in a thunderstorm is to get thoroughly wet. Benjamin Franklin remarked that he could kill a rat when dry by means of an electric discharge, but never when it is wet.

Action of a Single-Phase Synchronous Motor.*

BY FREDERICK BEDELL AND HARRIS J. RYAN.

The phase relations of the different variable quantities in any alternating current problem are of paramount importance, and have often been the subject of investigation in the study of the action of the transformer. The writers of this paper have recently had occasion to study the synchronous motor with particular reference to these phase relations, and to compare polar diagrams representing the action of the motor, constructed from *a priori* reasoning, with similar diagrams obtained by experiment. The complete discussion of the action of a synchronous motor which follows, is thus verified by experiment. Preliminary reports on portion of this work have already been published. The polar diagrams here given, constructed from experimental data, are now published for the first time. We are indebted to Mr. C. E. Hewitt and Mr. J. Lyman for assistance in conducting this investigation.

Although any alternating current generator will operate as a synchronous motor, it is not true that they will all thus operate equally well. The old smooth bodied armature alternator, with "pancake" armature coils, made a very poor synchronous motor, while the modern alternator, with "T-toothed" armature, fitted with machine-wound armature coils, has been found to give excellent results when run as a synchronous motor. This improved performance of the alternator as a synchronous motor is due to the increased self-induction of the armature and to the useful effects of the armature current on its own field. When the current developed by a generator is in unison with the generated E.M.F., such current exerts very little effect upon the field—neither strengthening nor weakening it. When the current lags behind the E.M.F. of the generator, the armature reaction effect that it produces upon the field is such as to weaken the field, and thus to diminish the E.M.F. produced by the generator. The reverse of this action occurs when the generator furnishes a current that is in advance of its E.M.F. This is shown to be true in the experiments which follow by the gradually increasing values of generator E.M.F. (given in the tabular data in the latter part of this paper) as the current, which at first lags behind the generator E.M.F., is brought into phase with it and finally into a position of advance. Precisely the same armature reactive effects on the field occur in a synchronous motor. There is this exception, however, that the motor E.M.F. is counter to that of the generator, so that what is a lagging current for the generator is an advance current for the motor, and the current that is in advance of the generator E.M.F. lags behind the counter E.M.F. generated by the motor. The current that strengthens the field of the generator will thus weaken the field of the motor, and *vice versa*, as will be explained later.

The speed, as is well understood, depends only on the periodicity produced by the generator and the number of poles of the motor. Neither variation of the E.M.F. impressed at the terminals of a synchronous motor, nor variation of its field excitation, will change the resulting speed so long as the motor operates at all. The armature circuits of the motor, generator and line always possess some self-induction. When, therefore, the generator pressure is higher than that of the motor at the moment when synchronism is obtained, and the machines are connected, a current will pass between the machines that will lag, because of the self-induction, behind the generator E.M.F., and will be in advance of that of the motor pressure. This current, as was just pointed out, will weaken the field of the generator and lower the E.M.F. that it generates; it will strengthen the field of the motor, and in proportion will raise its counter E.M.F. The result, therefore, is to equalize the developed pressures of generator and motor, and thus prevent a further increase of current. Such a current will have a larger component in unison with the generator pressure than with that of the motor, depending on the proportion of the electrical energy transformed into mechanical energy.

The diagram, Fig. 1, illustrates the action of a synchronous motor that develops a motor pressure E', equal to the generator pressure E. In this, and in all the diagrams following, positive rotation is counter-clockwise. In the case of Fig. 1, the circuits are assumed to have no self-induction, but to have the usual resistance. At the instant that synchronism is obtained and the connection of the motor completed, there can be no current established through the motor, and, therefore, no power developed. The motor will lag in rotative speed at once to some such position as d, where the resultant of the motor and generator pressures is ad or E''. Since there is no self-induction in the circuit, the resulting current I is in unison with E'. Such a current has component values in unison with the generator and motor pressures that are equal. No power can, therefore, be developed, and the motor would promptly come to a standstill.

The conditions represented by Fig. 2 are, that the generator pressure is greater than the motor pressure, and that the circuits possess resistance but no self-induction. At the moment that the motor is synchronized and connected, a current will be established that is in unison with the generator pressure and opposite to that developed by the motor. The developed power that thus results is, in general, more than sufficient to keep the motor running light at synchronism. The speed position of the armature is, therefore, advanced to a point d. Here is obtained a resultant E.M.F., E'', that, since there is no self-induction, establishes a current which is in unison with the resultant E.M.F., E''. The component ae along E is here greater than the component af in the direction of the motor E.M.F., E'. A balance occurs at that point where the power developed is just sufficient to keep up the synchronous speed of the motor armature, and no further acceleration takes place. On loading down the motor its armature position is retarded. The maximum load that the motor will stand is that at which the product of the motor pressure into the component of the current that is in unison with it is a maximum. This the diagram plainly indicates to be at the point of true synchronism. When this point is reached an increase in the load will further retard the armature, and the above product will again diminish; the motor, being overloaded, will come quickly to rest.

In Fig. 3, E and E' are equal, the armature and line circuits have no appreciable resistance, and self-induction is present. At the instant of synchronism and connection of the motor to the generator circuit no current will be established through the motor, because the generator and counter E.M.Fs. are equal. The motor armature will lag to a point where the resultant pressure is E''. E'' will establish a current I, one-quarter of a period behind itself. Such a current will have a large component that is negative with respect to the motor pressure and in unison with that of the generator. An early point is reached at which the motor will do good work. Later on a maximum component of this current, that is opposite to the motor pressure, will be found, beyond which the motor will lose synchronism.

In Fig. 4, the generator E.M.F. E is greater than the motor E.M.F. E'. The circuits possess self-induction, but no resistance. At the instant that the motor is synchronized and connected, the resultant pressure, E'', is the algebraic difference between E and E'. Inasmuch as the circuit possesses self-induction with no resistance, E'' will establish a current through the motor at right angles to itself and the motor and generator pressures. From such a current no power can result. The armature will lag to a later position, where the conditions are found to be practically the same as those discussed in connection with Fig. 3.

In Fig. 5, E equals E', and resistance and self-induction are both present in the circuits. Since E and E' are equal, no work can be done until the armature lags to some position, d, where the resultant E.M.F. is E''.

When the E.M.F., resistance, self-induction and periodicity of a circuit are known, the impedance is known, and the current becomes known from the relation

$$\text{Current} = \frac{\text{Resultant E.M.F.}}{\text{Impedance}}$$

The phase position of the current is determined by the relation between the resistance and the reactance of the circuit. The projection of I upon E' is a quantity that is proportional to the developed mechanical power. This projection, as in all other cases, at a certain position attains a maximum beyond which the motor will come to rest.

In the next diagram, Fig. 6, E is greater than E', and self-induction and resistance are present. In general, the position of the armature at no load will be in advance of the normal position of synchronism, the position of advance being limited, as in the similar cases cited above, and which the figure fully illustrates.

In practice, the relations of the magnitudes of E and E' are determined by the field excitation and the currents that are established through the motor. Armatures that develop powerful reactive effects upon their fields in action equalize the motor and generator pressures, and such armatures must necessarily possess considerable self-induction. These are the requirements for suitable working, as indicated by the above analysis.

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* Abstract from the *Journal* of Franklin Institute, March, 1895.

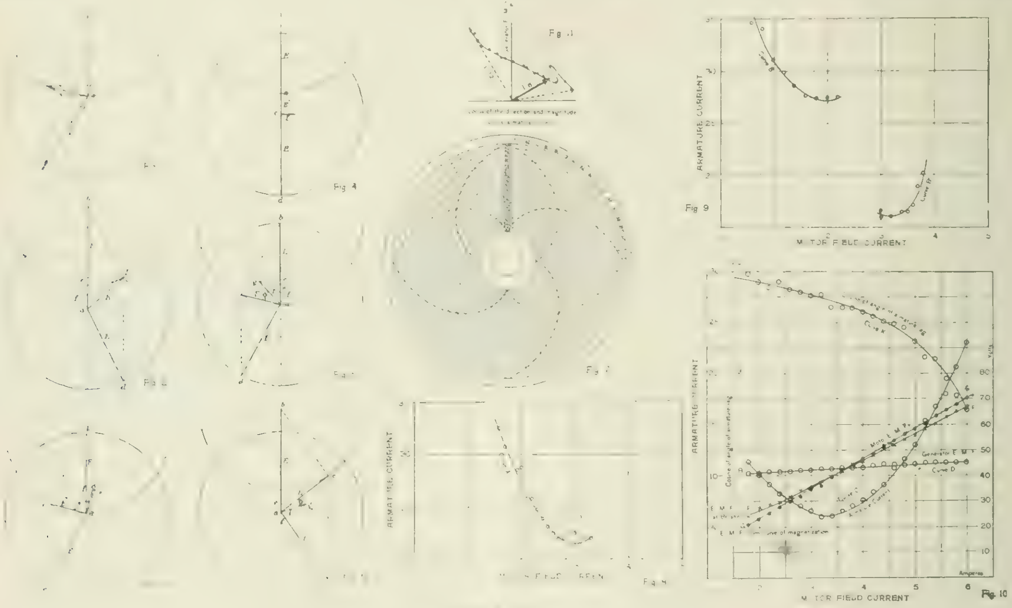
It is well to suggest, also, that the amount of the mass of the revolving parts of a synchronous motor has an additional effect upon the stable operating conditions. During every complete period, there are two short intervals, throughout which the motor, in general, must act as a generator and give back a small amount of power to the generator. The only source of this power is the fly-wheel property of the revolving parts of the motor. Multiphase motors are independent of this fly-wheel effect, because at no instant does the motor do work on the generator, while on the other hand, the amount of mechanical energy developed is practically uniform.

Two small Westinghouse alternators, of the same size and shape, designed to supply ten incandescent lamps, were used as generator and motor. Before being thrown into direct connection with the generator, the motor was brought o speed by means of a direct current starting motor, to which it was belted. A half horse power Edison machine was used for this purpose. When synchronism was reached, the direct current supplying this starting motor was broken at the instant that the alternate current motor was connected to the generator. The magnetization curve for the alternate current motor was found to be practically a straight line. The stability of a synchronous motor depends largely upon the field excitation and the amount of the self-induction in the armature circuit. With no added self-induction in the armature circuit the motor in the present case was found to be quite unstable. Curve *A*, Fig. 8, shows the relation between the current flowing through the motor and generator armatures and the exciting current of the motor field, when no added self-induction was in the armature circuit. The motor was driving the small Edison machine on open circuit as a light load. The generator field excitation was kept constant at 3.5 amperes; the speed was 2,080 revolutions per minute. The extreme range through which the motor could be kept in synchronism was from a motor field current of from 1.5 to 3.3 amperes. With a motor field excitation of 3 amperes, the armature current was a minimum. The operation under these conditions, however, was quite unstable, and a light load would throw the motor out of synchronism, and thus cause it to stop.

The stability was increased by the addition of self-induction to the armature circuit, and for this purpose a coil without iron was employed. Curves *B* and *B′*, Fig. 9, show the relation between the motor excitation and armature current, as was shown by curve *A*, for the preceding case without added self-induction. The motor ran synchronously with a field excitation varying from .6 to 2.2 amperes, and from 3 to 3.6 amperes, but would not run with an exciting current between 2.2 and 3 amperes. With the weak field excitation, a large current was consumed by the motor, while with the strong excitation current, a much smaller current was taken by the motor. This may be attributed to the phase position which the current takes in the two cases, with reference to the phase position of the impressed E.M.F., as is shown by the polar diagrams for such cases.

It was found that by gradually increasing the self-induction in the armature circuit, the two parts of the curve *B* and *B′* were brought together. The self-induction was increased by inserting in the coil an iron core consisting of a bundle of iron wire. At a certain position of this core the self-induction of the armature circuit was such that the motor consumed a much smaller current than at any time before, ran with great stability, and through a wide range of field excitation, as shown by curve *C*, Fig. 10, which will be discussed later. The final run was made under these conditions.

The coefficient of self-induction of the motor armature was found to be .32 millihenry, and that of the induction coil with the iron core, 1.68 millihenrys. The total self-induction was, therefore, 0.002 henry. The total ohmic resistance of the armature circuit and connections measured 0.31 ohm. The self-induction of the armature was measured for different field excitations and for different currents, the mean of all the values obtained being averaged and taken as constant. The excitation of the field seemed to make no appreciable difference in the coefficient of self-induction of the armature. The resistance and self-induction of the armature circuit vary somewhat with the value of the current flowing, on account of temperature changes and the saturation of the iron, but the error introduced by considering these constant is small. From these measurements the reactance and impedance were determined.



Figs 1 to 11.

Throughout the following investigation, the generator was run at a nearly constant speed of about 2,080 revolutions per minute, and with a constant field excitation of 3.5 amperes. The motor was brought up to speed by the small Edison starting motor mentioned above, and thrown into circuit at the instant when its phase position, as indicated by the ring of light of the phase indicator, remained 180 degrees behind that of the generator. The small Edison machine was then driven on open circuit as a light load for the alternate current motor, this being the only load throughout all the experiments here described. The exciting current of the motor field was changed by increments of 0.2 ampere between the limits 1.8 and 6 amperes. The motor and generator field currents were obtained from a storage battery, and were accordingly quite constant.

The quantities required were:

The impressed E.M.F. (*E*) of the generator;

The counter E.M.F. (*E′*) of the motor;

The resultant E.M.F. (E''), which is the resultant of the impressed and counter E.M.Fs.;

The armature current (I''');

The angle of lag (ϕ) of the current behind the resultant E.M.F. (E''); and

$$2\,\pi \times \text{frequency} = \omega = \frac{2\,\pi \times 4 \times \text{r.p.m.}}{60}$$

The above quantities are required in order to construct the graphical diagrams which show the complete action of the synchronous motor.

The following quantities were likewise obtained:

Generator field current (I').

Motor field current (I'').

Disc reading, angle θ.

The currents were measured directly by means of a Siemens dynamometer. The impressed E.M.F. (E) of the generator was obtained from a voltmeter connected to the generator brushes. The counter E.M.F. of the motor was taken directly from the magnetization curve for the motor, no correction being made for armature reactions. The disc readings indicate the lag of the armature of the motor behind that of the generator; these were obtained by means of the phase indicator, Fig. 7, described at the Philadelphia meeting of the Am. Inst. of Elect. Engrs., 1894.

The electromotive forces E, E' and E'' must all be in equilibrium when the motor is running. The motor, when running in synchronism, will take such a phase position with respect to the generator that this relation is obtained. The resultant E.M.F. (E'') is then just sufficient to overcome the product of the current (I''') and the impedance of the armature circuit. Therefore:

$$E'' = I''' \times \text{impedance}.$$

The E.M.F. is thus computed: The angle of lag of the current behind the resultant E.M.F. is

$$\phi = \text{arc tan.}\ \frac{\text{reactance}}{\text{resistance}}.$$

The resistance and self-induction being taken as constant, we have, therefore, a constant value for the angle ϕ, viz.: 82.5° (the speed varying little during the run, and ω being taken, therefore, as constant).

(To be continued.)

Electrical Condition of Buried Conductors Due to Leakage Currents from Electric Railways.—II.

BY W. STUART-SMITH.

Before beginning the tests along the San Mateo road it was known that the water pipes were wired to the track, and it was believed that the gas pipes were not. Care had been taken to wire to water pipes only under the belief that they would be much better conductors than the gas pipes. On this account it was expected that the water pipes would be generally positive to the gas along that road, and the gas pipes consequently safe from any corrosion. Tests had been made only at street crossings along the line of the Metropolitan road, and as no evidence was obtained to show that these tests were not sufficiently close for all purposes, the same plan was followed during the early stages of the test along the San Mateo road.

When gas was found to be slightly positive to water at Harrison and Spear, it was thought to be due to a gas service coming very close to the rails with consequent passage of current to the gas mains sufficient to raise the potential above that of the water pipes. The same conclusion was arrived at when gas was found + to water beyond First. The tests at the corners only were continued to Sixth on both Harrison and Bryant, and while on Harrison nothing was found to show that the tests were too far apart, on Bryant the gas became so much positive to water in some places that it seemed certain the track must be wired to gas pipes in some places, especially at Third and Fifth, with possibly a wire to both pipes at Fourth (and Bryant).

The changes from one street corner to the next were very marked, and as the blocks in that portion of the city are very long it was considered essential to make tests between those originally made (in order that the instructions of the gas company to determine every possible fact might be carried out). This was done, and the conditions found in the middle of the blocks differed so greatly from those found at the street crossings that it was determined to work back and test the half blocks. These tests brought to light the remarkable variation of potential relations between the two pipe systems recorded above, and furnished data that appeared to point certainly to wires between track and gas pipes at more than one point.

The first point noted was when testing between Fourth and Fifth on Bryant. An examination of the data given above will show that when a car passed Fourth or Fifth the gas between Fourth and Fifth became suddenly considerably more positive to water than it had previously been, and it was supposed this could only be due to a wire between track and gas pipe at Fifth, and possibly one at Fourth. It was supposed that if when a car passed a certain point one of the pipes became highly + to the other, quickly falling again when the car passed beyond the point, it denoted a wire at that point in virtue of which one system of pipes was made to receive a heavy current, and hence have its potential raised above that of the other. It was assumed that if when cars passed a particular point one pipe was always more + to the other than when cars passed any other point, that point was where a wire would be found. A number of wired points (to water pipes) were located by this method, but later considerations will show that the rule is by no means infallible.

The next point of special note was found when testing in the middle of Stanley place between Bryant and Harrison. There it was found that gas was generally neutral, or but slightly + to water until the car reached the top of the grade and turned into Harrison street, when it suddenly became + to water, as noted in the data given above. This was entered in the test record as a sure indication of a wire to gas pipe at that point, and it seemed to be confirmed by the fact that when testing at Rincon place gas was also found to be + to water to a very considerable extent. A very peculiar circumstance, however, was the fact that when testing at Harrison and Stanley place, the point of supposed wiring to gas, the pipes were found to be practically neutral, contrary to what should be expected if one of the pipes was wired.

The fact was recognized that if the pipes came close together at that point (in fact, the two 4″ mains cross each other almost in contact) so as to equalize the potential between them, and if there was a considerable drop of potential over one of the pipes, the condition found in the middle of the block would be easily explained, but with the volume of current likely to be present in any one branch of a large network of pipes metallically connected at every street crossing, it was not considered possible there could be a sufficient drop of potential in a short length of pipe to cause the variations noted. Of course, if there was a reading between two pipes at one point, and none at another, and both were continuous between the two points, one must show a drop, but it was known that in some blocks the pipe systems were not continuous, a main coming toward the middle of a block, from both ends, and it was thought possible this might be the case in this instance.

In one or two places a test for drop over about 75′ of gas pipe was made and none found. The tests for potential relations were continued, and changes were found to occur at such intervals that it was evident there must be considerable drop over short lengths of pipe, and further tests demonstrated the fact that everywhere along the line of the road, and for considerable distances in the outlying territory, there was a very considerable drop over short lengths of both pipe systems, but that it was greater in the water pipes than in the gas pipes. This fact being determined, it was evident that a new method of testing had been discovered which, taken in connection with the methods previously employed, would not only enable wired points to be closely located, but also show to which system the wire was attached.

If there was a wire at a certain point, and a test for potential relation between the systems was made at that point, this test would certainly indicate to which system the wire was attached, because even if the mains were crossing close together, and even lying directly upon each other, the heavy coatings of comparatively highly resisting rust would prevent instantaneous equalization of pressure and the system to which the wire was attached would momentarily have its potential raised above the other. It has been seen, however, that the test may apparently indicate the presence of a wire at some distance from the test point, and this wire may not exist or there may even be a wire to the *other* system at that point.

This can be determined by the test for drop of potential, since such drop can everywhere be found. If there is a wire at any point the current entering the pipe will flow in all four directions, if the wire is at a street crossing, or in both directions if it is at the middle of a block, and consequently there will be a fall of potential in either direction from a wired point. As a drop of potential can everywhere be found the direction of current in the pipes can everywhere be determined, and by testing in the neighborhood of a suspected wire, if the wire really exists the current will be in opposite directions on each side of the point; while if after passing a suspected point there is no charge of current direction it is certain there is no wire there.

This new method of testing was applied at several points where possible gas wires were indicated with the result that it was shown conclusively that such wires did not exist at those points. The record of tests shows that in the neighborhood of Harrison and Stanley place the fall of potential and consequently current flow was always in the same direction both over water and gas pipes, proving that there was no wire at that point, as at first supposed. About 110′ down Harrison from Stanley place gas was considerably + to water as previously noted. Openings were made at both ends of the turn at Stanley place and Harrison, and between the opening at the Harrison street end of the turn and 110′ down Harrison there was a fall of $\frac{1}{8}$ volt over the gas pipe and $\frac{1}{3}$ over the water, the point down Harrison being + on both pipes. This made gas $\frac{1}{4}$ volts + to water at the Harrison street end of the turn, and yet the two pipes were neutral 25′ from this opening at the point where they cross at the head of Stanley place. Similar tests down Stanley place showed a much greater drop over water than over gas, thus accounting for the fact that in the middle of Stanley place gas was considerably + to water.

Tests on Bryant from Third to Sixth showed that there was no wire to either system except the one to water at Fourth, and the fact that gas was so generally and highly + to water in that region was due to very heavy fall of potential over the water pipes.

On the Eighteenth street branch many peculiarities were noted, and of these the results obtained by testing on opposite sides of Castro street seemed hardest to explain. (On Castro street a cable road crosses the electric road.) The results found were of the most contradictory character and the tests for potential relations gave no data by which any possible explanation could be offered for the marvelous changes which occurred in short distances, but when the tests for drop of potential were applied new data was obtained by means of which a very simple and complete explanation could be offered, thus showing the great value of this method of testing when used in conjunction with tests for potential relations.

The tests for potential relations on the northeast and northwest corners of Eighteenth and Castro gave the following results:

Eighteenth and Castro, east side.—Cars ran only every twenty minutes on this branch, and when no car was running water was steadily $\frac{1}{30}$ volt + to gas. When car started to come up 18th street water slowly became more + to gas until car was at test point, when it was $1\frac{1}{4}$ volt +.

As car passed over the Castro street cable track the potential relation was reversed, and with car 75′ west of test point gas was $\frac{2}{15}$ + to water, this reading increasing to $\frac{1}{4}$ + when car was one-half block above Castro; $\frac{1}{4}$ volt + held while car was moving over the next block and a half, after which a considerably steeper grade was reached, and gas rose to $\frac{1}{3}$ + to water, this being the maximum value, which held for some time while the car was climbing steep grades. As the car receded the positive condition of the gas slowly fell to zero, after which gas and water varied about $\frac{2}{15}$ volts + to each other. This + condition slowly subsided, and water became steadily $\frac{1}{30}$ + to gas as at first. These reversals on opposite sides of Castro could evidently be explained if there was a wire to the water pipe on the east side and one to the gas pipe on the west side and the electric road was not bonded across the cable track, the cable slot thus forming a complete metallic break in the ground circuit of the electric road.

With car coming up 18th the water pipe was at first $\frac{1}{3}$ — to the track, but this reading quickly fell, and the pipe and track became neutral when the car was about three blocks below Castro. Then the pipe became + to the track, reaching a maximum of $\frac{2}{15}$ + when car was almost at test point (this seemed strange as the pipe was + to the source of its own potential).

As car crossed Castro street (going west) water again became $\frac{1}{10}$ — to track, and at the same time gas and water approached a neutral condition, reading ± to each other for a short time, then gas becoming steadily + to track, reading a value of $\frac{1}{4}$ volt, which held for some time as car climbed grade. This fell as car receded and finally track again became + to gas. At the same time that gas and track were changing potential relations gas and water were doing the same.

Eighteenth and Castro, west side.—With no car moving within long distance of test point, gas was steadily $\frac{1}{30}$ volt + to water. With car coming through 18th from Guerrero gas remained steadily + to water as long as the car was on the east side of Castro, reaching a maximum value of $\frac{1}{10}$ volt with car just east of Castro. As soon as car crossed Castro the potential relation at once changed, and water became $\frac{1}{2}$ volt + to gas. As car passed up the line this reading slowly fell, the pipes varied about $\frac{1}{10}$ + for a time, then gas became steadily $\frac{1}{30}$ + to water, as at first.

As car came up 18th toward Castro, gas was at first $\frac{1}{15}$ volt + to track and water just perceptibly + to track. As the car approached Castro gas became neutral to track and track became $\frac{1}{10}$ to $\frac{1}{15}$ + to water. As soon as car crossed Castro the track became $\frac{1}{4}$ + to water and about $\frac{1}{2}$ + to gas, these potentials slowly falling as car passed up the track until track became neutral to both pipes, and finally gas became $\frac{1}{30}$ + to track, as at first.

The reversals of potential relation between pipes on this side of Castro will be explained if there is a wire to the gas pipe on the east side of Castro and a wire to water pipe on the west side, but this is exactly contrary to the indications found when testing on the east side. It is absolutely certain that no mistake was made as to which pipes were gas and which water on either side of the street (Castro).

Eighteenth street, 150′ west of Castro (same side of Castro as last test).—With car waiting at 18th and Guerrero the pipes were practically neutral (note that at last test under these conditions gas was $\frac{1}{30}$ + to water). As car came up 18th water slowly and regularly rose in potential until as car passed test point it was $\frac{1}{2}$ volt + to gas. As car receded the water potential slowly fell, and pipes became neutral.

The relations between pipes were perfectly regular; there was no reversal of relations as car crossed Castro, and in fact, no sign of the peculiar changes noted at each side of Castro This makes the conditions there seem all the more peculiar.

Nevertheless, Castro street was a critical point, for as car approached the east side the water potential slowly rose to $\frac{1}{10}$ + to gas, quickly rising to $\frac{1}{2}$ + as car crossed Castro. Tests for several blocks above and below Castro showed none of the peculiar changes found at Castro, as the potential relations between pipes were perfectly regular, but all pointed to the cable track crossing at a critical point. (It must be remembered that there is a continual grade up 18th, and only cars going up can have effect, as the down cars run on brakes.)

When these results were found, the fact that drop of potential over a few feet of pipe could everywhere be noted was not recognized, and later tests for drop of potential were made, which cleared up the mystery. The tests for drop of potential were made about two weeks after the original tests for potential relations, and before making them it was considered advisable to make new relation tests in order to be sure no mistake had originally been made. This was done, and the surprising fact discovered that on both sides of Castro the tests agreed in character, no sign of the reversals previously found existing. The test on west side of Castro was the same as at first, but on the east side the test was the exact reverse of that originally found. This was most surprising because the original tests were made with extreme care. Another test was then made 175′ east of the original est on the east side, and the relations were exactly in accord with those originally found on the east side, and exactly the reverse of those now found on both sides. This being the case it was certain that the original test was correct, and that in the interval between the two tests some change had taken place to throw the peculiar changes found on east side still further east. The reversals of potential relation now seemed all the more remarkable because they occurred in 175′, both points being on the same side of Castro.

The tests for drop of potential gave results as follows: From east side of Castro to the point 175′ east the drop over gas pipe was east to west, slowly increasing as car came up 18th, reaching a value of $\frac{1}{5}$ with car near lower contact point and dropping to $_{15}$ volt with car at Castro. As soon as the car crossed Castro to the west side, contacts on gas pipe remaining as before, the drop became west to east $\frac{1}{6}$ volt, slowly falling to zero as car receded. This current direction in the pipe is exactly the reverse of what it would be if there was a wire to gas pipe on the east side of Castro, proving conclusively that there is no such wire. Over the same length of water pipe on the east side of Castro the drop was $\frac{1}{30}$ east to west before the car started, 1 volt east to west with car about a block below Castro, $1\frac{1}{2}$ volts with car near lower contact point, and $2\frac{1}{2}$ volts when car started near the east side of Castro.

Further tests located a wire from track to water pipe about one-half block on both sides of Castro, but none immediately on either side of Castro.

It is now easy to give an explanation of the peculiar changes that occur at this point, due regard being given to the fact that the electric track is not bonded across the cable slot, and that the ground circuit is thus broken. This being the case the movement of a car on one side of Castro street can have no effect upon the potential of the track on the other side except as current may pass from one side to the other through the water pipe.

It will be remembered that from 175′ east of Castro to Castro there was a drop of from 1½ to 2½ volts east to west over the water, and but ⅓ volt east to west over the gas, so that whereas 175′ from Castro water was + to gas, yet at Castro gas was + to water. The currents producing these drops were largely introduced through the wire to water pipe located a half block below Castro, and the effect would extend across Castro in the pipes, making gas on the west side + to water as car approached Castro, notwithstanding the fact that there was a wire to water and none to gas. With the car on the west side the current to the pipes would cease to pass to the pipes through the wire below Castro, as the track was not bonded across the slot, while the wire a half block above would pass current to the water pipe with the result that the water pipe would reverse potential and become + to the gas. The direction of current with car on west side was the other way, and the drop was west to east, and since the east to west drop from 175′ below Castro to the corner was much greater for water than for gas, the same would be the case for the west to east drop, with the consequence that though water was + to gas just at the east side when car was on the west, yet 175′ below Castro gas would be + to water as was found. Thus every fact relating to the peculiar reversals of potential is accounted for. Exactly similar reasoning will account for the original readings found on east side of Castro by supposing that there was a highly resisting joint in the section of pipe spanning Castro, and the change found two weeks after the original test must in some manner be due to the breaking down of that resistance, so that on both sides of Castro the potential of the water pipes would be practically the same.

With regard to the theory that a breaking down of resistance could occur, some tests were made to determine whether the drop in pipes was due to the natural resistance of the pipes or whether artificial resistances at the joints were the determining causes. Many joints were uncovered and contact made just across them, and generally some drop could be noted, and in some cases it was large. Generally it varied from $\frac{1}{100}$ volt to ¼ volt, but in one case over one joint there was a drop of 1⅓ volts, the current being simply that which leaked to a service passing under the track, and hence of small amount. Where several joints were tested and the drop over each determined, a test for drop over the pipe including these joints gave a drop equal to the sum of the drops over the joints, and if several joints in succession gave no drop none would be found over the pipe including them. These tests were made both in the immediate neighborhood of wires to pipes and long distances away, and it was determined beyond doubt that for such volumes of current as are likely to be found in pipes even under the most adverse conditions, the conductivity of a line of pipes has no relation whatever to the section of metal in the pipes, but is entirely determined by the joints. The San Mateo track was wired to the water pipes under the impression that they would be the best conductors, but in this city it is certain that the joint resistance of the water pipes is on an average much greater than that of the gas pipes, and that the latter are the best conductors. This is probably due to a difference in the methods of preparing pipes and joints by the two companies.

Between the region where the track is permanently + to the pipes and that where the pipe is permanently + to the track there will, of course, always be found a zone where the potential relations reverse, these reversals occurring very frequently and being governed by the movement of the cars in the neighborhood. The limits of this zone will vary at different hours of the day, depending upon the load. In applying remedies this region of reversals will not be considered, but a portion of it must be treated as having pipes permanently + to the track, and the other portion as having track permanently + to the pipes. Outside these limits tests taken at considerable distances apart for potential relations between pipes and track will be sufficient, because once the region of definite relations has once been fairly entered, though the potential differences will vary greatly, yet the character of the readings may be expected to remain constant, nevertheless it may happen that conditions will be encountered that will cause a reversal of potential relations in unexpected places. The test records show several places where the pipes for short distanes become + to the track where the track was + to pipes for long distances on both sides of these short stretches.

These reversals depend upon local conditions and have no relation to the general character or controlling factors in the surrounding region. They may occur on the lower reaches of the road farthest removed from the power house. It need not be considered certain, however, that such places are dangerous for the pipes, but rather the contrary, for the conditions acting to produce such reversals will in themselves prevent any passage of current. These cases emphasize the fact that conclusions drawn from potential relations alone may be entirely erroneous unless due regard is given to the other conditions, principally the resistance between the conductors. Where there is a high potential difference it may happen that the resistance is so great that no appreciable current can pass.

The test on the east side of Castro and 18th street showed that as the car came up 18th the water pipe became + to the track. A short distance above Castro street are two streets, Diamond and Eureka, between which this effect was very pronounced as the following record will show:

Eighteenth, between Diamond and Eureka.—When no cars were moving within long distances of test point the pipes were neutral to each other and both steadily ^{5} volt — to track. When car came up 18th street the water pipe remained — to track until the car crossed Castro, when the negative reading at once became less and continued to decrease as the car approached test point. The pipe and track became neutral with car one and a half blocks below test point, after which the pipe became + to track, reading a maximum of $\frac{1}{10}$ volt with car at Diamond and holding this until car reached Eureka, after which it slowly fell and finally track again became +. When the car started at Castro or any point between that and test point the track potential, instead of increasing as it might have been expected to do, decreased and became less + if car started at Castro, and if car started where the water pipe was + to the track the pipe became more + instead of less, as might be expected. If the car stopped when the pipe was + to track the track at once became + to the pipe, but at once became — when the car started. This seemed very peculiar, as the pipe apparently became + to the source of its own potential. This peculiarity was only between water pipe and track. The water pipe steadily increased its potential relatively to the gas, becoming ⅞ volt + with car near Diamond or Eureka, and the track was at all times + to gas. With the conditions known the explanation was simple. It was found that at every street crossing for several blocks above and below Castro the track had been wired to the water pipe, such wired points being at both Diamond and Eureka a half block above and below test point. In the neighborhood of these wired points the potential of the pipes was nearly that of the track. The track bonds in the middle of the block were in a very poor condition, and hence the drop of potential over the track was greater than that over the pipes, with the result that whereas at the corner the track was + to pipes, yet in the middle of the block the pipes were — to the track. The + condition of pipes in all such cases was of brief duration and would disappear entirely with a rebounding of the track, but even if it was permanent no damage could be done, as the conditions producing it would in themselves prevent the passage of current.

On Stanley place the pipe was + to track, but the conditions were different from those found on 18th street. Here the pipes were + to the track at all times (reaching as high as 2 volts), except when a car was climbing the grade from Byrant to Harrison, when the track was +. The explanation of this probably is that the bonds were badly broken at both ends of the grade, thus preventing current following the track when cars were some distance away. There is a break in the pipes on Harrison street in virtue of which a considerable portion of the current in the pipes is forced down Stanley place, thus considerably raising the potential and making these permanently + to track. Nevertheless, the condition was not necessarily dangerous for the pipe in that block, because even if the resistance between track and pipe had been low the broken bonds would cause the current to remain in the pipes rather than pass to the track. The same conditions would cause the track to be + with a car in the block. The broken bonds would largely prevent the current leaving the block via the track, and would force leakage to the pipes.

Flashing at the joints showed that the bonds were broken and when they were remade the track became + to pipes.

(To be continued.)

Electrodynamic Machinery.—XXIX.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

149. Even in the best designed types of electrodynamic machinery there are certain losses of electrical energy which necessarily occur in the operation of the machine. These losses may be grouped under the general heads of frictions and include mechanical, electrical and magnetic frictions. Since in certain types of machines the efficiency may be as high as 95 per cent., it is evident that the losses from all these causes combined can be kept within a small percentage of the total output.

150. This high efficiency, however, can only be obtained in the case of large machines. In those of smaller output the proportion of the losses may be much greater. It is, therefore, advisable to examine the causes of these various losses, their variation with the output of a machine, and the means by which they are commercially reduced.

Considering first the mechanical losses. These may exist as friction in the bearings of the moving parts of the generator, friction arising from the pressure of the brushes on the commutator, or contact parts, and friction from air churning. Journal bearings are lubricated either by sight-feed oiling or self-oiling devices. In sight feed oiling devices, a glass oil cup, filled from time to time with oil, allows oil to drop slowly on the journal bearings, but requires to have its outlets opened by hand when the machine commences to run and also to be stopped when the machine stops.

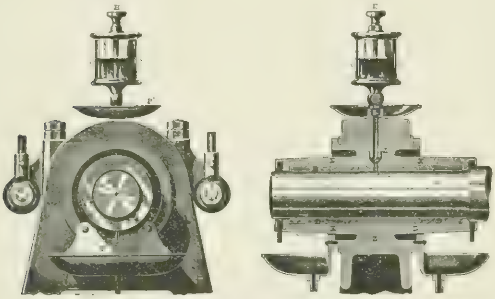


Fig. 137.—Sight Feed Lubricated Bearing.

Fig. 137 represents an end view and longitudinal section of such a bearing. The oil cup *CC* is provided with a head *H*, by the rotation of which an outlet in the base is adjusted. The oil descends by gravity to the shaft *SS*, where, by the movement of the shaft, it is mechanically carried through spiral grooves on the inner surface of the babbit-metal sleeve *BB*, passing finally, from the ends on the bearing, into the pans *FP*, whence it is drawn off at intervals and filtered.

The upper pan, *P*, is intended to catch any overflow of oil that may occur during the process of filling. The box *XX*, enclosing the babbitt-metal sleeve, is capable of rotation within small limits, about a vertical axis, upon the spherical surfaces *ZZ*. This play admits of the true alignment of the bearings to the shaft *SS*. As soon as the shaft has been introduced and becomes self-aligned, any further undue play in the bearing is prevented by tightening the nuts *NN*.

151. Sight-feed lubricating bearings necessitate the opening and closing of the oil cup at the starting and stopping of the machine. They have been, consequently, almost entirely replaced by self-oiling bearings which require no such attention; here the oil is automatically fed to the revolving shaft by its rotation. A self-oiling bearing of this description is represented in Fig. 138. The oil is supplied to the bearing into the oil well *OO*, through a screw hole *h*. During the rotation of the shaft *SS*, two rings *r*, *r*, which rest upon the upper surface of the shaft, and dip into the oil within the well, are set in rotation and carry oil on the surface of the shaft, where it is spread over the bearing along suitable grooves in the babbit-metal sleeve, as in the previous case. Grooves are made in the upper surface of the babbitt-metal sleeve for the reception of the rings, and the rings are prevented from leaving the grooves by the screw clips *m*, *m*. The rings are carried around by the friction caused by their weight as they rest on the shaft, and, therefore, do not necessarily rotate as rapidly as the surface of the shaft. The babbitt-metal sleeve, which holds the shaft, is contained in a cylindrical box with a spherical bolt *B*, at its centre. A pin or projection *p*, at the bottom of this box, engages in a hole in the frame work thus preventing the box from rotating with the shaft, but enabling the shaft to align itself freely in the sleeves. Nuts *n*, of which only one is seen, clamp the box *B* in position. A draw-off cock is provided at *d*, for withdrawing the oil from the well at suitable intervals.

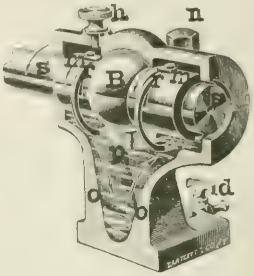


Fig. 138.—Detail of Self-Oiling Bearing.

152. Fig. 139 represents a longitudinal cross-section of a similar bearing employed in machines of larger size. Here oil is fed through two openings *f*, *f*, and accumulates in the lower part of the hollow cast-iron support *SS*. The rings *r*, *r*, by their revolution upon the shaft carry the oil into the babbitt-metal sleeve *b b b b* as before. The shaft is supported upon the bracket *p p*, which forms part of the pedestal or support *SS*, and is hollowed spherically so as to permit of the alignment of the babbit-metal sleeve and its box. Fig. 140 shows a general view of the babbitt-metal sleeve with grooves for the reception of the oil groove rings and with lugs *L*, *L*, *L*, for assisting in the aligning. Fig. 141 represents partly in elevation, and partly in longitudinal section, a similar bearing sometimes employed in still larger machines, differing from the last described only in details of construction. The weight of the shaft is taken directly upon the lower half of the bearing *BBB*, which has its lower surface bowl shaped, and fitting into a pedestal or support *SS* in such a manner that the bearing can be readily aligned and finally tightly secured in place by suitable bolts. The gauge glass *T* enables the level of the oil in the bearing to be clearly discerned.

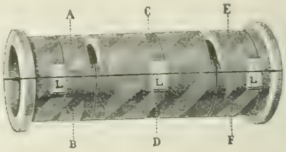


Fig. 139.—Longitudinal Section of Self-Oiling Bearing.

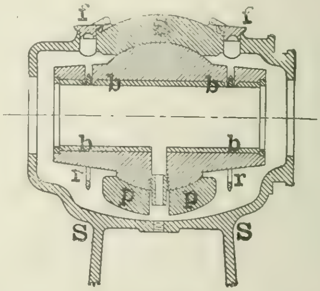


Fig. 140.—Sleeve of Babbitt-Metal in Journal Bearing.

153. The amount of energy expended as friction in journal bearings varies with the weight supported on the bearing, the accuracy of the workmanship, the correctness of the alignment, the nature of the lubricating material, the character of the surfaces in contact, and the diameter of the shaft.

Other things being equal, the energy expended is proportional to the diameter of the journal in the bearing. In order to keep the friction as low as possible, the diameter of the journal is always kept as low as is consistent with ample mechanical strength.

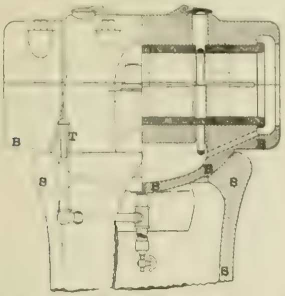


Fig. 141.—Details of Large Self-Oiling Journal Bearing.

The power expended in brush friction depends upon the number of brushes and the pressure with which they bear upon the commutator. It also increases with the diameter of the commutator and with the speed of rotation of the armature. This waste of energy is often an appreciable fraction of the total waste in a small machine, but is usually quite negligible in a large one.

(To be continued.)

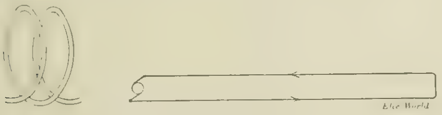
Electrical Power Transmission.—XVIII.

BY LOUIS BELL, PH.D.

The special difficulties to be met in working with alternating currents are two—inductance in the line and apparatus, and electrostatic capacity, bringing with it the very serious phenomena of electrical resonance. In addition to these, whatever the character of the current used for transmission purposes there is danger of getting accidentally upon the line a voltage much higher than the normal. Inductance is met with to a very considerable extent in all alternating circuits; resonance in a small degree is probably much commoner than is generally supposed, and abnormal voltage, due to the generators themselves, must always be guarded against.

Passing at once to the practical side of the question, we find that when an alternating current is sent through any conductor it has to deal not only with the electrical resistance of that wire, but with a virtual resistance due to the fact that the electromagnetic stresses set up at any point of the conductor set up electromotive forces at other points in the same conductor, which oppose and retard the passage of the current.

For example, if a wire be bent into a couple of spiral coils like Fig. 27, the electromagnetic field of one coil will affect the other just as we have induction from one separate ring to another in Fig. 4. If such a spiral has an iron core, this *self-induction* will be much increased. Even if only a straight wire be concerned in the carrying of current there will be a similar inductive relation between the inner and outer portions of the wire at any point, since the electromagnetic stresses exist inside the wire as well as outside.



Figs. 27 and 28.

Let Fig. 28 represent a circuit carrying an alternating current, which at a given moment is flowing as shown by the arrows. The electromagnetic field set up by this current in the loop has a direction perpendicular to the plane of the paper and sets up an E. M. F. opposing that of the wire. The greater the area of the loop, *i. e.*, the farther apart the two wires, the greater proportion of the electromagnetic field will pass *within* the loop and produce self-induction.

Similarly the larger the wires for a given distance between them, the less effective field within the loop to set up inductance. In fact, the amount of inductance in the circuit depends directly on the ratio between the radii of the wires and the distance between them. So if the diameter of the wire is decreased to one-half the original amount, the wires must be strung one half as far apart in order to produce the same inductance.

The practical effect of inductance in the line is to necessitate the use of an initial E. M. F. large enough to overcome the inductive loss of voltage, as well as that due to resistance, and so keep the E. M. F. at the receiving end of the line up to its proper value. The simplest way to take account of inductance in figuring a line is to treat it as an additional resistance, which, while it does not materially increase the energy lost in the line, must be taken into one's calculation of the E. M. F. to be delivered by the generator. Its effect is to require a little greater generator capacity, *i. e.*, a machine giving, say, 1,050 volts, must be used when the effective voltage wanted is only 1,000. The combined resistance and inductance of a line is called its impedance, and this may be readily tabulated for common cases, giving the *impedance factor*—that is, the relation of the total impedance to the real line resistance. This is the easiest way of considering inductance in line computation.

The following table gives the impedance factors for wires from 0000 to 6 B. & S., for 120 and 60 cycles per second, and for a uniform distance between wires of 18″. The impedance factor increases with the size of wire because the resistance decreases so rapidly for larger wires, and the question of length of wire does not enter, because both inductance and resistance increase directly with the length, so that they are always proportional. The inductance E. M. F. increases with the cycles since the field in the loop changes more rapidly, and, therefore, gives a greater E. M. F. of self-induction.

No. Wire.	Impedance Factor.	
	60 periods.	120 periods.
0000	2.3	4.3
000	2.0	3.7
00	1.79	3.08
0	1.53	2.54
1	1.39	2.16
2	1.28	1.85
3	1.19	1.61
4	1.12	1.42
5	1.08	1.30
6	1.05	1.21

The figures in the table are for a complete metallic circuit, consisting of two parallel copper wires, and the impedance factors may be applied at once either to determine the virtual resistance of a given wire, or the total drop of voltage that will take place on a given circuit. Suppose, for example, that we have an alternating circuit composed of No. 1 wire, delivering 1,000 volts at the receiving station. Suppose the volts lost due to resistance alone at full load current are 90, and the plant is working at 60 periods. Then the total loss in volts will be $90 \times 1.39 = 125.1$, and the voltage of the generator must be 1,125.1 in order to give 1,000 volts at the end of the line; and so on for any load on any size of wire. It is apparent that it is undesirable to use very large wires for high frequency alternating currents, and in some cases it is better to divide the circuit, using two No. 1 wires, for instance, instead of one No. 000.

It must not be forgotten that one of the effects of inductance is to cause the current to lag behind the E. M. F. so that for the delivery of a given amount of energy at the receiving end a current larger than the watts divided by the E. M. F. must be delivered by the generator, which must be of corresponding capacity. This increase may amount to 10 or 15 per cent., according to the character of the load, often less, and rarely more.

Intimately connected with this is the fact that in finding the voltage at any part of the system account must be taken of all the impedances in circuit, for they are not generally in the same phase, so that their vector sum is almost always less than their algebraic sum. Hence, while the impedance factor applied to the line will give correctly, neglecting line capacity, the drop produced in each line wire, the voltage across the terminals of the line will often be greater than that figured from the impedance factor applied to the line alone. This difference is, generally, not great unless there is capacity at the receiving end. All these considerations complicate the exact computation of a system, and unless its character is thoroughly predetermined, no exact computation can be made.

Practically these complications can be largely brushed aside in designing a plant. In very few cases will the impedance factor of a line be over 2, which means generally that the whole matter can be taken care of by an increase in generator voltage of less than 10 per cent.

It should be noted that the impedance factors given can be applied at once to three-phase circuits, in which the wires are equidistant. The impedance factor of such a system is the same as that of any pair of the wires. Really the most serious practical difficulties in an ordinary alternating plant are those in which the generator is involved by inductances in the system. These are of far greater moment than the impedance factor of the line. An inductance in the system produces two effects on the generator—first, as just noted, it demands a larger current to deliver the same energy; second, it tends to beat down the E.M.F. of the machine. This effect is analogous to that produced by shifting the brushes of a continuous current generator away from the position of maximum E.M.F.

This reaction of the armature is serious in that it not only demands a considerable increase in the exciting current, but causes a severe strain on the insulation when it suddenly ceases. It is not uncommon to find an alternator that requires on a heavy inductive load double the light-load excitation of the field. For instance, if the voltage be 2,000 on open circuit, the excitation may have to be increased on inductive load to a point that on open circuit would give 4,000 volts. If, now, this load is cut off, or the line is broken, the insulation will be exposed, momentarily, at least, to double the normal voltage.

Such generators should not be used on inductive loads or in any case where the extra strain on the insulation is important. It is perfectly easy to build a generator which requires only 15 to 25 per cent. more excitation at full and inductive load than on no load, and such machines should be used in all cases where a steady voltage under all working conditions is needed. The other type has its uses, but the general work of power transmission is not one of them. With a properly designed machine, inductive load is not in the least to be feared.

Another possible source of danger is that under certain conditions of inductive load the reaction of the load on the generator, without materially lowering its effective voltage, may so change the shape of the E.M.F. wave as to give to it an abnormally high maximum, and thereby greatly increase the strain on the insulation. This effect may readily occur, but usually in so small a degree as to be of little moment. Occasionally, owing to a combination of severe inductive load and badly designed generator, the results may be somewhat formidable, the more so as the change takes place under heavy load and not as in the case just treated, only on open circuit or a sudden light load. The rise in voltage thus produced may amount to several times the nominal value. The same sound principles of design that insure good regulation under changes of load will obviate any danger of this kind. In fact, most of the possible disturbing factors in alternating current work become negligible in an installation carried out with due regard for the general principles of good engineering.

These abnormalities of voltage lead naturally to the consideration of another far more serious, due to the static capacity of the system. Of course, the fact that under certain circumstances capacity in the system will cause a lessening of the apparent "drop" on the line or even overcome it altogether and show a higher voltage at the receiving end than at the generator, is already known to the reader. This is, however, but a special, and, save for its convenience in connection with synchronous motors, a trivial case of the general phenomenon known as *electrical resonance*.

The practical importance of this has been but recently realized, although the thing itself is strictly analogous to very familiar occurrences. Suspend a heavy weight by a string a yard long or so, and then begin tapping the weight lightly with the finger. So long as the taps are irregular or bear no particular relation to the time of oscillation of the weight considered as a pendulum, the only effect will be slightly jerky vibrations. As soon, however, as the taps are so timed as to coincide with the swinging period of the weight, it will slowly get under way, and presently work up an oscillation of considerable amplitude. Each tap catches the weight at the end of the double swing started by the previous one and augments its motion.

Every system capable of oscillation is similarly affected by impulses coinciding with its natural period, which is determined by its physical properties. The property of increasing amplitude by synchronous impulses is generally known as resonance from the very marked way in which the phenomenon appears in sounding systems such as that composed of a tuning fork and the box (resonator) to which it is generally affixed.

(To be continued.)

Definition of a Polyphase System.

To the Editor of The Electrical World:

SIR: Under the heading of "A New Definition," in your editorial columns of March 9, two explanations are given as to the correct meaning of a polyphase or multiphase system of distribution. I have also read the definition advanced by Mr. C. P. Steinmetz, but I must confess that none seems to me to be correct.

The definition unnecessarily given in the excellent paper of Dr. Bell was probably inserted to create the impression that a difference exists between the monocyclic system and the Tesla two-wire system. Dr. Bell and Mr. Steinmetz give as the distinctive feature of a polyphase system, that its flow of energy is constant, and the latter refers also to a paper in the Transactions of the A. I. E. E., of February, 1892, where, no doubt, the advantages of the possibility of securing such results have been emphasized.* But does this mean that a fluctuating field or a fluctuation of energy would make this system anything else but a polyphased system? Let us assume, for example, a five-phase system of distribution, and that, owing to some cause, two or even three fuses have given out, and the motor (on which the load may have been reduced to a considerable extent) continues its work with two or three of the currents lagging in phase. Evidently the opening of the two or three circuits will cause a fluctuating field, or pulsating field, surely not a constant one, but could anybody call this distribution now anything else but polyphase?

To select the degree of constancy of energy as a sign for the different systems is a very weak attempt to find a difference having only a theoretical significance, and I am sure that before engineers knew enough to make this flow of energy constant it was a fluctuating one, and any other than a perfectly proportioned system will always show more or less deviation from a constant flow.

Mr. Steinmetz is, however, correct in asserting that the definition you give as the "generally accepted one," is, in reality, no definition; not, however, because there may be produced in a single-phase circuit currents differing in phase, but because a polyphase system has a given tangible and limited meaning; your definition, therefore, of "a system in which the apparatus operates through difference of phase" is certainly far beyond the scope of such a definition.

The fact is that polyphased currents may be utilized in a device without producing a rotary or shifting field by applying them on separate cores, and in this case the field may be a pulsating one in spite of the polyphase currents; again, a device may be operated by polyphase currents without coming under the heading of devices belonging to a polyphase system, and similarly, machines producing a rotary magnetic field are not necessarily devices belonging to a polyphase system. This is clearly indicated by Mr. Steinmetz's remark concerning the single-phase induction motor. It is now well-known that in such motors or some types of them the reaction of the armature on the field may produce a rotary or shifting field.

What then constitutes a polpyhase system? In my opinion, there need be no theoretical contention in regard to the currents and their time or effects. A system means not only one thing, but an aggregation of things, arranged in a rational connection or relation to one another, each depending on the particular construction performing a given function, and all parts together forming a harmonious and complete organization. In a polyphase system there are required, first, a source which produces polyphased currents, viz., two or more alternating currents differing in phase; second, receptive devices to utilize such currents, and third, transmission circuits to convey this particular form of energy from the source. In the system under consideration, a generating source produces a number of distinctly separate currents in separate, or interconnected, or defined circuits; devices are employed for utilizing such currents, provided with an equal number of circuits, a circuit for each current, and there are an equal number of circuit conductors for conveying the currents from the source to the place of consumption. This, in my opinion, holds good, whether all the circuits are utilized constantly or not, or whether the system is so thoroughly worked out that the energy supplied is constant or not. I doubt

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[*] The following is the passage referred to by Mr. Steinmetz in his letter.—Ed.]

"I wish to direct attention to one remarkable fact with regard to the polyphasal system. If we have, for instance, three polyphased currents (shown in diagram), and add their power curves together we get a straight line. That means *While in an alternating current system the instantaneous power values fluctuate twice during each period, between zero and a maximum, in a polyphasal system the instantaneous power values of the system remain constant, just as in a continuous current system.*"

very much whether there is any polyphase system on the market that can show constant supply of energy.

In a polyphase system there is, therefore, a generator of electricity having two or more windings inducing currents lagging in phase, the respective number of coils for each of said windings being, as regards the principle, entirely indifferent; a motor having corresponding circuits or windings, and wires connecting such circuits with their respective windings on the generator.

This definition would at once help Mr. Steinmetz over his trouble or objection; a device operated from a single phase source or circuit would not come under the head of polyphase apparatus, because the generator does at no time supply polyphase currents, nor are there enough wires to carry polyphased currents; if in a single-phase circuit devices are inserted, such as condensers or choking coils, or if by any other means the current is split and more circuits are provided on the motor to accommodate the split currents, such modification of the single-phase system does not come under the head of the polyphase system.

These questions seem to me to be more practical than theoretical, and only practical and tangible factors should be entered to determine the proper definition of a polyphase system.

CHICAGO, Ill. LUDWIG GUTMANN.

To the Editor of The Electrical World:

SIR: I agree heartily with Mr. Steinmetz's definition of a polyphase system. If polyphase or multiphase is to mean anything, it must mean that system in which the electrical power is constant at all instants throughout the duration of a complete cycle. This definition does not eliminate differences of phases; on the contrary, it includes all those alternate current cases of symmetry in which the rate of energy transformation is constant at all instants of the complete cycle. In all practical problems of power transmission you have to face the condition that the mechanical efforts that have to be exerted by the motor must be as uniform as possible throughout the complete cycle. With a polyphase system as defined by Mr. Steinmetz, no matter how light the moving parts of the motor might be, the motor would continue to do its work properly under all circumstances; other systems—single-phase, unsymmetrical-phase-difference systems, etc.—can only be made satisfactory where a sufficient flywheel effect can be gained, so as to apply with uniform effect the fluctuating power received from the generator. It seems to me that "polyphase system" must mean those systems that employ electrical circuits in which are developed amounts of electrical power that are constant throughout the time of a complete cycle, they are thus electrical systems that make things "go" without the flywheel. Without the flywheel effect the monocyclic motor would never be able to operate as such. Its most important working currents exist in a field that is produced by currents that owe their origin to mechanically produced E. M. Fs. in the secondary circuits. Now when the motor is at rest all mass-motion effects are absent, so that in starting up a motor of this type their places can only be fully supplied by the polyphase system as here defined.

In duplexing engines the mechanical engineer aims somewhat at the corresponding results produced electromagnetically by the polyphase system, while he does not realize such results to the same extent, and this is the reason why the direct current electric locomotive is the successful rival of the steam locomotive in a "tug-of-war."

The need of an alternate current system in which there is a uniform source of power was the original stimulus that induced men to develop the polyphase system, and this, it seems to me, must lead us to the conclusion that Mr. Steinmetz is right.

ITHACA, N. Y. HARRIS J. RYAN.

To the Editor of The Electrical World:

SIR: While it is true that we cannot have constant energy in an alternating current system without the use of polyphase currents, I do not believe that it is advisable to limit the definition of polyphase circuits to circuits which have this peculiarity, but rather to look upon such as one particular species of polyphased circuits.

For most purposes this peculiarity of constant activity is a valuable feature, but it is quite conceivable that in certain cases where the power transmitted is utilized through the means of a reciprocating movement, two currents differing in phase by, say, 45 degrees might be better than two currents differing by 90 degrees. In the former case the energy would not be constant, but it would be difficult to call them anything else than a polyphase system.

Even in a polyphase system, in practice, the energy is never constant, but varies, as the condition of constant energy is only attained throughout the system when the currents and voltages are sinusoidal, which is almost impossible of realization, though a close approach to it is made in the S-K-C system.

We have a somewhat parallel case in mechanical engineering. Compound or multiple expansion engines are generally so arranged as to give an approximately constant turning moment. But it would be obviously unfair to restrict the term "multiple expansion" engines to such as have their cylinders moving in different phases and giving constant turning moment, because in other classes of engines using more than one expansion, it is found advisable to have the pistons moving out of phase, and yet not giving constant turning moment. REGINALD A. FESSENDEN.

PITTSBURGH, Pa.

To the Editor of The Electrical World:

SIR: The term polyphase has always appealed to me as a generic name applying to all alternating current apparatus which requires for its operation two or more alternating currents differing in phase, or to alternating current apparatus which is intended for operation upon joint circuits carrying two or more currents differing in phase. A polyphase motor remains a polyphase motor, whether operated directly from a polyphase alternator, or from a single-phase alternator with a current splitter consisting of a condenser and an inductive coil intervening. If Mr. Steinmetz will grant the generic name nobody will dare dispute his right to apply any specific name he desires to such combinations as his great ability enables him to devise. D. C. JACKSON.

MADISON, Wis.

To the Editor of The Electrical World:

SIR: Regarding the question as to the proper definition of a polyphase system, I do not see that very much is to be gained by defining the system in terms of some of its properties. It would not be of any particular value to define a man as an animal that cooks his victuals, because that is a very small part of the story. The term polyphased indicates what is being discussed, but I do not see how the consideration of what is meant by a polyphased system is to be compressed into a definition. F. E. NIPHER.

ST. LOUIS, Mo.

A New Method for Deducing the Expression for Electromagnetic Force.

To the Editor of The Electrical World:

SIR: Will Dr. Hutchinson and Mr. Carichoff pardon me if I point out that the "new method" of deducing the expression for electromagnetic force, which they give on page 220, is already published on page 335 of the new edition of my "Elementary Lessons?" I may add that it was communicated by myself and Mr. Moorsom jointly, some ten years ago to the Physical Society of London, and has been taught to my students ever since. There is this difference, that incidentally I deduce the law of Savart and Biot instead of having to drag it in as a point in the proof.

LONDON, England. SILVANUS P. THOMPSON.

The Relative Values of Central Station Storage Systems.

In a communication received from Mr. Herbert Lloyd, of the Electric Storage Battery Company, exception is taken to certain figures given in a letter from Mr. N. W. Perry, printed in our issue of last week. It is stated that the price given by Mr. Perry for a storage battery plant is 50 per cent. higher than Mr. Edgar, of the Boston Edison, said was paid for the one recently installed by his company. Mr. Lloyd says that Mr. Perry did not distinguish between horse power and horse power hour, and calls attention to the fact that in figuring batteries at a 12-hour rate of discharge, the cost per horse power hour is of course much lower than when worked at an hour and a half rate, and that even when worked at an hour and a half rate Mr. Edgar's figures were $33.33 per horse-power hour, which would amount to about $24 per horse-power when worked at a 12-hour rate. Mr. Lloyd says it is a fact which cannot be disputed, that batteries can be installed to-day, of central station type, for this latter figure, and he offers the above table as giving a correct comparison between the various systems considered by Mr. Perry.

	Recapitulation.		Saving Effected.	
	Coal $1.75	Coal $3.50	Coal $1.75	Coal $3.50
Present method, steady load	48.68	65.62	...	.
Present gas engine	88.28	103.61	29.50	44.79
Combined feed and steam storage	94.42	111.35	23.36	37.05
Feed storage	97.58	117.58	...	30.82
Without storage, load factor 25 per cent	117.78	148.40	..	....
Steam storage	97.24	114.27	20.54	34.13
Complete battery storage	83.19	100.12	34.59	48.29

DIGEST

OF CURRENT TECHNICAL ELECTRICAL LITERATURE
COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS
BY CARL HERING.

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors, or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 922 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French, or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Air Gap.—"L'Eclairage Elec.," Feb. 23, contains a short article on the theory of dynamos by Mr. Farman. As the air gap is the greater part of the magnetic reluctance in the magnetic circuit, it is on first thought believed that it should be reduced as much as possible; practice, however, shows that this is not the case; dynamos constructed with a very small air gap will be found to require a large angle of lead of the brushes and do not generate as high a voltage as others of the same type having a larger air gap; the reason for this is the transverse flux generated by the armature which shifts the lines of force, increasing the angle of the brushes, and on this angle depends the counter magnetomotive force. The windings located in this angle develop a flux which tends to oppose that of the magnets. He gives a formula which shows that as the reluctance of the air gap is diminished the flux is not increased greatly and that there is a minimum value for the air gap. But even considering that this phenomenon does not affect the result, there is another and not so well known action, which is that in diminishing the air-gap one does not always diminish the magnetic reluctance on account of obliquity of the lines in the air gap; he discusses this algebraically, giving a formula for the obliquity, the effect of which is the same as increasing the air gap; he shows that there is a certain value beyond which there is no advantage in diminishing the air gap, as the obliquity becomes too great; he gives a formula from which he obtains a minimum value, which (with some difficulty) might be applied in practice to determine the best value for the air gap.

Reversible Regenerative Armatures and Short Air Space Dynamos.—The complete paper by Mr. Sayers (see Digest last week and March 9) is published with the numerous illustrations in the Lond. "Elec.," March 8; the lengthy discussion is also reprinted in full with the illustrations; the subject is also discussed in the leading editorial, in which it is claimed that in spite of the favorable reception of his first paper read about two years ago, it cannot be said that in the interval the invention has won much way into every-day practice; the discussion did not show whether this method, when tried by others, had been found successful or economical or both or neither; there appears to be no question that it results in lessening the total weight of the machine.

The discussion of the paper which was abstracted in the Digest, March 16, is given in full in the Lond. "Elec. Rev.," March 8, including two illustrations.

Parallel Running of Alternators.—In a communication to the Lond. "Elec.," March 8, Mr. Addenbrooke states that the difficulty at Coat. bridge (where the parallel running of gas engine driven alternators has been abandoned) is not the parallel running of alternators but it is a question of the margin of safety which he calls the "rectifying factor" in each type of alternator, that is, what alteration in the driving power or pressure, the phase of the current on the omnibus bars, will be sufficient to throw the alternator out and in that case what is the maximum current which can be forced through the armature; these questions he will soon consider in an Institution paper. The subject it discussed also in two other communications.

Ball Dynamo.—An illustrated description of a 100-light 10-ampere Ball dynamo, with automatic regulation, is given in the "Elec. Eng.," March 20.

LIGHTS AND LIGHTING.

Blackening of Lamp Bulbs.—"L'Elettricista," March 1, contains an article by Mr. Tolomei, a translation of which is given in full in another column.

Reflectors and Reflection.—An article in the "Zeit. fuer Beleucht.," Feb. 28, contains an editorial article in which attention is called to the fact that much care is taken by engineers to obtain a good efficiency in a lighting plant, but the subject of reflection and reflectors by means of which the light can be increased two and three fold at a very small extra cost or perhaps even for nothing, is often not considered at all. Reference is made to the paper by Dr. Sumpner (see Digest March 4, Sept. 29, 1894, and THE ELECTRICAL WORLD, March 18, 1894, p. 205) in which he shows the advantages of using diffusion surfaces, stating that the effect of whitewashed walls would be to increase the lighting five fold as compared with what it would be with black walls; the lighting engineer is recommended to consider the reflector as a true source of light and a very cheap one. The article contains nothing new.

Cost of Lighting.—Some tabulated figures taken from a French gas journal are given in the "Zeit. fuer Beleucht.," Feb. 28. The cost of a certain amount of light by means of electricity, oil and gas is given, as also the heat generated, efficiency, etc.

Lighting with Gas Engines.—In a paper by Mr. Langlois abstracted in "Elec.," March 9, he discusses the cost of lighting by gas and by means of electric lights driven by gas engines, showing that the former is over twice as great as the latter.

The Manufacture of Incandescent Lamps.—A detailed description by Mr. Krueger of the manufacture of the Siemens & Halske lamp is given in the "Zeit. fuer Beleucht.," Feb. 28.

Portable Projector Plants.—The illustrated serial by Mr. Brunswick is concluded in "L'Elec.," March 9.

Electric Lighting Statistics.—In the "Elec. Eng.," March 20, Mr. Wood discusses the subject of the cost of lighting by arc lamps with a view to comparing the cost in municipal plants with that in private plants. He reprints some tables recently published, the results of which are very favorable to municipal plants, but he points out that neither the interest on the cost of the plant nor the depreciation were included in the figures for the municipal plants; these two items represent an annual outlay of 13 per cent. of the total cost of the plant. He discusses the data compiled by Mr. Foster and compares it with the other tables, showing a very great difference in the cost per lamp per annum, which in some cases is over 100 per cent. He claims that the cost of lighting cannot be compared with sufficient accuracy by comparing the costs per lamp per year, illustrating his argument by deducting the costs of a candle power per hour; the relation of the latter figures is entirely different from that of the cost per lamp per year; although South Norwalk (municipal plant) pays less than half the amount per year per lamp paid by Buffalo to a private company, yet Buffalo gets almost twice as much light. (In reducing the figures to candles, the candle power of the light must be known, but as this is often a very uncertain quantity the figures based on it are equally uncertain.) In an editorial discussion in that journal the recent article of Prof. Meyers in the March number of "Political Science Quarterly" is referred to; he refers to the municipal lighting plant of Chicago, and shows that each lamp costs nearly $168 per year; it is believed that there is no city in the country that pays a private plant any such sum; the average price paid to-day for an all-night 2,000-cp lamp is from 35 to 40 cts.; he believes that it is extremely doubtful that the city has saved any money by operating a plant of its own prior to 1893 while during that year the expense exceeded considerably the amount paid for hired lamps.

Welsbach Light.—"Elec. Eng'ing" for March contains an article by Mr. Burton, advocating the use of arc lamps on alternating or constant potential circuits. Fifteen Welsbach burners equaling 900 cp, cost 10.3 cents per hour; one arc lamp of 900 cp, 4 cents per hour; two arc lamps of 1,800 cp, 8 cents; balance in favor of arc lamps, 6.3 cents, or 2.3 cents; 100 cp in arc light costs ⅔ of a cent an hour, and in Welsbach burners 1.14 cents per hour.

Recent Progress in Railway Car Lighting.—In a brief article in "Eng. News," March 21, the electric system is discussed among others, but only very briefly.

POWER AND HEAT.

Electric Power in Factories.—In a paper read three months ago by Mr. Alex. Siemens, abstracted with some of the illustrations in the Lond. "Elec. Eng.," March 8, and more briefly in the "Elec. Rev.," he describes the installation in the Siemens factory in which motors have been installed replacing to a large extent the separate steam engines and belt transmission; at present 72 motors are in use varying from 100 to ⅙ brake hp and amounting to a total of 1,407 brake hp; the output of the central station is 1,200 hp; before the introduction of electric transmission 18 steam engines were used; only very scant figures are given regarding the economy, but it is stated that there was a saving of 3,000 tons of coal in a year; as far as they go, his comparisons prove that electric transmission has been economical. Two tables are published giving results of tests in detail of several engines coupled directly with dynamos and showing a coal consumption per electrical hp from 4 pounds to 2.5 for about ⅓ and full load respectively; in another case from 4 to 3 pounds; the capital outlay per brake hp was 30 per cent. higher in the case of the old steam plant; the load factor is 0.28, showing that many more motors could be connected without fear of overloading the plant; the results show that electric transmission is certainly more economical than either separate steam engines or belts and ropes. A brief reference is made to a similar case in which the saving would be sufficient to pay for the outlay in 10 years.

Transmission of Power.—Two papers read at the Institution of Civil Engineers are briefly abstracted in the Lond. "Elec. Eng.," March 8; one describes a haulage plant at a colliery in which the daily output amounted to 1,200 tons; the cost of electric haulage was found to be less than half that of horse traction, there being an annual saving of about $10,000, the cost of electrical installation having been $17,500. The second paper describes an installation in which water power was applied by electricity to gold dredging; the power was transmitted electrically to the motors operating the dredges in different portions of a distant river thus rendering available the gold deposits in districts in which the scarcity of fuel would not permit them being worked by other means.

Transmission of Power in Norway.—According to the "Elec. Tech.," Feb. 15, an English company has obtained a concession to use two waterfalls aggregating 20,000 hp, one-half of which is to be transmitted at 10,000 volts to Christiania, a distance of about 24 miles; alternating currents are to be used.

Transmission with Synchronous Alternating Motors.—The "Bul. Soc. Int. des Elec." for February contains a paper of some length by Mr. Picou in which he discusses the various conditions in such transmissions by a purely graphical method based on the well-known diagram of Blakesley; the method appears to be quite simple and practical.

Percussive Drills.—In the Lond. "Elec.," March 8, Mr. Snell gives some data regarding the performance of a Van Depoele drill and of an air drill, showing that both are about equally efficient as regards rate of boring, but the cost of attendance and repairs of the electric drill is only one-quarter of that of the compressed air drill.

Windmills.—A small plant for experimental purposes is described and illustrated in the Lond. "Elec. Rev.," March 8.

Organ Blowing.—An electrical device is illustrated and described in the Lond. "Elec. Eng.," March 8.

Heating at the Vaudeville Theatre.—The heaters used are described and illustrated in the Lond. "Elec. Eng." and "Elec. Rev.," March 8. The current for warming the auditorium is 90 amperes at 100 volts, which at the rate of 8 cents per unit is about 75 cents per hour, or $3 for an evening, and it is believed that any other system would cost as much.

Power Development from a Mine Drainage Tunnel.—The "Eng. News," March 21, gives a brief description of a plant in which the drainage from the Ontario mine through a tunnel is utilized for developing power for lighting and other purposes; 90 hp are developed by Pelton water wheels driving a monocyclic dynamo of 816 incandescent lamps capacity; the current is transmitted six miles on three No. 3 wires.

Niagara-Buffalo Transmission.—The proposals submitted by the company to the city of Buffalo are discussed editorially in "El'ty," March 20.

Niagara Falls Plant.—The "Elec. Rev.," March 20, reprints a recent interview from Lond. "Lightning," with Prof. Forbes, in which he comments on Americans.

Transmission of Power Plant in Egypt.—The project of Mr. Prompt, mentioned in the Digest March 9, is briefly described in the "Elec. Rev.," March 20.

Boat Propeller.—An apparatus for a small boat is described and illustrated in the "Elec. Eng.," March 30; it consists of an electric motor placed on the handle of the rudder and connected by a flexible shaft with the propeller which is placed at the end of the rudder plate (similar devices have been described in these columns several times before); the whole apparatus can be hooked on to a boat in the same way in which a rudder is secured and it therefore can readily be attached to any boat; the tube in which the flexible shaft revolves is filled with oil; the weight of the batteries is said to range from 75 to 275 pounds (but for what capacity or duty is not stated); the weight of the motor and propeller combined is 35 pounds.

TRACTION.

Conduit System.—The Hoerde system is briefly described in "L'Eclairage Elec.," Feb. 23. Along the rails there are narrow plates of ridged iron separated from the rails by the slot; about every six feet are cast iron boxes with covers; the corrugated iron is in the form of a right angle having the conductor in the upper part; repairs can readily be made at these boxes; the lower part of the corrugated steel conduits is for drainage; the system is said to be quite cheap, costing but eight to ten dollars per metre (probably referring to the conduit only); an experimental plant is running at Hoerde, Westphalia. No illustrations are given and the descripion is somewhat meagre. A much more complete description is given at some length with the aid of a number of good illustrations in the "Rev. de L'Elec.," Feb. 28

Electric Railways in Europe.—According to a German engineering journal the number of electric railways in Europe on Jan. 1, 1894, was 43, with a total length of 174 miles; the total power represented was 10,650 kw; the number of cars was 538; the number of kilometres in the different countries was as follows: Germany 100, England 70, France 40, Austria 30, Switzerland 20, Spain 13, Italy 11, Russia and Belgium each 3.

Light Railways.—The subject is discussed in a long editorial in the Lond. "Engineering" and in the Lond. "Elec. Eng.," March 8.

Geneva.—A description of the system is published in the "Rev. de L'Elec.," Feb. 28.

Steam Railways in Italy.—An illustrated paper by Mr. Amoretti is published in Lond. "Elec. Eng.," March 8.

Protecting Pipes from Electrolytic Corrosion.—The "St. Ry. Rev.," March 16, contains an article of some length by Mr. Brown, in which he describes what he calls a method of permanently protecting underground pipes. He believes that nearly half of the energy generated by the dynamos at full load is wasted in the conductors to and from the motors; even with perfect feeder wires and rail joints the currents in the pipes are only reduced and they will still carry a considerable portion, suffering corrosion at the joints where the current leaves them. He discusses the three-wire system and its bearing on electrolytic corrosion, showing that it would be somewhat reduced but not eliminated and it would then be impossible to find out the condition of the pipes from electric measurements on the surface of the streets; even if perfect balancing were possible the claim that there will then be no damage he considers as untrue. There is no need of insulating rail feeder wires unless the rails also are insulated. He discusses the question of pipe feeder wires in which the negative terminal of the dynamo is connected with points on pipes which are positive to the rails; this ideal result is utterly impossible unless when broken or rusted bond wires are present in all the rails not far from the station. The three essential problems in a successful method are: To keep the pipes at least one volt negative to the rail at all points and at all times; to diminish as much as possible the flow of current on pipes; and to secure some permanent contact of low resistance between the pipes and the feeder wires. He describes a system in which an auxiliary dynamo has its negative pole connected, not to the rails but to the pipes, its voltage being 5 to 12 volts greater than that of the other generators; it should represent about one-quarter of the total capacity of the station; it should be connected by feeder wires to such points of the pipes which were positive to the rails, thus maintaining the pipes negative to the rails; the system has been used in Newark and when it was introduced it was said to have checked all further corrosion; the closing of the circuit of the auxiliary dynamo caused a drop averaging 60 hp in the station load, due to removing the resistance of the earth. The method is claimed to check electrolysis entirely except around some poor joints and these can easily be protected by a feeder wire; no continuous regulation of this auxiliary dynamo is necessary. In conclusion he describes the "perfect" rail bond, a description of which is given below.

Rail Bond.—What is entitled a "perfect rail bond" is described and illustrated by Mr. Brown in the "Elec. Eng.," March 20. He points out the great line loss in most railway circuits, showing the great importance of perfect bonding; he believes that very few electricians have suspected that there is in all copper bonding of steel rails a loss which does not depend upon the cross section, the contact area nor the mechanical perfection of the joint; he apparently refers to the thermoelectric difference between steel and copper which he says causes many times the loss due to the resistance of the copper alone. He mentions the experiments made in the Edison laboratory covering a period of several years in which hundreds of methods were tried including every practical combination of metals, but only a single one of these withstood the test and has proved to be a "perfect" rail bond; after a test of four years it showed no increase in the resistance. It is called the plastic rail bond and consists essentially of a flat piece of specially moulded cork cut in the form of a large washer 3⅞ inches outside, 1.5 inch inside diameter and ⅝ inch thick; this is placed between the fish plate and the web of the rail, the opening in the middle being filled with a plug of plastic metal surrounded by a steel spring, this material being a conductor and forming a very good contact with the rail and the fish plate; the surfaces of the rail and the fish plate are first cleaned and then rubbed with a special alloy discovered by Mr. Edison which is claimed to change any iron rust into pure metallic iron forming a bright deposit which repels water and will not corrode, forming what is said to be an iron amalgam; by tightening of the bolts, the cork is compressed to half its former thickness and it is claimed that if these bolts should slacken and the plate drop back one-quarter of an inch the cork will expand but will not allow the plastic material to run out; the material is said to remain plastic indefinitely. For cross bonding and for feeder wires a similar connection is made with the rail. He gives a table of the loss in voltage for various currents as also for a ⅝-inch copper bond made with the best mechanical contact of ten times its cross section; these results show that the drop in voltage is from 1-20 to 1-7 that of the latter, for small and large currents respectively. A description of this joint, but without the illustrations, is given in the "St. Ry. Rev.," March 15.

Rail Bonding.—The communication of Mr. Low (see Digest last week) is briefly abstracted in the "Elec. Eng.," March 20, in which an illustration of the joint is given.

Continuous Track.—The "St. Ry. Rev.," March 15, discusses continuous tracks, which it considers an assured success; it refers in detail to some of the roads where it has been used; such joints have stood the crucial test of the exceptionally severe winter better than was expected.

Trolley System on Steam Roads.—The "Elec. Eng.," March 20, contains a communication from Mr. Frenyear, who is in charge of an existing line in New York State, which parallels the steam road. The advantages of the electric railway, namely, frequent service and the utilization of the weight of car and passengers for traction, should not be sacrificed by using electric locomotives; the motor car mile expenses on that road have been about 1-6 of the train mile expenses on the steam road. The cars are 36 feet long, 8 feet wide and are provided with double trucks with 33-inch drivers; four wheeled cars should never be used on such lines; they are equipped with two motors of 30 hp each, but they should have been 50 hp and wound for high speed, there is nothing to prevent a speed of 40 miles an hour and the handling of trailers if 50-hp motors are used; the wheels and track should correspond to steam railway rather than street railway practice. It is perfectly feasible to operate a twelve-mile section from one power house with 500 volts; he believes the use of the alternating current is bound to come; he prefers the use of a large amount of copper rather than to resort to the three-wire system and the use of "boosters" except under unusually favorable conditions.

Electric Motors vs. Steam Locomotives.—In a short paper by Mr. Baxter in the "Elec. Eng.," March 20, he summarizes the advantages of electric motors over steam locomotives. The coal bill is only such a small item that even a very great reduction in it would not determine the superiority of one system over the other; other advantages of the electric locomotive are found more important; among these are: The cost of repairs, which is less with electric motors than with locomotives as the mechanism is far more simple; the miles run per day are greater with electric motors than with steam locomotives and therefore the cost of labor per mile run is much less and the amount of work done with a given sum invested in motors is greater than with locomotives; locomotives averaging 30 to 40 miles per hour do not make more miles per day than motor cars at one-third of this speed; locomotives are idle during a large part of the day as they have to be examined and cleaned; the weight of the train and therefore the power is less for electric traction, which also represents a saving of power and subjects the track to less strain.

Competition of Electric and Steam Railways.—The "Eng. News," March 21, gives a few figures showing how the receipts of certain steam railroads have diminished since the introduction of parallel trolley lines; it states that the average loss seems to be considerably over 50 per cent.; on one road it was 90 per cent. In referring to the projected line from New York to Washington it states that "when these lines are once in operation a struggle will be inaugurated that may result in completely changing our whole system of transportation."

Underground Railway in Budapest.—The "Eng. News," March 21, gives quite a full description of this railway accompanied by a large double plate supplement containing ilustrations of the tunnel, the roadbed and the cars; much of the data has already been given in these columns. Some illustrations are also given in the "Elec. Eng.," March 20, showing method of construction of the tunnel and the cars with their dimensions.

New York Rapid Transit.—The "Eng. News," March 21, discusses at some length the question of whether it is not a mistake to place the railway underground and whether more elevated railways or an addition to the present tracks is not the best thing to be done.

Street Railways in Budapest.—The "St. Ry. Gaz.," March 16, abstracts a descriptive, illustrated article from the "Review of Reviews."

Buffalo Street Railway Plant.—The power plant is described and illustrated in the "West. El.," March 23, in an article by Mr. Perkins.

Minneapolis & St. Paul.—The report of this railway is discussed in the "St. Ry. Rev." March 16; detailed items of the cost are given.

Storage Battery in a Railway Power Station.—A description of the plant in Zurich, an abstract of which was given in the Digest July 28, is published in the "St. Ry. Gaz." March 16.

Telephone vs. Trolley Companies.—A recent decision in Nashville, in which it was held that the street railway company is liable for damages except when due to induction, is discussed by Mr. Fisher in the "St. Ry. Gaz." March 16.

Conduit Systems.—The "Eng. News," March 21, gives a brief illustrated description of the conduits to be used in New York and Washington.

Motormen and Car Repairs.—An article by Mr. Reynolds is begun in the "St. Ry. Rev." March 15.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Method for Charging for Current.—The Wright method is commented on briefly in the Lond. "Elec.," March 8; it has resulted in a large net profit at Brighton; his plan is (see Digest Sept. 8) "to charge 14 cents per kw hour until the quantity consumed amounted to a use of the average maximum demand for at least two hours a day, after which only 7 cents was charged;" in view of the great profit reductions in price are to be made and meter rents are to be nearly done away with.

Combined Electric Lighting Station and Water Works.—The article mentioned in the Digest last week under "Profitable Plants for Small Towns" is translated in abstract in the Lond. "Elec.," March 8.

Cost of Working at the Portsmouth Station.—The discussion is continued in the Lond. "Lightning," Feb. 14.

Private House Plant.—An illustrated description of a small plant for a private house, driven by an oil engine, is given in Lond "Elec. Rev.," March 8.

Sondrio.—"L'Elettricista," March 1, contains an illustrated description of an electric lighting plant in this city (Italy) which was recently started; the power is generated by three vertical turbines driving three Brown alternators by means of gearing; the output is 25 amperes at 2,000 volts each; the current is carried to the town by an overhead line two miles long after which it is transferred down.

Wolverhampton.—An illustrated description of this station is published in the Lond. "Lightning," Feb. 7.

Blackburn.—Lond. "Lightning," Feb. 21, contains an illustrated description of this station.

The Monocyclic System.—"Elec. Eng'ing" for March contains an editorial showing how the monocyclic, in its broadest sense, is a combination of the single-phase and three-phase systems, and referring to the discussion of Dr. Bell's recent paper, asking why advantages and disadvantages are so hazily considered, and why the absence of definite figures is the most conspicuous feature of a manufacturing engineer's papers.

WIRES, WIRING AND CONDUITS.

Formation of Metallic Sodium in Conduits.—The Lond. "Elec.," March 8, contains a communication by Mr. Keiffenheim regarding the subject of the formation of metallic sodium in conduits containing stoneware insulators (see Digest last week under "Explosions"); he believes that it is not quite correct to attribute the formation of sodium to the decomposition of stoneware in the presence of moisture, but infers that it is formed by the decomposition of the glaze which is formed of salt; he states that nearly all qualities of glass also contain sodium or potassium, and concludes that there is still some mystery regarding this important subject. Messrs. Doulton & Co. (manufacturers of stoneware) believe that the assumption that sodium is formed by the decomposition of the stoneware is made without adequate evidence; they explain that stoneware is a term covering a large class of pottery products and that this kind of ware possesses in the highest degree quality to withstand corrosive action; it has been used with very satisfactory results for telegraphy; glass insulators have been used in connection with bare copper mains but their use has been discontinued; they have made investigations to confirm their views that the deposit is not derived from the stoneware but they do not give the results; they intimate, however, that the source is the cement, the brickwork and the surrounding soil. Editorially it is stated that all salt glazed insulators must be condemned for electric supply purposes; glass differs in not being porous and therefore not absorbing moisture; the satisfactory use of stoneware for telegraph insulators is no criterion, as the voltage is too low and the insulation resistance of a supply main and a telegraph wire cannot be strictly compared; if the body of the stoneware is thoroughly vitrified all over its surface it is almost inconceivable that any electrolysis can take place; the sodium is found in globules almost as fluid as mercury, which indicates the presence of an alloy; there is no cause for alarm about the use of porcelain switches and other fittings. The subject is also discussed in two other communications in the same journal; it appears that the matter will be investigated by the Royal Society and the Institution of Electrical Engineers.

Cause of Explosions.—The Lond "Elec. Rev.," March 8, in a long editorial, discusses unfavorably the conclusions of the Board of Trade and the statements in the Lond. "Elec." (see above) that metallic sodium is formed in conduits which in contact with water produces the flame to ignite the gases. It is stated that metallic sodium in a damp atmosphere, such as exists in conduits, rapidly changes, forming caustic soda; no flame will appear when metallic sodium is in contact with water, but under certain artificial conditions the escaping hydrogen will inflame; the silicates are among the most refractory and stable substances known to chemists and are very difficult to decompose; it suggests making an experimental demonstration of the extraction of metallic sodium from stoneware, but intimates that results would be unfavorable; it questions whether metallic sodium can be formed under conditions "which may easily and do arise" as claimed by the other journal. Certain statements are made and a number of references cited; among these it is claimed that coal gas contains acetylene and ammonia, and that the former in the presence of the latter will combine with copper, forming a highly unstable and explosive compound termed copper-acetylene; accidents have been recorded caused by the formation of this compound in copper pipes through which this gas passed; sodium, which is said to have been found, in the presence of acetylene forms a compound which in contact with water is decomposed with explosive violence; the conclusion, therefore, is that coal gas should be kept out of conduits. The explanation that sodium is the cause would apply only to cases where bare cables are used but not to those explosions in which high tensions and heavy insulation were used, and it was in the latter kind of conduits that nearly all the explosions took place; it is stated that explosions are on record which had occurred before electricity was applied; whatever be the cause, the gas company is responsible for the material which causes the explosion; the safest remedy, therefore, is to prevent the escape of gas from the pipes.

Kelvin's Law of Economy Conductors.—"Elec. Eng'ing" for March contains an article by Mr. Perrine calling particular attention to the fact that the law as published by Lord Kelvin treats the problem as though a constant current were flowing continuously, and as though the cost of the conductor varied directly as its area. This solution is considered incomplete, as no account is taken of the cost of erecting and maintaining the line, which does not vary directly with the area of the conductor. The subject is treated more from the practical engineering standpoint, the total annual cost of any conductor for the electrical transmission of energy is reduced to a number of terms in each of which there is a constant factor besides the one dependent on the area of the conductor. This treatment applies the law to cases involving insulated wires, cost of right of way, erection and maintenance.

ELECTRO-PHYSICS AND MAGNETISM.

Ferranti Effect.—A paper by Mr. Pichelmayer is reprinted in the "Zeit. fuer Elek.," Feb. 15. He gives an explanation taken from the book of Dr. Fleming, and describes experiments made by himself which gave very satisfactory results, agreeing very well with this theory. In view of the present knowledge of electric oscillations he describes this phenomena about as follows: a system consisting of self-induction and capacity in series corresponds to a very definite period of oscillation of the current; if such a system is subjected to a periodic E. M. F. then this E. M. F. can generate a higher voltage than the original and the increase in voltage will be a maximum when the duration of the period of the external E. M. F. is equal to that of the system. A further cause of this increase in voltage may be due to the increase in the transformer ratio on account of the formation of shunted magnetic circuits; by some writers, as also Dr. Sahulka (see Digest Jan. 20, 1894), the latter is given as the sole cause of the phenomena, but the present writer believes that one is not justified in considering this as the only cause. To explain the phenomenon he makes the following mechanical analogy: a tube bent in the form of a ring closed on itself contains a diaphragm and on each side of it an easily moving piston separated from the diaphragm by air spaces, the rest of the pipe being filled completely with water; if a periodically varying force acts on this system so as to make the column of water oscillate, then the inertia of the water will represent the self-induction, while the compression and rarification of the air in the two compartments represent the action of the condenser, the diaphragm being the dielectric; such a system will have a definite rate of oscillation and if the period of the external forces corresponds with this, then the oscillations of the water column will increase so that the air pressures will become greater than would be possible without the action of the water. In conclusion he states that by a proper selection of the self-induction and the capacity, oscillations as low as desired can be generated, thus making it possible to produce the whole range of values from that of the smallest in the ultra violet light up to those having a period of several hundredths of a second. In the discussion, which is given briefly in another part of that journal, Dr. Sahulka describes briefly his experiments explaining the phenomena by means of the transformer ratio.

Ozone and Carbonic Acid.—In the Lond. "Elec. Rev.," March 8, Mr. Andreoli answers some questions asked by a correspondent. He knows of no records of experiments showing that carbonic monoxide is produced during the electrification of air; the presence of a large proportion of carbonic acid and its long electrification would probably be required to produce even a small amount of carbonic oxide. When sparks pass through carbonic acid gas it is rapidly decomposed; when carbonic acid and oxygen are subject to the spark, no action seems to occur, although another case is cited in which 5 per cent. of the gas was decomposed into carbonic oxide and oxygen, the latter containing ozone and percarbonic acid which attacks mercury and oxidizable substances with great energy; "if the oxidizing part of this gas is ozone the percentage of this substance would be enormous in comparison to the yield of ozone by the electrification of oxygen."

Electric Oscillations.—The first part of an article by Prof. Righi on "Electrical Oscillations of Small Wave Length and Their Use in the Production of Phenomena Analogous to the Principal Optical Phenomena" is given in "L'Eclairage Elec.," Feb. 23, the present portion is mostly descriptive and is accompanied by a number of illustrations of the apparatus.

Maxwell's Theory Concerning Electromagnetism, Light and the Vibration Theory.—The "Elec. Tech.," Feb. 15, contains an article of some length by Mr. Mewes.

Propagation of Magnetism in Iron.—An abstract of the discussion of the paper of Messrs. Hopkinson and Wilson (see Digest last week) is published in Lond. "Elec.," March 8; the remarks are complimentary to the authors but contain little of special interest. Mr. Mordey remarked that he had found that the magnetic density in laminated iron was uniform even though the length of certain parts of the magnetic paths was greater than that of others, which he accounted for by assuming that any tendency to a greater density in one place would be counteracted by the relatively stronger permeability elsewhere. He referred to the excitation of a solid core by redressed currents, such as takes place in the magnets of some alternators; he expected to find the arrangement wasteful and thought the magnets would have to be laminated, but to his surprise he found that this was not the case, it requiring the same current and the watts were very little higher than with a direct current; the magnet apparently settled down to a certain stable condition, there being only a slight surface fluctuation. Mr. Addenbrooke called attention to the self-induction of alternators; it has been assumed that the permeability of the magnetic circuit was the ordinary one but it is evident that with large masses in field magnets the self-induction apparently could not rise to the amount that would be anticipated in the ordinary way and that therefore the reaction of the armature on the field magnets could not be quite as great as would otherwise be anticipated.

Magnetic Properties of Iron.—Mr. Lori's paper is concluded in "L'Elettricista," March 1; it contains a table and other data of interest which do not admit of being abstracted.

Atmospheric Electricity.—The "Elec. Rev.," March 20, reprints an article by Prof. Magie from the American Meteorological Journal in which he shows that the conditions at sea are much more favorable for systematic work with atmospheric electricity than they are on the earth, where the proximity of surrounding buildings and the presence of dust introduces errors that cannot be allowed for; to this Exnar ascribes the occasional observations of negative potentials in the air. He describes the instrument and method used; he found that the potential was always positive and increased with the elevation; for a difference of elevation of one metre it varied from 7 to 100 volts; there appeared to be no relation between the potential and the humidity; the potential differences were greater when the sky was clear although there are some marked exceptions; he believes that many of the inconsistences that appear in any comparisons of the potentials with the humidity or with the clearness of the sky are due to the effects of winds which are found to be more than enough to counterbalance the opposite effect due to a clouded sky and to give unusually high potentials on cloudy days.

Tyndal.—The "Pop. Sc. Mo." for March contains an article by Lord Rayleigh on the scientific work of Tyndall.

ELECTRO-CHEMISTRY AND BATTERIES.

Chemical Reactions in Accumulators.—"L'Eclairage Elec.," Feb. 23, abstracts an article by Messrs. Elbs and Schoenherr from the "Zeit. fuer. Elektrochem.," Feb. 1. These writers criticise the theory of Mr. Darrieus, published three years ago, who stated that during the charge persulphuric acid is formed at the positive plate which transforms the oxides and sulphates in peroxide, after which it decomposes itself into sulphuric acid and oxygen thereby indicating the end of the charge. The present writers believe from a large number of experiments that this is not correct; when weak currents are used to charge accumulators there is no appreciable amount of persulphuric acid formed; with a density of 2,800 amperes per square metre and an anode of platinum, 24 per cent. of the calculated quantity of persulphuric acid was formed, but with a density of 1,300 only traces were obtained; the normal rates used in charging accumulators are well below this density; which shows that persulphuric acid plays no important part. Free persulphuric acid does not react on lead or sulphate of lead with the formation of peroxide no matter what the degree of concentration; lead in sulphuric acid containing persulphuric acid is rapidly covered with sulphate and there is never a formation of peroxide; on a plate covered with peroxide the latter is converted into sulphate with an evolution of oxygen, in a mixture of persulphuric acid with sulphuric acid; the alkaline salts of persulphuric acid transform lead and its salts into peroxide but in an accumulator the solution is always acid.

Improvement in Leclanche Batteries.—According to the "Elec. Tech.," Feb. 28. Dr. Grueninger states that by adding to the concentrated solution of sal-ammoniac a tenth of its volume of anhydrous vinegar and protecting the solution as much as possible from the air, there will no longer be any formation of the objectionable crystals of insoluble zinc salts; the internal resistance in that case will not increase nearly as rapidly as with the ordinary solution; as anhydrous vinegar sometimes contains sulphuric and hydrochloric acids it should first be tested for these and if they are found to be present it should not be used on account of their action in dissolving the zinc; the vinegar acts to form easily soluble basic zinc acetate.

Copper Batteries from a Hygienic Standpoint.—The question of whether the vapors from copper batteries such as are used largely in telegraphy is a source of danger to the health is discussed by Mr. Schubert in the "Elektrochem. Zeit." for March. He gives the results of a careful investigation made by the German government telegraph department; the question was whether vapors of arsenic were generated, due to impurities in the zinc; the results show that no such vapors were produced; the same was found when the experiments were conducted on a larger scale; to find whether it was possible that such vapors are generated in a dead cell by the electrolytic action of the current passing through it, careful experiments were made, but like in the other cases no arsenic vapors were produced.

Amalgamation of Zinc.—Some methods are reprinted in the "Elektrochem. Zeit." for March. Besides the well known methods and others which are not as good, the following is recommended very highly: the zinc is placed in a glass vessel containing a small amount of a solution of nitrate of mercury, which is electrolized, the mercury depositing on the zinc. To alloy zinc with 3 or 4 per cent. of mercury, the latter must first be dried and then allowed to drop slowly into the crucible containing the molten zinc, which must then be cast very rapidly in order to avoid vaporizing the mercury.

E. M. F. of an Iodine Cell.—A paper by Mr. Laurie read before the Chemical Society is abstracted briefly in the Lond. "Elec. Eng.," March 8; the cell was used for measuring the rate of diffusion of dilute solutions.

Electricity from Coal.—The "Zeit. fuer Elek.," March 1, contains an article by Mr. Manfai in which he discusses the subject in detail, arriving at the conclusion that a solution of the problem by means of the cold combustion of coal does not look very promising; the combustion of coal without heat he says is impossible, there is no affinity of carbon and oxygen in the cold state; he concludes that the most promising solution is by improvements in heat engines and he describes a system of his own in which coal dust is burnt periodically like in a gas engine, heating the air in contact with it, which is then used in an engine. The article contains nothing of importance.

Electrolysis of Fused Salts.—An article by Mr. Andreoli is begun in "L'Elec.," March 9. He gives a brief history showing that the electrolysis of fused salts preceded that of salts in solution. Davy states that nitrate of potash and soda conduct a current when fused; he describes Faraday's researches in this direction. In many cases electrolysis by the dry method is destined to supersede that by the wet method; in the electrolysis of fused salt the great advantages are that the separation of chlorine and caustic soda is complete, while by the wet method only a weak solution is produced which must be evaporated; the E. M. F. is also much lower in the former; the great difficulties with diaphragms and diffusion no longer exist, but on the other hand there are other difficult problems to be solved; he considers that the electrolysis of fused salt is the only process by which chlorine and soda can be produced cheaply although it may take some time to convince electricians of this. He gives a summary of all the principal methods for the extraction of metals from their salts or oxides or the separation of different products by the electrolysis of the fused material; he describes Mathiessen's experiments.

Impurities in Commercial Aluminium.—In a paper by Mr. Moissan from "Comptes Rendus," vol. 119, page 12, briefly abstracted in the Lond. "Elec. Rev.," March 8, he contends that when the metal is produced by electrolytic processes it is always impure and variable in its composition; the effect of carbon on the physical properties is given in a table, which shows that if rolled after carburetting its breaking strain is nearly doubled, while if cast, it is reduced.

Production of Bitartrate of Potash.—Mr. Villani in "L'Elettricista," March 1, suggests an electrolytic method for the production of this substance, which consists in treating the deposits from wine first with caustic potash and then with sulphuric acid, the sulphate of potash is then decomposed in an electrolytic bath; various calculations are given; the method is said to be very economical.

Determining the Condition of Plating Baths.—Dr. Krueger's serial in which he gives simple methods for testing baths is concluded in the "Elektrochem. Zeit." for March; he discusses silver, gold and nickel baths.

Metallurgy of Gold.—An abstract of Mr. von Garnet's paper mentioned some time ago in the Digest, describing the Siemens & Halske process for the electrical deposition from cyanide solutions, is abstracted briefly in the Lond "Elec. Eng.," March 8.

Electric Disinfection.—A paper by Mr. Farman is published in the "Bul. Soc. Int. des Elec." for February. He describes the Hermite process, giving some figures and some illustrations of the apparatus.

Electrolytic Dissociation.—An abstract of a paper by Mr. Tanatar from the Chemical Society's Journal is given in the Lond. "Elec. Eng.," March 8.

Ions.—The serial by Dr. Gerstmann on ions is continued in the "Elektrochem. Zeit." for March.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Determining the Efficiency of Dynamos and Motors.—In the conclusion of the serial by Mr. Ashworth in the Lond. "Elec. Plant," Feb. 1, he gives a detailed description and discussion of the well-known Hopkinson method and the improvements which have been suggested; also the methods of Swinburne, Cardew, Menges and Mordey, all of which are well known. In conclusion he gives a method suggested by himself in which the power supplied is calculated from the formula for rotational energy; the rate of change of speed at any speed when the power is cut off is used as a measure of the power that was being supplied; the observations necessary are measurements of the speed, and the change of speed when the power is suddenly cut off; the power required to drive the armature is then given by the formula

$$4 \pi^2 I \times \text{change of speed}$$

in which I is the moment of inertia which would have to be found experimentally as it could not be calculated accurately.

Voltmeter.—A small compact form, for storage battery measurements, is described and illustrated in "L'Elec.," March 9. There is a permanent magnet having between its poles a coil whose axis is perpendicular to the lines of force. In the centre of this coil there is a pivoted soft iron needle which is connected to the pointer by means of multiplying gears; the deflections are said to be proportional to the currents. An important feature consists in a bar of soft iron laid across the poles of the magnet forming a magnetic shunt to the field, which, by keeping the magnetic circuit closed, overcomes the tendency of the magnet to lose its magnetization; by adjusting this magnetic shunt the constant of the instrument may be varied.

Construction and Use of Electrical Measuring Instruments.—The serial by Mr. Yeamans is being continued through successive numbers of Lond. "El'ty;" it is somewhat elementary in character; the first portions deal with descriptions of standards, terms, units, etc.

Secohmmeter.—Mr. Smith in the Lond. "Elec.," March 8, in referring to the Ayrton & Perry instrument (see Digest last week) stated that the late Mr. Willoughby Smith had described and used the identical instrument in 1882, it having been constructed one year before.

Measuring the Internal Resistance of a Cell.—The "Phys. Rev." for March-April contains a short paper by Prof. Carhart on the "Variation of Internal Resistance of a Voltaic Cell with Current," in which he describes, with the aid of a diagram, a method of making the measurements, in which a pendulum beating seconds is used to operate the switches for charging and discharging the condensers, etc. The methods commonly used are not sufficiently exact to exhibit the relation between the internal resistance and the current. He gives the results for a Gassner dry cell.

Determination of the Conductivity of Certain Salt Solutions.—In an article of some length by Prof. MacGregory, in the "Phys. Rev." for March-April, he gives the results of some recent tests made by himself, and describes the method and apparatus. The two objects of such investigations are, the determinations of the velocities of the ions, and the gaining of some insight into the conditions of the salts when in solution. His determinations fill a few vacancies in the list of results heretofore obtained for salts of the alkaline earths and acetates.

Students' Apparatus for Determining the Mechanical Equivalent of Heat.—The paper of Prof. Ayrton and Mr. Haycraft which was abstracted in the Digest Jan. 12 and referred to a number of times since, is given in abstract, together with the illustration, in the "Elec. Eng." March 20.

Demonstration Apparatus for Thermoelectric Currents.—The apparatus described in the Digest Dec. 22 is illustrated in the "West. El." March 23.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Controlling Apparatus for Switches.—The system used on a French railroad is described and illustrated in the "Zeit. fuer Elek.," Feb. 15.

Pacific Cable.—The estimates for eight different routes, taken from the "Montreal Gazette," are given in Lond. "Elec. Rev.," March 8.

Telephone Agreement.—The Parliamentary discussion is published in the Lond. "Elec.," March 8, and discussed editorially in the "Elec. Rev."

Communication with Lightships.—The arrangement used to connect the Scotland lightship with the shore at Sandy Hook is described and illustrated in the "Elec. Eng., March 20, taken from the government report by Prof. Blake. The system of direct connection was used and abandoned and is now superseded by another in which the cable is run to a spot near the lightship's anchor, where it is connected to a similar cable at right angles to it, to which are again connected small cables parallel to the first, thus covering the area over which the ship moves; no further description is given; the system is said to be satisfactory and it is proposed to use it at other stations farther apart.

Telephone Situation.—In a supplement the "Elec. Rev.," March 20, enumerates the patents which have become void and some that have not in view of the recent Bate decision.

Alarm for Safes.—Mr. Hachenberg, in the "Elec. Rev.," March 20, describes a system in which a metallic ball is suspended so as to be in very close proximity with a metallic cup but not in contact with it, both cup and ball being mechanically connected with the safe; the least vibration caused by a blow or opening the door of the safe will cause a contact between the ball and cup, thereby sounding an electric alarms To prevent the wires from being cut, another circuit with a continuous current flowing through it is used, keeping the magnet locked at the bell, when this current is broken the alarm is given by a clockwork arrangement.

Block Signals.—The system used on a railway in Denver is described and illustrated in the "St. Ry. Rev.," March 16.

MISCELLANEOUS.

Stress and the Corrosion of Metals.—A paper by Mr. Andrews is briefly abstracted in the Lond. "Elec. Rev.," March 8. He investigates the influence of stress upon the corrosion of metals; bars of the same kinds of iron or steel were subjected to different stresses and placed in an electrolyte, usually common salt, the difference of potential being taken as a measure of their relative corrodibility; tensile stress causes an average of 0.016 volt between strained and unstrained bars, the latter being positive and therefore the more corrodible; torsional strain gave 0.018 volt, the unstrained being again positive; flexional strain on plates gave 0.012 volt; wrought iron in sea water is more resistant than steel, sometimes amounting to 25 per cent.; the more carbon present the greater the corrosion; the voltage existing between strained and unstrained metal may induce local corrosion; the original paper is published in the "Proceedings of the Institute of Civil Engineers," vol. 118, 4.

Acetylene.—The "Zeit. fuer Beleucht.," Feb. 28, states that according to Moissan (whom it entitles as the discoverer of calcium-carbide) a current of 350 amperes and 60 volts will be required for producing 120 to 150 grams of calcium-carbide in 15 to 20 minutes; with the best steam engines the current for one kg (2.2 lbs.) calcium-carbide will cost 75 cts., a cubic metre of acetylene would therefore cost two dollars; the lighting power is thought to be about the same as that of benzole and the cost of lighting by acetylene would therefore be about 25 times as great as with benzole.

Electric Currents in the Living Body.—In the Lond. "Elec. Rev.," March 8, Dr. Hedley replies at some length to the paper of Prof. Horsley abstracted in Digest last week; he differs decidedly on a number of points; he claims that the paper is not satisfactory from the standpoint of electrotherapeutics; he considers that the scope of electrotherapeutics is here so understated as to be little short of misleading; regarding the statement that the use of electric currents is purely arbitrary he states that this cannot be accepted; D'Arsonval found that with sinusoidal currents the so-called respiratory capacity of the blood was notably increased, and therefore this is a means of altering the nutritive conditions of the whole body. The use of electricity in medicine cannot be considered more arbitrary or more empirical than the employment of many prominent drugs.

Electrical Fishing.—The "Elec. Tech.," Feb. 28, states that in Japan very good results were obtained with an electric lamp in the form of a fish which was lowered into the sea about 100 feet and which attracted a large number of fish which could then be easily caught. To catch shark a mackerel was tied to the end of a conductor connected with a source of an induction current of 50 volts, the current being started after the shark had swallowed the fish, the effect being to produce unconsciousness, during which time the shark can be caught and killed.

Biographical.—The death of Dr. Martin Kiliani is announced; a biographical sketch of some length and a portrait are published in the "Zeit. f. Elect. u. Electrochem.," March 1.

Patent Statute.—The American electrical journals of last week continue to publish articles and comments on the recent Bate decision. The "Elec. Rev." contains a communication from Mr. Maynard discussing briefly Prof. Thompson's recent article. "Elec. Eng'ing" for March contains an article by Mr. Smith commenting on the Bate decision and explaining the rules applying to foreign patents. The same issue also contains an article by Mr. Brown reprinted in the "Elec. Rev.," March 20; he believes the decision to be of advantage to all electrical interests but certain forms of telephone transmitters are yet covered and the circuit court of appeals may sustain the Berliner patent. An editorial in "Elec. Eng'ing" for March speculates on the formation of a lamp trust and intimates that the Bell Company is ready to flood the market with telephone apparatus at a price so low that new companies cannot afford to bid.

Electrical Exports.—The "West. El.," March 23, gives a compilation from the report of the Treasury Department, of the exports of electric light appliances, telegraph and telephone instruments and the imports of gutta percha, for the last fiscal year. The exports of electric light appliances amounted to a total of $650,418, of which the largest portions went to British Australasia, Canada, England, Brazil, Cuba and Mexico; the exports of telephone and telegraphic instruments amounted to $1,534,277, most of which went to the same countries, including also Germany.

Calcium Carbide.—The 'Eng. and Min. Jour.," March 16, reports a discussion on this material at a recent meeting of the New England Association of Gas Engineers; it appears that companies are about being formed in Berlin, England and France to manufacture this material.

Self-Winding Clocks.—A description of the Salisbury system is begun in the "Teleg. Age," March 16.

Flying Machine.—An illustrated description of the Wellner machine, which has been referred to a number of times in these columns, is given by Helene Bonfort in the "Pop. Sc. Mo." for March.

Glass vs. Porcelain.

Messrs. Doulton & Co.'s statement in our correspondence columns last week, that experience with glass insulators in connection with bare copper mains has led to their use being discontinued, in certain instances, is confirmed by information which we have received in reply to inquiries from the Kensington & Knightsbridge Company; but the cause of the difficulty which has arisen is not at all clear. The positive and the middle conductor quickly dry off any dampness, and the insulation resistance of the glass insulators is good. But on the negative side this drying off does not occur, or occurs to so small an extent that where the concrete sweats, owing to moisture of the surrounding soil, or to other local conditions, the condensation which is facilitated, and perhaps to some extent induced, by the so-called hygroscopic nature of the surface of the glass, may exceed the dissipation; and it is found that low insulation results. This selective action is not, as we have already remarked, very clear. The sealing up of a fault on a telegraph cable is, of course, due to the formation of insoluble salts, but no corrosion worth mentioning is found in the present case. When the earthing of the middle conductor was advocated some years ago, the reply by experienced engineers was: We can get good insulation on the positive and middle; they mend themselves up, but the negative *will* earth itself if it can, and won't mend. It seems possible that there may be a surface tension effect, as in the Lipmann electrometer, which causes the film of moisture near the positive to retract.

A curious experiment of Lord Armstrong, which only awaits correlation to be admitted into some branch of electrical science, may be recalled in connection with glass insulators. Two glasses full of water are placed nearly touching, and a wetted cotton thread forms a connection. A powerful induction coil is arranged with a spark-gap, allowing only the "break" spark to pass. If the water is perfectly pure and clean it will rapidly travel across the thread connection *with* the current, while the thread will move in the opposite direction.

It is possible that the rapid rise of insulation resistance between two conductors, when supported on glass, or stoneware or glazed pottery, is not due to electrolysis of the moisture, or to its dissipation by heat, so much as to this unexplained withdrawal from the positive, and that this increase of resistance may indeed be unaccompanied by any material rise of insulation between the negative and the earth.—London *Electrician*.

Stedman Transfer Tickets and Newark Trolley Conductors.

The New York *Sun* asks why the Newark trolley line conductors, as a matter of fact, have come to shirk their duty with respect to the punching of the little row of seven heads at the top of the Stedman transfer ticket, designed to identify the holder. The *Sun* is inclined to think that their inattention to this particular detail of the system is due to unofficial embarrassment in the presence of female passengers. There are not enough female types on the ticket. The women of Newark have somehow taken it into their heads that the distinction between the sixth portrait and the seventh is not merely a distinction between hat and bonnet, but substantially a classification according to age. The conductors have discovered that they incur resentment when, after a swift inspection of a female passenger, they conscientiously rate her as belonging to the comparatively mature class typified by number seven. This is the only flaw the *Sun* discerns in the Stedman system, and adds that there ought to be at least five female heads on the ticket, representing different types of beauty, but all beautiful and all young.

Covered Fuse Cut-Outs Dangerous.

BY WALTER E. HARRINGTON.

The rules of the Boards of Fire Underwriters indicate covered fuse cut-outs. The probable reason of such a requirement is based on the natural assumption that the "blowing" of a fuse if not entirely covered up will cause fire. The reason a fuse is employed is for protection, but experience has demonstrated that fuses rarely "blow" in practice under the conditions which have determined their rating. That is to say, the rating of fuses is based upon the minimum current causing fusion in the maximum time, and the usual condition in practice under which a fuse "blows" is such that an abnormal current flows through it before fusion occurs.

When a fuse "blows" under the conditions which have determined its rating, the phenomenon is one of very little manifestation—the metal simply melts quietly and drops. Consequently if a fuse be covered this latter behavior does not effect in any wise the action or result of the fusion, particularly so if the difference in potential be low, say 50 volts. There is no question but that the observation of this latter method of fusion led to the adoption of the method of using covered fuse cut-outs.

The writer believes that the use of covered fuse cut-outs is radically wrong, as it is based upon practically wrong premises. As stated before, fuses rarely "blow" in practice under the conditions such as have determined their rating. The usual causes of fuses "blowing" are due to crosses, grounds and short circuits. It therefore follows that the momentarily great flow of current which the fuse permits to flow through it during its fusion causes it to blow quicker, and the more severe the condition, the higher the voltage, the quicker the fuse blows, with the consequence that a veritable explosion follows.

In 500-volt practice it is impossible to have a fuse "blow" under a short circuit in any of the commercial covered fuse blocks without their destruction. Every fuse block manufactured and placed on the market for sale was recently subjected to short circuit tests in the power station of the Philadelphia Traction Company, and in every instance the lids were shattered and the terminals burned, and further, the circuit was opened by the switchboard magnetic circuit breakers.

The blowing of a fuse under a short circuit in 500-volt work, when the fuse is open in the atmosphere, is accompanied by a loud rifle-like explosive report. It is manifestly incorrect then to take this explosive and enclose it in a small space. The writer read a paper upon "The Destructive Arcing of 500-volt Fuses" before the American Street Railway Association at Atlanta, Ga., in October, 1894, which dwelt upon the destructive and vicious character of the gases attending the blowing of fuses, and showed that the incidental troubles following the blowing of the fuse due to the gas could be worse than the damage incident to the flow of current causing the fusion.

The sudden formation of gas in a closed fuse block under a short circuit condition is attended with the most severe results, as the gas is an excellent conductor, and being enclosed without free vent the gas is at its maximum density, and therefore minimum specific ohmic resistance; the result is that, while it is true the fuse is disintegrated, yet a most excellent flexible, floating conductor is present carrying current; furthermore, this gas is maintained at the expense of the terminals, and is a most fruitful source for fires.

The natural remedy is to provide fuse blocks, the fuse having free unobstructed vent to the atmosphere. Copper makes the best fuse metal, as it gives the minimum cross section of metal per ampere of any metal excepting silver. The length of fuse should be made as small as possible, and have protected terminals such that when the fuse has "blown" the arc is killed by the protection on the terminals.

If protection outside of the fuse is desired against the vicious gases following the explosive blowing of the fuses, a spacious box or closet should be built for the fuse blocks to vent into, provided with proper ventilation and protected inside against fire.

Experience shows that no dependence can be placed upon fuse metals as a protection on circuits carrying over ten amperes, and that magnetic circuit breakers are the only means available for sure protection.

Electricity in a Shoe Factory.

An interesting electric power transmission plant is in process of installation by the General Electric Company at Rochester, N. H., for the operation of Messrs. E. G. & E. Wallace's shoe factory.

The system adopted is the regular three-phase devised by the General Electric Company. The source of power is steam, and the fuel scrap bark—the refuse from the tanneries located on the ground. The generator will be a 140-kw machine wound for 560 volts, the distance of transmission being insignificant. The motors will be of the induction type without commutators or moving wires, and will be wound for 500 volts, so as to operate without the use of transformers. They will be 5, 15, 20 and 25-hp machines. Another generator, to be used principally for lighting, will shortly be added.

The installation of this plant was determined upon after a careful investigation of the merits of the three-phase system and the economy likely to be induced by its adoption, as compared with the cost of installation and maintenance of a system of mechanical distribution of power, *i. e.*, line shafting, belts, etc. Messrs E. G. & E. Wallace had already experimented with motors in the operation of their shoe factory, and the pronounced advantages which accrued proved the deciding factor which resulted in the present installation.

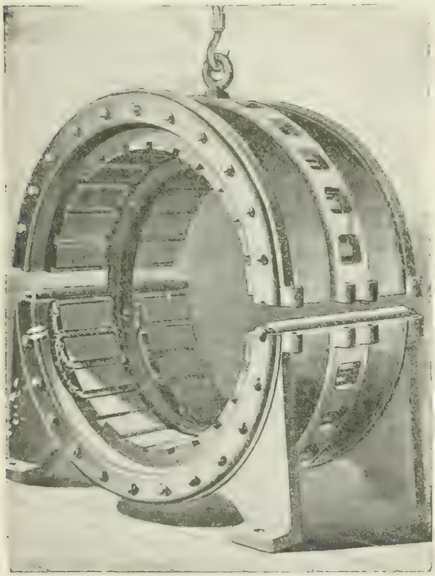


Fig. 2.—Dynamo Frame.

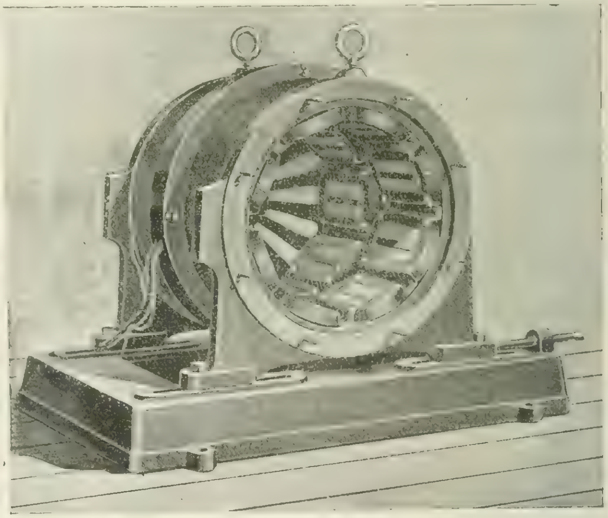


Fig. 3.—Motor Frame.

Two-Phase System for Lighting and Power.

An exhibition of the S-K-C two-phase system was given on Friday of last week at the station of the Citizens' Electric Illuminating Company, Brooklyn, at which there was present by invitation a large number of electricians from New York, Brooklyn, and vicinity.

The plant consisted of a 60-kw S-K-C generator from whose circuits current was taken for a 10-hp motor driving a Hochhausen incandescent dynamo, a 3-hp motor driving an exhaust fan and both arc and incandescent lamp circuits.

The dynamo has no collector rings or moving wire, the revolving portion (Fig. 1) consisting of a cylindrical steel casting with laminated polar projections, the number of these projections corresponding with the number of pairs of stationary coils on the dynamo frame. Concentric with the movable part, which is called the inductor, is the field coil; this is stationary in the armature frame and magnetizes the moving inductor, which it embraces without coming into actual contact with it.

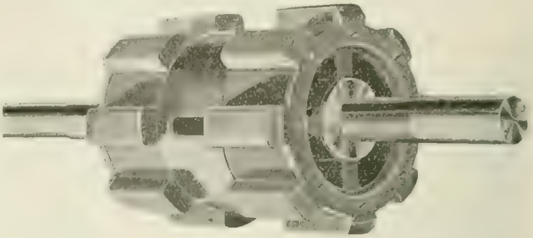


Fig. 1.—Inductor.

On projections from the dynamo frame (Fig. 2) on each side of the inductor coil are placed the coils in which two alternate currents are generated, the coils on the projections on one side being "staggered" with respect to those on the other, thus producing a difference of phase between the two currents generated.

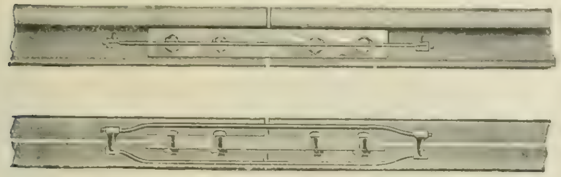
The frame of the motor (Fig. 3) corresponds in principle to that of the dynamo (though differing in construction), but with the inductor coil absent, and the two currents of displaced phase are led to the two circuits in the stationary part of the motor corresponding to those in the generator. In the face of the polar projections of the motor frame is sunk an oblong copper ring, called a compensator, which partly overcomes the armature reaction, its action being somewhat similar to the Ryan armature reaction winding for constant current machines. The armature of the motor is of the short circuited or induction type, but its winding is connected to two collector rings to enable a resistance to be put in series when starting; this resistance is for the purpose of reducing the armature reactance (which is large until the motor gains its normal speed), thereby securing a good starting torque; it is cut out when normal speed is attained, the armature then running with its winding short circuited.

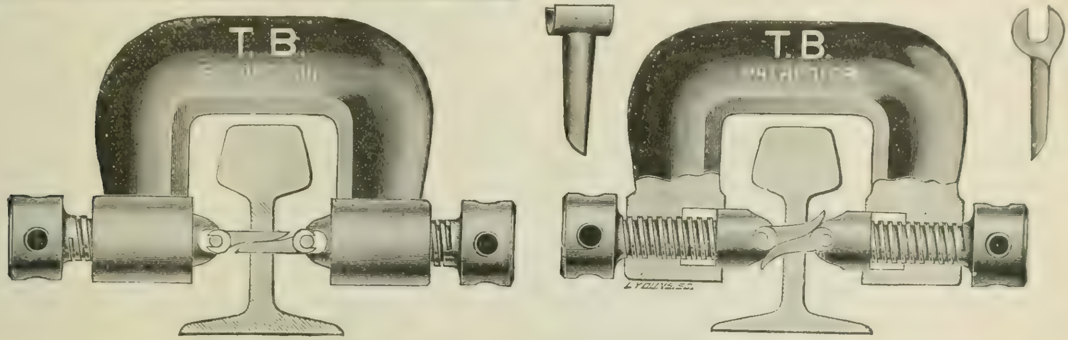
In order to neutralize the effects of the inductance of the motor, condensers are connected in parallel with it, thus obviating the idle current which otherwise would load up the generator and also, of course, increase the $C^2 R$ line loss. The effect of the condenser was illustrated by throwing it in and out of circuit; the current with the condenser in was 6½ amperes and became 9⅓ amperes when it was thrown out.

The exhibition was a most satisfactory one, all of the apparatus working with great smoothness and little or no heating. One side of the circuit was purposely made to carry a considerably greater load than the other, but with no noticeable effect on the lights.

A New Self-Locking Rail Bond.

The novel rail bond and means for attaching which we illustrate below is being placed on the market by the Thompson-Brown Electric Company, of Boston.





NEW RAIL BOND AND METHOD OF ATTACHING.

The terminal piece is made of bronze, and tapering as to its body. At one end is a grooved lug, the slot of which is so proportioned as to make a tolerably snug fit on the wire bond. The tapering body or stem of the terminal is half round. To attach the device to the rail a nine-sixteenths inch hole is drilled through the rail, and the stems of the terminals are pressed in from opposite sides, the two half round stems filling the round hole. The pointed ends enable the two stems to slide by each other. After the ends of the wires have been laid in the grooves, each of which is about one and a half inches long, a small machine is applied as shown, and operated by powerful screws, nuts and levers. The pressure, which by this means can be instantly applied to the bonds, at once folds over the lips of the groove on to the wire, thereby making solid contact. At the same time the stems are forced home in the hole in the rail tightly, turning out or clinching themselves in such a manner that it is simply impossible even to loosen the wire or the terminal. They must be cut out. The entire work of placing them is a matter of a very few moments.

A Three-Phase Plant.

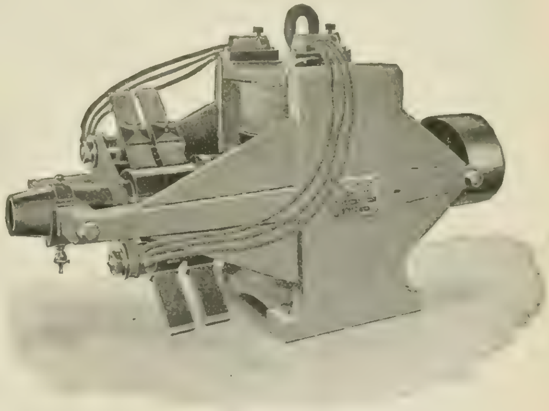
In a recent letter to the General Electric Company, Mr. Eugene F. Carpenter, superintendent of the Concord, N. H., three-phase plant, which has been in operation since September, 1893, speaks highly of this pioneer installation. There are now over 400 hp in motors and over 6,000 incandescent lamps in operation from two 250-kw generators. It is four miles from the station, at Sewall's Falls, where over 5,000 hp have been developed, to the centre of the city of Concord. The voltage at the city is 2,200 on the primaries and 110 on the secondaries. The loss between the generators and transformers is 7½ per cent. on the heaviest load that has been carried. The generators were put into service, running continuously, with the exception of one and one-half hours every Sunday afternoon for cleaning up, and have never given one minute of trouble, from any cause. Type F transformers are used, and with the single exception of having a primary coil open in one, these have proved satisfactory. After having the vexation of commutators, sparking brushes, burned-out armatures, coils and starting boxes to contend with in the old 500-volt circuit, their absence from the present system with no corresponding annoyance attending, Mr. Carpenter says, is a relief that words cannot express. The motors start promptly, with load, and their speed is almost absolutely constant, varying less than 2 per cent. from load to running free. The motors and lights are run from the same transformers, and starting a motor does not affect the lights any more than starting lights which took the same amount of current would. No difficulty is experienced in balancing the circuits and a difference of loads between two sides of 25 per cent. is not noticeable in any way. Heating and cooking apparatus are operated, as well as laundry and tailors' irons, with great satisfaction.

A Compact Iron-Clad Dynamo.

We illustrate in the accompanying engraving an iron-clad dynamo made by Max Mayer, 136 Liberty street, New York. This machine, as the illustration shows, is bipolar with the magnet cores arranged in a vertical plane, and the magnet frame is cast in one piece from the best grade of steel. The armature is of the drum type, and is comparatively large in diameter, enabling the machine to run at moderate speed. The winding is sunk in slots in the usual manner, and the armature coils are so connected as to electrically balance the winding and thus eliminate local currents.

The electrical and mechanical details have been very carefully worked out with a view to making the machines entirely reliable and to minimizing the amount of attention required during operation. It will be noticed that the arms which support the journal yokes are very massive giving the armature a rigid support and obviating any tendency to get out of alignment. The journals are extra long and the shaft is unusually large, carrying out the object had in view in providing the stiff supporting arms.

The electroplating machines are provided with heavy copper gauze brushes, and those of higher voltage have carbon brushes. The commutators on all machines are of the best modern construction, tempered copper and mica insulation being used throughout.



IRON CLAD DYNAMO.

A New Diaphragm For Telephones.

A diaphragm for telephones has been invented by Mr. John Henry Demser, 556 East Main street, Bridgeport, Conn., which, it is claimed, obviates the bad effects which inductive line disturbances have on the telephonic rendering of speech. The diaphragm is very simple in construction, consisting of two metallic discs with a granulated substance sealed between them. Different metals may be employed for the two discs, one type of diaphragm being constructed with discs of different metals—one of plate tin and the other of brass. It is claimed that the diaphragm works equally well over long and short distances, and that it has been tested upon long distances up to 1,000 miles, and also used on a grounded circuit of 20 miles with excellent results, almost entirely obviating the effects of induction and permitting of easy conversation in case where before its insertion in the receiver it was almost impossible to hold a conversation.

An Efficient Water-Wheel Governor.

The accompanying engraving illustrates a water-wheel governor manufactured by the Lombard Water-Wheel Governor Company, of No. 61 Hampshire street, Boston, Mass., which is a considerable departure from common practice. The actuating force of the governor is compressed air, which is contained in the cylindrical reservoir under the bedplate, in which a pressure of 210 lbs. is maintained by an air-pump operated by the pulley shown on the front of the machine.

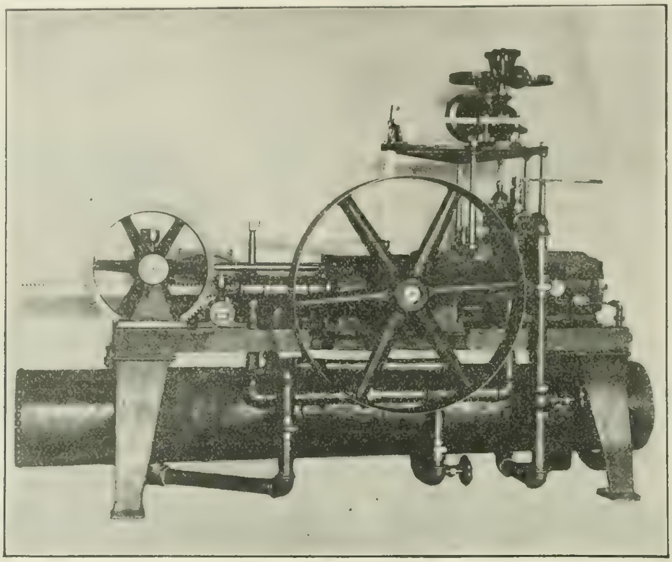


Fig. 1. Water Wheel Governor.

The governor consists essentially of a hydraulic piston which applies its thrust in either direction to the rack, pinion and gears at the left side of the machine. These gears transmit the motion of the piston to the gate mechanism of the turbine. The movement of the hydraulic piston is controlled by the governor balls, which actuate a perfectly balanced piston valve, having a lap of one-sixty-fourth of an inch. This valve opens and closes a passage between the air reservoir and one side or the other of the piston, according to the movements of the governor balls.

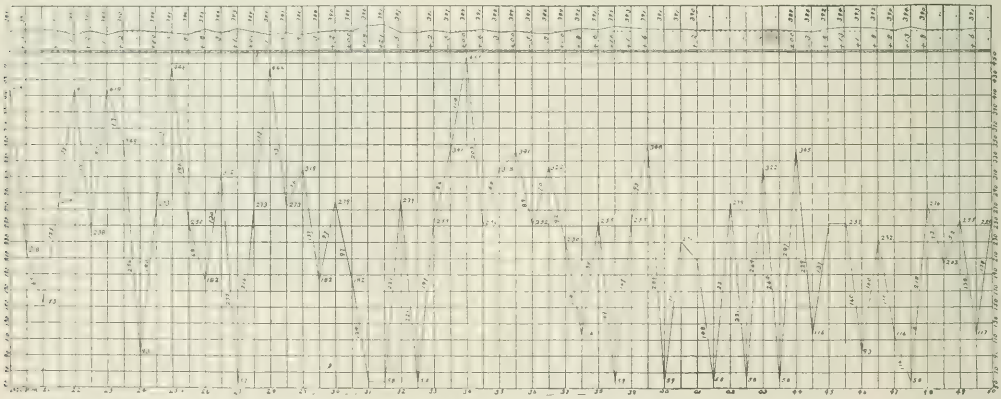


Fig. 2.—Diagram Showing Load and Speed Relations.

The cylindrical pressure tank is about one-third full of a thin, non-viscous oil, and the piping is arranged so that oil, and never air, enters the hydraulic cylinder. It will be noticed that about one-third of the distance from the left hand end of the pressure tank there is a row of rivet heads. At this point there is a tight partition across the tank, and there is no connection between the right and left hand end of the tanks except by way of the piping and through the hydraulic cylinder. In the right hand end of the tank are oil and air under high pressure, and in the left hand end of the tank is a vacuum. The oil is discharged from the hydraulic cylinder into the vacuum chamber of the tank, and is immediately returned by the pump to the pressure chamber. In this way a constant pressure and a constant vacuum are maintained. The circulating system is provided with a lever throttle valve and globe valves at various appropriate points; also pressure and vacuum gauges.

It is not claimed that this governor will give absolutely constant speed, but it is said to afford speed regulation that compares favorably with the best steam engine practice. Observations were recently made at Baltic, Conn., of the work of these governors used in connection with three pairs of Holmes horizontal wheels under a 35-foot head, and the readings showed a very creditable performance. Under a variation in load from 57 to 76 hp in one minute, the speed of the water-wheels is reported as varying $2\frac{1}{10}$ per cent.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, March 23, 1895.

THE ELECTRICAL STOCK MARKET opened strong this week and displayed none of the lethargy which characterized it recently. General Electric closed Monday firm at last week's closing quotation. and immediately began to climb, showing unusual strength during the whole week, notwithstanding the bearish reports as to the decreased profits on the apparatus manufactured, due to cutting in prices. Some attribute the sudden accession of strength to the reported understanding between the General Electric and Westinghouse Companies, looking to a cessation of hostilities in patent matters. This mutual arrangement is also held accountable for the very strong aspect of Westinghouse stocks which have been gradually climbing all the week. Both companies are doing a large business, but that fact has been known and made the most of for some time, so that it would not affect the stocks just now. General Electric went to 35⅛ at one time on Thursday, and Westinghouse has been firm at 35 and 36 for the past three days.

PHILADELPHIA TRACTION COMPANY has authorized an issue of 100,000 additional shares, which increases the capitalization from $15,000,000 to $20,000 000.

THE CONSOLIDATED ELECTRIC STORAGE COMPANY has declared a 1 per cent. dividend, payable April 10, to stockholders of record and holders of receipts and certificates of the General Electric Company. Books close March 20.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	97½	100
" " " Brooklyn	100	..	108
" " " Boston	100	..	..
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	29½	30½
General Electric	100	37	37⅛
General Electric, pref	100	68	70
Westinghouse Consolidated, com.	50	36½	37
" " pref	50	52	52½
BONDS.			
Edison Electric Ill., New York	100	..	106⅝
Edison Electric Light of Europe	100	75	85
General Electric Co. deb. 5s	100	..	90¼
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	196	197
American District Telegraph	100	..	45
American Telegraph & Cable	100	90	92
Central & South American Telegraph	100	117	120
Commercial Cables	100	130	140
Erie Telephone	100	50	50½
Gold & Stock Telegraph	100	105	..
New England Telephone	100	70½	.
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63½	..
Western Union Telegraph	100	88⅛	88½
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	15	15¼
Binghamton RR. com	100	100	..
Brooklyn Traction	100	9	11
" " pref.	100	..	53
Buffalo St. Ry	100	66½	69
Cleveland City Ry.	100	68	70
Cleveland Electric Ry.	100	59	60
Chicago City Ry	100	305	315
Columbus St. Ry	100	46	49
Consolidated Traction of N. J	..	30	33
Electric Traction, Philadelphia	50	79	80
Long Island Traction	100	5½	6⅛
Louisville St. Ry. com.	100	37	39
" " " pref.	100	87	88
Metropolitan Traction, Philadelphia	100	97¾	98
New Orleans Traction	100	15	18
" " pref.	100	56	60
North Shore Traction	100	..	..
" " pref.	100	74	83
People's Traction	25	49⅞	50
Philadelphia Traction	50	90¼	90⅛
Rochester St. Ry	..	38	..
Union Ry. (Huckleberry)	100	112	115
West End, Boston.	100	61	61½
" " pref	100	87½	88
Worcester Traction	100	..	13
" " pref	100	77	80
BONDS.			
Buffalo St. Ry. 1st con. 5s	100	101	..
*Binghamton Railroad Co. 5s	100	99	100
*Columbus St. Ry. 1st 5s.	100	9	..
Rochester St. Ry. 1st. 5s.	100	95	97
*Union Ry. 1st. mtge 6s.	100	105	108
*Westchester Electric 1st. mtge. 5s.	100	98	101

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* With accrued interest.

LONG ISLAND TRACTION'S RECEIVERSHIP is regarded as its only salvation. The jobbery connected with the company was sapping its life away at a painful rate, and the appointment of the receiver, together with the declaration of an intention to reorganize on an honest basis, caused an upward jump of 1 per cent. in the price of the stock.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD.
253 BROADWAY, NEW YORK, March 25, 1895.

A BILL has been introduced at Albany requiring an electric railway to get the consent of 75 per cent. of property owners along its line in order to obtain a status for a franchise. The measure is said to have the Vanderbilt railway interests behind it.

THE STRIKE OF ELECTRICAL WORKERS was declared off on March 21 and about 6,000 men in different trades went back to work the next day. The new agreement embodies some concessions on both sides, but principally on the part of the men. The eight-hour work-day will be granted on May 1. The settlement of the difficulty was largely due to the efforts of the New York Council of Conciliation and Mediation, of which Bishop Potter is president.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, March 23, 1895.

LINTON & SOUTHWICK, Worcester, Mass., are working night and day to keep up with orders, and are at present estimating upon some special work with excellent chances of success, which will place them still further in the front ranks in the line of switches and switchboard manufacture.

THE THOMPSON-BROWN ELECTRIC COMPANY, Boston, is, without much noise, "getting there" wonderfully well. Its business has shown increases steadily since the first of the year, January and February showing good profits, while March is away beyond the most sanguine expectations of President Thompson and Treasurer Brown.

MR. W. C. PIERCE, the latest accession to the staff of the Thompson-Brown Electric Company, of Boston, while comparatively new in the electrical field, will undoubtedly make a good record for his company and himself, as he possesses all the best qualities of the successful salesman. He will travel principally in western Massachusetts and New York State, and we bespeak for him a cordial reception.

MR J. J. GATES, general manager of the Perkins Electric Switch Manufacturing Company, of Hartford, Conn., favored this office with a call this week. He was overwhelmed with business, having been called to Boston unexpectedly to look after some big orders. Planning always for business success, Mr. Gates is never happy unless he secures it, and those who know him best know that he rarely misses the mark. The Perkins Company is doing now the best business of its existence, and in its regular line of specialties—switches, sockets, cut-outs, etc.—is scoring success, while orders for the Waterhouse-Gamble incandescent arc lamps are constantly increasing. It will very shortly be in a position to furnish incandescent lamps, in the manufacture of which the names of C. G. Perkins and J. J. Gates have in the past conspicuously and creditably figured. Its facilities in this direction are most excellent as to both factory space and the most modern improvements.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, March 13, 1895.

WATER POWER.—The Worcester Corporation are experiencing, as was generally predicted, the costliness of water power. Bitten with the mania for making use of waste power, they placed their central station several miles outside the town with the utilization of the water power in view. The station has during the past winter been alternately flooded and frozen out, and recently a little bill of £5,000 for extras was presented, bringing up the total cost of the station to 30 per cent. more than was estimated. In this connection I may mention that a 25,000 hp water fall, situated in Norway, is being advertised for sale. This valuable property should certainly be brought to the notice of the Niagara Falls financiers.

THE WORRYING OF ELECTRIC LIGHT COMPANIES.—The St. James & Pall Mall Electric Light Company, which has its two stations in the heart of the West End, has been subject for some time past to spasmodic actions in connection with the nuisance alleged to be caused by the working of its stations. The latest action of this kind was settled yesterday. It was taken by no less a personage than Her Majesty's Attorney General, representing the vestry of St. James, Westminster. The electric light company succeeded in appeasing its persecutors by entering into the following undertaking: It was agreed that if, in the opinion of an engineer to be appointed by the Board of Trade, or by [illegible] between the parties, the electric light works now caused, or should [illegible] any nuisance by any vibration or noise, or by permitting to [illegible] from the chimney shaft of the works black smoke, soot, ashes or dust or effluvia offensive and injurious to health, or by discharging into the sewers of the vestry hot water or steam, the electric light company would forthwith and at their own expense erect and execute all such works necessary for remedying the nuisance as the engineer should direct. It is to be hoped that this voluntary surrender will allow this company to pursue its further operations in peace. The high pressure companies, however, have not much to rejoice at since they themselves have been almost as much subject to actions for injunction as their low pressure rivals.

General News.

NEW INCORPORATIONS.

THE CHARLOTTE & MECKLENBURG RAILWAY COMPANY, Charlotte, N. C., has been incorporated to build an electric line.

THE UNION TELEPHONE COMPANY, Easton Md., capital stock $5,000, has been incorporated. M. M. Higgins, A. G. Pascault and others are interested.

THE HAMBURGH RAILWAY COMPANY, Hamburgh, N. Y., has been incorporated by James E. Curtis, John O'Brien, William E. Ellwood and others, to build, operate and maintain a street surface railway, capital stock $10,000.

THE ELECTRIC CONSTRUCTION & SUPPLY COMPANY, of New York, has been incorporated with a capital stock of $12,000. Arthur A. Lawrence, of New York, and Frank R. Kinsman, of Plainfield N. J., are among the incorporators.

THE MIDDLEBURGH & OAK HILL TELEPHONE COMPANY, Middleburgh, N. Y., capital stock $50,000, has been incorporated by Elias W. Dutton, Azano B. Brayman, W. J. Chase, Wm. Earle, Geo. Graham, Abalom Graham and others.

THE CAPITOL ELECTRIC ENGINEERING COMPANY, Lansing, Mich., capital stock $5,000, has been formed to manufacture and sell electrical supplies, etc. A. A. Robinson, Geo. L. Robinson, and E. P. Kinney, all of Detroit, Mich., are interested.

THE JEFFERSON PARK COMPANY, Charlottesville, Va., capital stock $50,000, has been incorporated with T. O. Troy, president; V. B. Peyton, secretary; Geo. Perkins, M. O Troy, and others for the purpose of erecting an electric light or gas plant.

THE WELLSVILLE ELECTRIC LIGHT COMPANY, Wellsville, O., capital stock $30,000, has been formed to generate and deal in electricity for heat, power and light. The promoters are Homer Laughlin, W. E. Wells, R. L. Andrews, Julius Coetz and H. C. Wells.

THE MARION LIGHT, HEAT & POWER COMPANY, Marion, Ia., capital stock $50 000, has been formed to manufacture, buy and sell electric light and power machinery, fixtures, appliances, etc. J. E. Bowker, C. C. Hodges and W. M. Hodges are the promoters.

MISSISSIPPI VALLEY HARRISON TELEPHONE COMPANY, Grand Rapids, Mich., capital stock $100,000, has been formed to do a general electric telephone business and sell patent rights. The organizers are J. M. Beakesly, T. Stewart White and Wm. T. Hess, of Grand Rapids.

THE HOME TELEPHONE COMPANY, Baltimore, Md., capital stock $500,000, has been organized by Franklin Noble, of New York, president; W. S. Risley, Camden, N. J., and C. H. Ware, of Baltimore, as vice-presidents, and W. J. Atkinson, of New York, as general manager.

ROCHESTER CHARLOTTE & MANITOÙ ELECTRIC RAILWAY COMPANY, Albany, N. Y., has been incorporated by Michael Doyle, Chas. W. Briggs, Louis Warfield and others, to take over and possess the property and franchise of the Grandview Beach Railway Company.

THE TOPEKA (KAN.) WATER & ELECTRIC POWER COMPANY has been incorporated with a capital stock of $1,000,000, for the purpose of erecting an electric plant, etc. F. A. Sessions, of Ionia, Mich., and J. D. McAfee, of Topeka, are among the incorporators and can be addressed.

THE ELECTRIC CONSTRUCTION & SUPPLY COMPANY, New York, capital stock $12,000, has been incorporated to deal in all kinds of electrical and mechanical apparatus and specialties. A. A. Lawrence, New York; C. E. Rocap and F. E. Kinsman, Plainfield, N. J., are the promoters.

THE PETER BALLINGALL COMPANY, Atlantic City, N. J., capital stock $60,000, has been formed to construct, enlarge, complete or cause to be built railways, gas works for light and heat, and electric light works for light, heat and power. The promoters are Peter Ballingall, Wm. Martin and James Brown, of Philadelphia, Pa.

THE AYER ELECTRIC TYPEWRITER COMPANY, Concord, N. H., capital stock $300,000, has been formed to manufacture electric and other typewriters, and to buy and sell machinery patents, etc. Chester M Sprague, Claremont, N. H.; Chas. A Herbert Concord, N. H., and Henry E. Adams, Boston, Mass., are the promoters.

THE BRANDENBURG UNDER CAR ELECTRIC RAILWAY COMPANY, Chicago, Ill., capital stock $5,000,000, has been formed to manufacture, acquire and own inventions and patents in railway appliances and devices, and operate and own street railways. Geo. Brandenburg, Geo. W. Van Zandt and Wm. M. Youmans are interested.

THE CONSOLIDATED TELEGRAPH & NEWS COMPANY, Boston, Mass., has been incorporated by Wm. H. T. Hughes, Jas A. Davis, Geo W. Cummings, Joseph Thorn, Frank M. Clute, Richard H. Jaeger and Henry Herrold, for the purpose of manufacturing, purchasing leasing, supplying and selling telegraph instruments and appliances. Capital stock $600,000.

THE PACIFIC POWER COMPANY, San Francisco, Cal., capital stock $500,000, has been formed to purchase, sell and lease property, steam power and machinery for same, and to generate and supply electricity for lighting and other purposes. The promoters are W. A. Aldrich, San Francisco; G. W. Howard, San Mateo, and A. W. Bowman, Oakland, Cal.

THE BALTIMORE, SEVERN PARK & ANNAPOLIS RAILWAY COMPANY, Baltimore, Md., has been incorporated by G. Howard White, Benjamin F. Simons, David S. Collett, Dr. Robert B. Johnstone, Robert I. Dungan and Arthur M. Easter, to construct a railway from Westport, Baltimore county, to Severn Park, Anne Arundel county. Capital stock $100,000.

THE FAULTLESS GAS SAVER COMPANY, San Francisco, Cal., capital stock $100,000, has been formed to purchase patent rights for gas, water, and electrical machines, appliances, regulators, etc., and to manufacture appliances for measuring water, gas and electricity. The promoters are E. J Norris, A. K. Stevens, J. Kroaker, M D [illegible] and C W Nevine, San Francisco Cal.

TELEGRAPH AND TELEPHONE.

MONROE, LA.—W. B. Reily is forming a telephone company.

CHESTERTOWN, MD.—Steps are being taken to establish a telephone exchange.

MILLEDGEVILLE, GA.—W. E. West is in the market for equipment for telephone lines.

LANCASTER, PA.—Address T. E. Fraim concerning new telephone equipment to be purchased for the Citizens' Telephone Company.

SHREVEPORT, LA.—Address Jno. W. Taber concerning complete equipment for a telephone system for the Citizens' Co-operative Telephone Association.

CHATTANOOGA, TENN.—The People's Telephone & Telegraph Company, of Knoxville, J. C. Duncan, general manager, is contemplating the establishing of a new telephone system here.

WOONSOCKET, R. I.—The New England Printing Telegraph Company's property has been purchased by the Baldwin Brothers' Company. The property includes two telegraph lines from this city to Boston and Providence.

MONROE, LA.—A company has been organized by W. B. Reily, W. L. Morris and J. H. McCormick, to construct a telephone system. The capital stock is $7,500.

MOBILE, ALA.—D. R. Burgess, E. O. Zadek and S. L. Hahn are interested in the organization of a company to establish a telephone system of 400 instruments. About 200 subscribers have been secured.

LAPORTE, IND.—The Elkhart Telephone Company, which will be a competitor of the Bell corporation, has been organized under the laws of Indiana. The board of directors includes R. B. Campbell, general manager Baltimore & Ohio Railway Company, Baltimore, Md.; H. E. Bucklen, president Elkhart & Western Railway Company, Chicago, Ill.; Charles Selden, superintendent of telegraph, Baltimore & Ohio Railway, Baltimore; O. N. Lumert, Elkhart, Ind.; Jospeh Claybaugh, Indianapolis, Ind.; W. F. Ranfiel, Frankfort, Ind. The company claims to have unlimited capital at its command.

ELECTRIC LIGHT AND POWER.

GREEN ISLAND, N. Y.—A $20,000 electric light plant is to be established.

PORT EWEN, N. Y.—Steps are being taken to establish an electric light plant.

TAMPA, FLA.—E. W. Henck, of Longwood, has obtained an electric light franchise.

MORRISVILLE, N. Y.—A stock company is forming to operate an electric light plant.

LOVELAND, COL.—J. S. Alexander has been granted a franchise to build an electric lighting plant.

ORLANDO, FLA.—E. W. Henck, of Longwood, has been granted a franchise for an electric light plant at this place.

BRIDGEWATER, MASS.—A $10,000 municipal electric lighting plant will be built. Address the clerk of the council.

ARLINGTON, MASS.—The erection of a municipal electric lighting plant is contemplated. E. Delmont Locke is interested.

SANDY HILL, N. Y.—The authorities have decided to light the streets with electricity. The village clerk can be addressed.

KINGSTON, N. C.—Address the mayor concerning $40,000 worth of bonds to be issued for the establishment of an electric light plant.

ROCHESTER, N. Y.—An isolated electric plant is to be installed in the new court house. The Board of Aldermen can be addressed.

GOSHEN, N. Y.—$3,000 is to be appropriated for the purpose of lighting the village streets for the ensuing year. Address the village clerk.

ROXBURY, MASS.—The Globe Electric Light Company has purchased a site on which it contemplates building a plant. Address the secretary.

ELBERTON, GA.—At a recent election it was decided to build an electric lighting plant. The mayor can be addressed for detailed information.

ALTOONA, PA.—An appropriation of $70,000 is projected for building an electric lighting plant. The clerk of the council can give detailed information.

ELM GROVE, W. VA.—Address Paul Reyman, at Wheeling, regarding the erection and equipment of an electric light plant to be established at Elm Grove.

ONTARIO, CAN.—At a meeting of the Ontario Electric Company it was decided to proceed at once with the putting in of an electric light and power plant.

LINCOLN PARK, PA.—We are informed that a new dynamo is to be installed in the electric lighting plant at this place. The board of town trustees can furnish further details.

ATLANTA, GA.—Sealed proposals will be received by C. E. Harman until March 30 for the lighting of the streets of this place with electricity for terms of one, five and ten years.

LAUREL, MD.—The Laurel Electric Light, Power and Heat Company's plant has been purchased for $7,000 by Jos. Friedendwald and a Mr Miller, of Baltimore, and will be put in operation.

ST. LOUIS, MO.—The County Electric Light & Power Company has a 20 year franchise from the St. Louis County Court to establish a plant to erect poles, etc., and the right to use the poles of the St. Louis County Telephone Company.

PHILADELPHIA, PA.—The Cheltenham Electric Light, Heat & Power Company, Oak Lane, Station A, this city, is in the market for a 150-kw, 1,000-volt generator, a 200-hp compound high-speed engine and a suitable condenser

BLOOMINGTON, ILL.—The electric light plant owned by the Bloomington Electric Light & Power Company, which was destroyed by fire recently, is to be rebuilt in the near future. The secretary of the company can be addressed for details.

SPRINGFIELD, MASS.—It is reported that the United Electric Light Company will put in a 500-hp motor to displace the engines now driving its power generators. This motor will be supplied with current from a generator to be driven by water power at Indian Orchard.

PHILADELPHIA, PA.—Sealed proposals will be received at the county prison, Tenth and Reed streets, until 12 m., March 29, for the following work on the new county prison at Holmesburg Junction: Incandescent electric light plant, boilers, telephones, electric bells, burglar alarms, elevators, etc., etc. Plans and specifications can be seen and all information, together with requisite blank forms, can be obtained at the office of the engineers and architects, Messrs. Wilson Bros. & Co., Drexel Building, Philadelphia, Pa.

THE ELECTRIC RAILWAY.

PARKERSBURG, W. VA.—The Parkersburg Traction Company has been chartered to build an electric line.

SOUTH ORANGE, N. J.—The New York & Philadelphia Traction Company has secured a franchise for a trolley road on Springfield avenue.

BALTIMORE, MD.—Mr. Geo. R. Webb and Mr. Simon J. Martenet are interested in the construction of an electric railway on the Belair road.

STOWE, VT.—At an adjourned town meeting, March 10, it was voted to issue $40,000 in 4 per cent. bonds to build an electric road to Waterbury.

ALLENTOWN, PA.—An electric railway is projected from this place to Reading. Victor D. Barner and W. A. Heller are among those interested.

COLUMBIA, PA.—The Columbia, Ironville & Mt. Joy electric railway is to be built as soon as possible. Messrs. H. H. & B. D. Heise are interested.

DIGHTON, MASS.—The Selectmen have given the franchise for the electric road to the Taunton Company. The road must be in operation by Oct. 1.

EDGEWATER, S I., N. Y.—The Town Trustees have granted the Staten Island Electric Company right of way on the turnpike road to South Beach.

COLUMBIA, S. C.—The Columbia Street Railway Company has decided to make several extensions in the suburbs. President Marshall may be addressed.

FAIR VIEW, PA.—The Cumberland Valley Traction Company will extend the road up the river to Marysville. The secretary of the company can furnish details.

PITTSBURGH, PA.—The Second Avenue Traction Company has secured right of way and will extend its lines from McKeesport to Elizabeth, a distance of four miles.

SOMERSET, MASS.—The Taunton & Fall River Street Railway Company has been granted a franchise for a line to be built at this place. The secretary can furnish details.

PARKERSBURG, W. VA.—The Parkersburg Traction Company has been granted a charter to build an electric railway in this city. Address the secretary for details.

KINGSTON, N. Y.—An electric railway is to be built from Kingston to Lake Katrine, New York parties having subscribed a sufficient amount to make this project a success.

ORANGE, N. J.—The Suburban Traction Company will equip their lines at East Orange, Bloomfield and this place with electricity at once. Watson Wittlesee, receiver of the road, can be addressed.

DENTON, MD.—The Delaware legislature has granted the Queen Anne's Railroad Company a charter to build to Rehoboth Beach from Queenstown, Queen Anne County. W. H. Bosley, of Baltimore, is interested.

NEW ORLEANS, LA.—Three hundred thousand dollars' worth of bonds are to be issued for the purpose of converting the Orleans Railway into an electric system. Peter Cougot, La Harpe and White streets, is president of the company.

NIAGARA FALLS, N.Y.—The construction of an aerial tramway along the edge of Niagara Falls is contemplated. A company has been incorporated to be known as the Niagara River Tramway Company, with a capital stock of $90,000. Robert N. Campbell, of this city, and A. M. Cutler, of New York, are among the incorporators, and can be addressed.

Trade and Industrial Notes.

CLUTE BROTHERS, Cohoes, N. Y., dealers in electrical supplies, etc, have removed to larger quarters at 72 Remsen street.

ELECTRICAL INSTALLATION COMPANY, Chicago, has removed its offices to Suite A, 1,116 Monadnock Building, where it will have largely increased facilities.

THE GENERAL ELECTRIC COMPANY has closed a contract with the Troy City Railway, Troy, N. Y., for thirty-two General Electric 800 car equipments to be delivered early in April.

THE TRIUMPH ELECTRIC COMPANY, of Cincinnati O., reports business so flourishing as to cause serious contemplation of an extensive addition to its facilities, so as to enable it to fill orders promptly.

THE AMERICAN ELECTRIC COMPANY, 102 Pearl street, Boston, has sold its business, machinery, stock, etc., to Mr. H. A. Williams, its ormer manager. Mr. Williams will continue the business under the old name.

THE DEANE STEAM PUMP COMPANY, of Holyoke, Mass., is distributing pamphlets descriptive of its triplex power pumps, pumping apparatus for artesian wells, boiler feeding pumps and other interesting specialties.

STABLER & McREYNOLDS, real estate and insurance agents, have established an office at 1,410 G street, N. W., Washington, D. C. Mr. Jas. P. Stabler, the senior partner, is well known in electrical circles as an engineer and inventor.

GODFREY G. LUTHY, representing the Royal Electric Company of Peoria, Ill., is East establishing agencies for the well-known Royal transformers, etc. The company has a fine Western trade and is now reaching out for Eastern business.

THE CUMMINGS & ENGLEMAN CONDUIT COMPANY, of Detroit, has closed a contract with the Niagara Falls Hydraulic Power Company for all the conduit necessary for the local power transmission mains to be supplied from the new station.

A. O. SCHOONMAKER, 158 William street, New York, is making a specialty of mica insulation for commutator segments, stamped from the solid sheet, and reports an increasing demand for these goods, to meet which he has put in an additional press which will enable him to fill all orders promptly.

THE ELECTRIC APPLIANCE COMPANY is doing a splendid business on "O. K." weatherproof wire and is laying in an exceptionally large stock for the coming spring business. The company claims to be in a position to ship a weatherproof wire order of any size from Chicago stock immediately on receipt.

THE NATIONAL TELEPHONE MANUFACTURING COMPANY, of Boston, has received a large order from the city of Cambridge, Mass., for specially wound receivers and granular carbon transmitters to equip the police signal boxes of that city. The National Company is also preparing special instruments for the West End Street Railway Company.

THE METROPOLITAN ELECTRIC COMPANY, 186-188 Fifth avenue, Chicago, has been appointed agent for the Solar arc lamp for incandescent circuits. The lamp has neither springs nor dashpots, is simple in mechanical construction, and is claimed to be remarkably efficient and reliable in operation. It is manufactured in various styles, plain and ornamental, to meet the requirements of purchasers.

ELMER G. WILLYOUNG & CO., Philadelphia, have just issued the first edition of their Catalogue N, embracing electrical and scientific instruments and apparatus manufactured and imported by this firm. The catalogue is very nicely gotten up, both as to print and binding. Messrs. Willyoung & Co. are American representatives for Nalder Bros. & Co., and L. Oertling, of London, and also handle the celebrated instruments of Lord Kelvin.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., has secured through its Western contractor, Mr. J. Holt Gates, of Chicago, the order for five 100-kw multipolar generators, with station equipment, for the new station of the Indiana Electric Railway Company, at Goshen, Ind. This contract was secured against the strongest competition, and reflects great credit on Mr. Gates as a salesman as well as being a tribute to the merits of the new Mather multipolar apparatus.

THE GENERAL ELECTRIC COMPANY has the contract for equipping the new water works at Canandaigua with apparatus for driving the pumps electrically. The power house will be located at Canandaigua Lake, and contain one 100-kw three-phase generator driven by a steam engine. The current will be transmitted 18,000 feet to the pumping station on the lake shore, where two pumps of a million gallons capacity each will be located. Each pump will be direct geared to a 100-hp induction motor, thus giving a duplicate plant at this point. The proposed pressure on the line is 2,030 volts.

THE SESSIONS FOUNDRY COMPANY, of Bristol, Conn., has found it necessary, owing to largely increasing business, to make plans for more extensive quarters and has accordingly purchased a 26-acre tract of land at the north end of the town, having a railroad frontage of 900 feet. The main foundry building will be 110x500 ft.; shipping building, 70x300 ft.; pattern shop, 60x80 ft. (two stories); and pattern storage building, 50x100 ft. (two stories). There will also be a large power house and commodious office building. The work will be lighted by an isolated electric plant.

M. T. DAVIDSON, builder of the "Davidson" steam pump, will, after April 15, remove his New York office and salesroom from the quarters so long occupied at No. 77 Liberty street, to No. 133 same street, where the entire first floor will be occupied. This will provide for an extensive showroom where a large and interesting exhibit of Davidson pumps in various styles and sizes will be made, and will afford every facility for the convenient and expeditious handling of the yearly growing business. Parties interested in high class pumping machinery for all purposes are cordially invited to look in at the new quarters and examine the line of pumps which will be shown.

THE GOULDS MANUFACTURING COMPANY has just begun the erection of a new addition to its extensive works at Seneca Falls, N. Y., necessitated by its steadily increasing business in triplex power pumps. The building will be a modern structure of the slow burning type. Its length is 86 ft. and width 35 ft. The framework, beams, columns and roof truss will be of steel The building will be two stories in height, with basement for storage of castings. The main room for heavy machines and erecting purposes will be 22 ft. high, and served by an electric bridge crane of 10 tons capacity. The gallery will divide one side into two stories for lighter machine tools. The walls will be of brick, while the skylight and upper windows will be glazed with ribbed glass. The entire main floor is designed to stand a uniform strain of 400 pounds to the square foot, although a limited area is capable of bearing 600 pounds to the square foot. It is expected that the building will be completed about June 1.

Business Notice.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

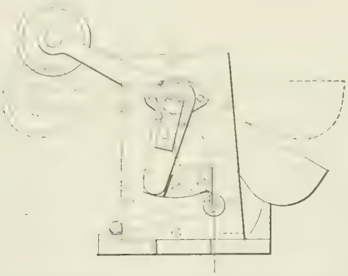
Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 19, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

535,810. SPRING-WINDING MEANS FOR PRINTING-TELEGRAPH INSTRUMENTS, J. Burry, Long Island City, N. Y. App filed May 12, 1894 The combination with the escapement of a main spring, means for automatically winding it at intervals, a main gear connected to said spring, a second gear driven by said main gear and loose on its shaft, a spring connecting it with its shaft, and a momentum device for continuing the spring-winding.

535,838. INCANDESCENT ELECTRIC LAMP; W. S. Lowe, Lima, Ohio. App. filed Oct. 15, 1892. The combination of an incandescent electric lamp, and a conical shaped reflector in the upper portion, the base of the reflector beginning near where the outside cap ends and extending downward to a point at the stub end through which the filament enters the bulb.



No. 535,936.—Conduit Electric Railway.

535,840. ELECTRIC ARC LAMP; G. R. MacIntire, New York, N. Y. App. filed July 5, 1894. The combination of a supporting plate, a shaft having a spiral groove supported by said plate, a traveling nut mounted on said shaft, a carbon holder connected to said nut, a ratchet wheel fixed to said shaft, a pawl and means to actuate the same, a short shaft supported by said plate and having an arm with a tooth to engage said ratchet wheel as a hold pawl, and also to disengage the actuating pawl from said wheel.

535,841. ELECTRIC ARC LAMP; G. R. MacIntire, New York, N. Y. App. filed July 5, 1894. The combination of a supporting base, a sleeve mounted on said base and composed of insulated longitudinal sections, a carriage mounted to slide on said sleeve and composed of insulated sections in contact respectively with the sections of said sleeve, carbon holders carried by the sections of the carriage, other corresponding carbon holders, and a single feeding mechanism for actuating said carriage.

535,842. ELECTRIC ARC LAMP; G. R. MacIntire, New York, N. Y. App. filed July 10, 1894. The combination of arms mounted to swing toward each other, carbon holders supported by said arms, a screw threaded shaft, a traveling nut mounted on said shaft, and intermediate means between said nut and arms to swing the latter.

535,885. ACCUMULATOR PLATE; G. R. Blot, Paris, France. App. filed May 22, 1894. The combination of a frame, bands in the form of coils and the supporting means for said coils, comprising bars with bifurcated ends, said ends embracing the coiled bands and bearing against the sides of the frame, said coils being transformed into active matter up to the greatest expansion, and connected through solder to the frame.

535,905. METHOD OF AN APPARATUS FOR OBTUNDING NERVES; W. P. Horton, Jr., & A. B. Jones, Cleveland, O. The combination for excavating dental cavities and simultaneously obtunding the sensory nerves which are being affected by the operation, the use of a generator, an electrode connected with one pole of said generator, and means for securing the same against the patient's face, with the revolving burr of a dental engine having an insulating hand piece, suitable electrical connections between said burr and the other pole of the battery, and means for varying the resistance in the circuit by small increments.

535,917. INDUCTION COIL; A. F. W. Meyer, Blue Island, Ill. App. filed Nov. 27, 1894. An induction coil having a spool, a primary wire and a secondary wire coiled about the spool and separated by interposed insulation and each having its outer end extending from the periphery of the coil and its inner end extending out adjacent to the spool, and soft iron expanded heads in the opposite ends of the spool affording confining shields for the coils.

535,936. CONDUIT ELECTRIC RAILWAY; F. P. Bergh and C W. Tarbox, New York, N. Y. App. filed May 25, 1894. In an electric railway, a slotted conduit, a moving car, a contact shoe carried by said car and running entirely within the conduit, said shoe being constructed in sections hinged together and adapted to swing laterally and a roller mounted in a pivoted frame at each end of the shoe, arranged to project into the slot of the conduit to guide the shoe around curves.

535,971. INSULATED TROLLEY SECTION AND CROSSOVER; M. M. Wood, Chicago, Ill.; C K. King, Mansfield, O. App. filed July 13, 1894. A trolley insulator comprising a piece of insulating material provided at each end with a cap having an opening or recess that increases in size as it increases in depth, a wedge within said recess adapted to enter the ends of the insulating material and expand them so as to prevent their removal, and a tongue fastened to each of said caps and adapted to be connected to the trolley wire.

535,993. CLOSED CONDUIT ELECTRIC RAILWAY; J. F. McLaughlin, Philadelphia, Pa. App. filed Oct. 23, 1894. In an electric railway the combination with a closed conduit provided with main and supply conductors, of switch boxes arranged alternately on opposite sides of the conduit and provided with switching mechanism for coupling the main conductor with sections of the working conductor, and two series of electromagnets, on opposite sides of a motor car, in line with the switch boxes for operating the switches therein by magnetic attraction.

535,998. PIPE AND MODE OF LINING SAME; W. T. Ruete, New York, N.Y. App. filed Dec. 18, 1894. The improvement in the manufacture of lined pipes, which consists in coating with paste or cement one or more lining strips, introducing such strip or strips into the pipe, expanding them against the inner walls of the pipe, and then dipping the lined pipe in asphaltum paint or other equivalent material for improving the insulating quality of the lining or increasing its durability.

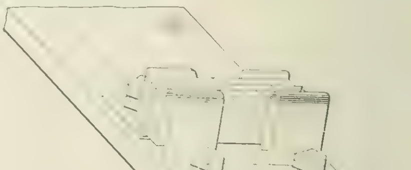
536,032. ALTERNATING CURRENT MOTOR; M. Hutin & M. Leblanc, Paris, France. App filed Nov. 17, 1892. A rotary field alternating current motor with two sets of field magnet coils supplied from a source of simple alternating currents, and a condenser or condensers connected up with the said field magnet circuits, whereby the currents in the same are displaced in phase.

536,055. APPARATUS FOR AUTOMATICALLY LIMITING SPEED OF ELECTRIC CARS; L. S. Wright, Philadelphia, Pa. App. filed Dec. 8, 1894. In an electric car, comprising a motor, a controller system and a brake system, the combination of a governor, means for driving the same in conformity with the speed of the car, actuating mechanism, a primary source of power for driving said actuating mechanism, and an engaging device operated by the governor and commanding the connection between the primary source of power for said actuating mechanism and the controller and brake systems.

536,076. COLLAPSIBLE CONDUIT FOR ELECTRIC RAILWAY CONDUCTORS H. C. Grant, New York, N. Y. App. filed Sept. 17 1894. An electric railway system having a main conductor and an inclosing casing therefor, composed of pairs of elastic metal plates secured together at their edges and of semi-elliptic cross section insulating supports for the main conductor within said casing and insulated contacts also carried by the casing, to be brought into electrical connection with the inclosed main conductor by a passing car.

536,095. PROTECTIVE DEVICE FOR ELECTRICAL APPLIANCES; Jos. J. O'Connell, Chicago, Ill. App. filed Nov. 23, 1894. A potential discharging protector comprising two conducting plates placed with parallel surfaces closely adjacent and adapted to be connected respectively with an electric circuit and with the earth, an intermediate dielectric strip such as mica, having a portion cut away so as to present a thin air space between the two plates, and an auxiliary interposed strip of sieve-like material, such as silk.

536,104. ELECTROMAGNETIC SIGNAL; T. Spencer, Cambridge, Mass. App. filed Sept. 10, 1894. The combination in a visible signal indicator, of a vertically mounted electromagnet, an armature therefor pivoted to the lower end thereof, a signal chamber with a horizontal window or aperture mounted on the upper end thereof, a disc or plate signal mounted on pivots therein and provided with an actuating arm projecting beyond the pivots, the said plate being adapted to remain by its own weight in a position retracted from the said window, but to assume a horizontal position, at the said window by pressure exercised on the said actuating arm; and an armature lever or rod attached to the said armature extending into the said signal chamber, and engaging the signal plate actuating arm lightly, while the said armature remains retracted, but adapted to exert thereon the force required for the elevation of the signal plate into its said position of display, on the attraction of said armature.



No. 536,095.—Protective Device for Electrical Appliances.

536,153. TIP FOR FLEXIBLE ELECTRIC CONDUCTORS; C. H McEvoy, Lowell, Mass. App. filed Feb. 4, 1895. A flexible conductor comprising a conducting core, a non-conducting covering and a conducting needle connected to said core and having a hook which passes through said covering, to retain said covering on said core.

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THE AMERICAN BELL TELEPHONE COMPANY.

In another column we print a resume of the annual report of the American Bell Telephone Company for 1894, which shows a decrease in net earnings of some $800,000 as compared with the previous year, but yet the company was able to pay three millions in dividends to its fortunate stockholders. The statistics given show the enormous extent to which the telephone has entered into daily life, the total number of calls, for instance, reaching 670,000,000, annually, or about ten for every inhabitant of the United States. The number of calls for each subscriber averages 8½ daily, the cost per call being from 2 to 10½ cents, according to the character of the service. The report refers to the greater use by subscribers of their telephone service, which in the last six years has increased 40 per cent. The plan of charging telephone rentals according to the amount of service received is, we learn from the report, being generally adopted in the larger cities. The American Bell Telephone Company deserves much credit for the valuable statistics which it includes in its annual report, in this respect, at least, giving evidence of a public spirit not usually shown by corporations.

GAS BATTERIES,

Renewed interest has been excited in gas batteries through the discussion caused by the recent work of Ostwald and Borchers in this field, and, therefore, the series of articles on this subject by Mr. C. J. Reed, the first of which we publish in this issue, will, we feel sure, be welcomed by our readers. The subject is one upon which it is ordinarily not an easy matter to obtain information, the references to it in text-books and technical treatises being usually of a perfunctory character. The experiments recorded by Mr. Reed in the present article are not favorable to the gas battery as a possible means of transforming the energy of gases directly into electrical energy, his conclusion being that the electrical energy of the cell experimented with is from some other source than the combination of oxygen and hydrogen. In another column is an abstract of a Franklin Institute paper, by Prof. A. H. Bucherer, bearing on the same subject, the results claimed for the Borchers gas battery being severely criticised. In this case also it is demonstrated that the electrical energy obtained was not derived from the combination of the gases—carbon monoxide and oxygen—but by means of the solvent used for their absorption.

SYNCHRONOUS ALTERNATING MOTORS.

In another column we print the concluding portion of the paper of Profs. Bedell and Ryan on the action of a simple alternating synchronous motor. As here condensed from the original in the *Journal* of the Franklin Institute, the many references to other authors who have contributed to the same subject are omitted, as well as tables of data from which the diagrams we print were prepared, but otherwise the paper is complete. We may add that it furnishes the most complete non-mathematical exposition of the action of this class of motors yet made, and will repay careful study by the student or others desiring to become acquainted with the more complicated actions present in alternating current working. The important function of self-induction in a motor is very clearly brought out, as well as the effect of phase relations of the generator and motor currents and E. M. Fs., many of the points developed applying also to the theory of simple alternators. A very interesting property of the simple alternating motor here explained is its condenser action when over excited. This property, which, we believe, was first mentioned by Steinmetz, is likely to have a practical application in connection with alternating distribution, as by its means the inductive drop of the lines may be very simply nullified by connecting in properly designed motors of this type and running them unloaded. The series of diagrams given with this section of the paper enable the relative action of the various factors entering to be easily followed, and, in connection with the curves printed in our previous issue, they show very clearly the effect of the armature reaction in the generator and motor on the self-regulation of the plant. The method adopted by the authors for explaining this branch of alternating current working is much more satisfactory than a mathematical one, and places a subject within reach of all which but a favored few could follow, if treated analytically, owing to the advanced knowledge of mathematics that would be required.

THE ELECTRICAL TRANSMISSION OF POWER.

The present year promises to be a fruitful one in the development of electrical transmission of power, which branch of the electrical industry may now be considered as firmly established on a commercial basis and with all of its electrical problems solved. The first 5,000-hp unit of the Niagara plant will start up in a few days, and the Folsom-Sacramento plant, an account of which we publish in this issue, is also well on toward completion, so that the many projects which have been awaiting a favorable practical demonstration will soon receive, we believe, the encouragement necessary to put them in course of execution. Whether it will pay to transmit power over long distances by electrical means is a question that does not need to be taken up at present, as transmissions over comparatively short distances are numerous enough to engage the activities of the industry for some time to come. It will, besides, be much better to confine attention to these latter, and let the commercial practicability of the more ambitious projects be determined by the result of gradual extensions of lines from plants which have been profitably established on the basis of shorter transmissions. In most of the discussions thus far on the commercial feasibility of electrical transmissions there has been much haziness in regard to the correct basis for comparison with steam power, the cost of an indicated horse power usually being compared with that of an electrical horse power, and even with that of an electrical horse power delivered in some cases. We believe that no authoritative test has yet shown a cost for steam power of less than $30 per annual indicated horse power, even for large units and cheap coal, which figure we will accept for comparison with the cost of electrical power from Niagara to Buffalo, on the supposition that in both cases the distribution of electrical current for power purposes is the final object in view. The Niagara company can sell with profit mechanical energy at the turbine shafts in its hydraulic station for $13 per annual horse power, and to put this on the same basis with a steam electric generating plant at Buffalo, only the losses, fixed charge and maintenance relating to the transmission line, step-up and step-down transformers should be considered, as the cost of the factors relating to the generation of current and its distribution apply equally to the case of the steam plant. For the line and transformer losses 80 per cent. would be a reasonable figure, which would bring the cost to about $16 per annual horse power, less the line and transformer charges, which latter would probably not increase the figure beyond $20. Accepting this estimate as approximately true, it follows that steam power generated at Buffalo cannot compete with Niagara power in the generation of current for distribution in that city for power purposes, and we believe the same to be true with respect to electric lighting, the only extra factor of cost in this case resulting from the partial employment of continuous currents for that purpose at present. As to the competition of electric power with steam power in manufactories, there is only room for discussion where the quantity used is very large, and of these cases there are very few in even the largest city—perhaps not half a dozen in Buffalo. Recent estimates of the cost of power from these large plants have varied from $32.70 to $50 per annual horse power, and the lowest of these figures can almost undoubtedly be met by Niagara power. It should be borne in mind, however, that the profitable field for electric power will be in replacing small and moderately sized steam plants, where the cost of steam power varies from $50 to $150 per annual horsepower. Owing to the less space occupied, and the much greater convenience of electric power, an electrical transmission company should be able to contract in these cases for the replacement of steam by electric power at a figure very near the cost of the former, thus securing a margin of profit which will render financial success assured in many of the cases where it has been thought dubious through estimates made on the minimum cost of steam power generated in exceptionally large quantities.

The Westinghouse and General Electric.

No official statement has yet been made by the General Electric or Westinghouse interests in regard to the terms of the arrangement recently entered into by the companies, and referred to in our last issue. There are rumors that the agreement also includes an understanding as to prices, but no confirmation of any of the various details published in financial journals and elsewhere can be obtained, the officers of the company positively refusing to affirm or deny any report. It is probable that the secrecy maintained is due to the fact that numerous details as to royalties have to be settled before the deal can be finally consummated, as well as questions relating to prices, should this matter form part of the arrangement.

Gas Engine Electric Lighting Stations.

The progress of gas driven electric supply stations in Great Britain only recently received an impetus through the starting of the Belfast station, which, however, has been subjected to a check through the failure of the system at Coatbridge. At this latter station, which was originally designed to work with alternators to run in parallel, it has been decided to abandon the whole of the gas plant, and to substitute steam engines. It is not to be supposed that gas engine stations are to be discredited on this account, for it is pretty certain that the difficulties arose from attempts to run the alternators in parallel. At the Morecambe station some annoyance has been created by the water gas used in the engines, and it has been decided to remove the station to a locality outside the suburbs. Besides the stations which are using gas power entirely, there are not a few where gas engines are used for the light day load, a practice which seems to have a great deal to recommend it on economical grounds. With the exception of Belfast, all the stations entirely using gas employ a form of water gas produced from anthracite, but at Belfast the experiment of taking gas from the town mains is being tried.

Charging for Current.

In the remarks of Mr. John W. Lieb on the discussion of Mr. H. Ward Leonard's paper, printed in the March number of the *Transactions* of the American Institute of Electrical Engineers, he referred to the system of charging for current in use at Milan, Italy, according to which the consumer is at liberty to choose between two systems of payment. He may pay either on the basis, first, of a fixed charge of a certain sum, $5.75 per lamp installed per year, plus a charge of .67 cent per lamp hour as registered by the meter; or, second, a charge per lamp hour as registered by the meter on a sliding scale at a rate varying from a maximum of 1.5 cents per lamp hour, to a minimum rate of .96 cent, depending upon the number of lamp hours used per month per lamp equivalent installed. This system, Mr. Lieb added, covers fully and satisfactorily the question of a consumer's load factor, and gives the best consumer—that is, the one giving the company the greatest return per lamp installed—the benefit of the best rate.

A Scientific Society at Yale.

The scientific society of Sigma Xi has been formally established at Yale University. This society has for its object the advancement of scientific scholarship, and is in many ways similar to its literary sister, Phi Beta Kappa. The stimulus of Sigma Xi has had a marked effect wherever the society is established. At the opening of the society in New Haven last week the charter was presented by Dr. Frederick Bedell, representing the society, who is also a Yale graduate. A number of Yale graduates have already been actively connected with the society at Cornell University, where its influence is particularly strong, W. A. Anthony, F. Bedell and A. C. Crehore being among this number.

Annual Report of the American Bell Telephone Company.

We print below a resume of the fifteenth annual report of the American Bell Telephone Company from advance sheets:

The report states that the increase, within the year, of the aggregate number of subscribers reported by the various companies, was somewhat larger than that of the previous year, and taking into consideration the facts that general business throughout the country had not recovered its usual activity, and that the growth of the telephone business must be, in great measure, dependent upon the prosperity of commercial and manufacturing interests, the results have been on the whole satisfactory.

In comparing the gain in the output of telephones for the year 1894 over that of the year 1893—16,015 telephones for 1894, as against 13,771 in 1893—attention is called to the fact that in the months of January and February the returns exceeded the output by 3,472, so that the actual growth in number of telephones during the remaining ten months would be little short of 20,000 instruments.

Extensive additions and improvements of plant have been made by most of the companies, especially in the direction of underground and toll line construction. A greater mileage of toll wires has been added than in any previous year in the history of the business. Not including the cost of current repairs and renewals, the companies operating under our licenses have expended during 1894, upon extensions of lines and apparatus, $4,138,000, and for buildings to accommodate their exchanges $411,000, making, with the amount reported last year, a total of investment in telephone property in the United States of $77,500,000.

The pole line construction of the Long Distance Company last year consisted mainly of the line from Pittsburgh to Chicago *via* Indianapolis, and the line between Erie, Pa., and Norwalk, Ohio. No very important new places were reached during the year. The principal points to which service was opened were Richmond, Waterloo, Terre Haute and Michigan City, Ind.; Piqua, Tadmore, Columbus, Springfield, Zanesville, Cambridge and Chillicothe, O.; Wheeling, W. Va.; Danville, Ill., and McKeesport and Northumberland, Pa.

The construction department reports that the total of lines, Dec. 31, 1894, was 4,617.24 miles of pole line and cables, and 75,555.72 miles of wire. Of this there were constructed during the year 633.26 miles of pole line, and 9,379.71 miles of wire. The metallic circuit system has grown rapidly in favor, and at the close of the year the stations of 54,680 exchange subscribers were furnished with the equipment for this improved class of service, a gain during the year of 17,032.

The steadily increasing use which subscribers make of the exchange service continues to be a noticeable feature of the statistics furnished by the operating companies. On the average, each subscriber throughout the country now uses his telephone, upon calls made and received, 17 times per day. While this enlarged use is gratifying to the company as an indication of the enhanced value which the subscriber derives from the service, it is stated that the greater demand thus made upon the exchange system of necessity involves a corresponding increase in the cost of rendering service, and a larger investment per station for central office apparatus and trunk lines.

Comparing the latest statistics with those of six years ago, we find the total number of subscribers has increased by 42 per cent. Within the same time the average daily use of the exchange service by each subscriber has increased 40 per cent., and the number of employes engaged upon exchange work 76 per cent.

The great disparity in the number of calls made by different subscribers in the same exchange, who, though paying the uniform yearly rate require in the transaction of their business a widely varying amount of daily service, has led several of the companies, especially in the large cities, to consider the adoption of a plan for measured service, of which advantage can be taken by smaller users.

The plan has already been put in operation in New York, Brooklyn, Boston and some other exchanges. The choice is offered to subscribers of paying either the fixed yearly rate with unlimited local service, or a graduated scale of charges, dependent upon the extent of use within the year, the cost for connection lessening with the increase in the number of calls for which contract is made.

This system is an alternative to that of unlimited use, is equitable to those whose requirements for service are not large, and has commended itself to a considerable number of the telephone users in the exchanges named, some thousands being now connected on the measured service plan.

Referring to the authority granted by the Massachusetts legislature to increase the capital to fifty millions of dollars, but providing that in the first instance the stock should be offered to the stockholders at the market price, to be determined by the Commissioner of Corporations, having in view actual sales and "other pertinent conditions," and that what should remain undisposed of in that mode should be offered for sale by public auction, the report states the price at which 5,000 shares issued was thus fixed was $190 per share. One thousand six hundred and thirty-two shares were taken by stockholders; the remainder, 3,368 shares, were sold on the ninth day of February, 1892, by public auction, at an average price of $189.75 per share.

The suit of the United States vs. the American Bell Telephone Company and Alexander Graham Bell still remains pending, notwithstanding that the two Bell patents, No. 174,465, of March 7, 1876, and No. 186,787, of Jan. 30, 1877, which it was brought to annul, have both expired. The deposition of Mr. Franklin L. Pope was concluded May 15, 1894, and on June 15, 1894, the court extended until Jan. 1, 1895, the time within which the defendants might take further evidence. Owing to unavoidable interferences and to the illness of counsel for complainant, the time for taking defendants' evidence has again been extended to June 12, 1895. By that date, if no accident prevents, the defendants expect to have closed their testimony.

Referring to the suit of the United States vs. the American Bell Telephone Company et al.—the Berliner suit, so-called—the report states that an appeal has been taken to the Circuit Court of Appeals, and the cause is expected to be argued this month (April).

In the Western Union Telegraph Company vs. the American Bell Telephone Company, a decree was made by the Circuit Court allowing the motion of the plaintiffs to dismiss their case without prejudice. This motion was made upon the coming in of a report of the master finding that the plaintiffs were not entitled to the account asked for. An appeal was taken and the decree of the Circuit Court has been reversed by the Court of Appeals, the case being remanded to the Circuit Court for further proceedings.

In the thirteenth annual report it was stated that Edison's application for a patent for the carbon telephone had resulted in patent No. 474,231; but it was said:

"It is necessary to add, however, that Edison's foreign patents for the same invention, although applied for subsequently to the application in this country, had expired previously to the grant of the American patent. Our counsel inform us that the law is unsettled, whether in such cases the American application should be defeated by the expiration of the foreign patent, but that the better opinion is that the expiration of the foreign patent is immaterial."

The question involved has recently been determined by the Supreme Court in the case of the Bate Refrigerator Company vs. Ferdinand Sulzberger et al., which holds in substance that the domestic patent in such case is determined by the expiration of the foreign patent, notwithstanding that the domestic application is earlier than the application for the foreign patent. The result of the decision is to annul the Edison patent.

Referring to the Long Distance Company, the report states it had invested up to Dec. 31, 1894, in line construction equipment and supplies, $7,460,662.97. The company shows an increase in gross earnings in 1894 over 1893 of 13.4 per cent., the amount for 1894, gross, being $1,011,961.82. It will be remembered that the gross earnings for 1892 were $643,436.77; for 1893, $892,361.62.

The following is a comparative statement of earnings and expenses:

	1893.	1894.
Rental of telephones	$3,513,711 42	$2,502,992 17
Dividends	1,824,431 98	1,937,657 77
Commission from ex-terr lines	108,621 38	106,939 46
Commission from teleg. business	29,192 79	29,352 96
Real estate	68,097 06	69,675 09
Interest	225,936 28	196,455 11
Miscellaneous	11,086 08	5,172 38
	$5,781,076 99	$4,848,244 94
Expenses	$1,855,591 30	$1,724,459 87
Net earnings	$3,925,485 69	$3,123,785 07
Surplus account, December 31, 1893	$2,151,011 61	
Net earnings, 1894	3,123,785 07	
		$5,274,796 68
Regular dividends, 1894	2,400,000 00	
Extra dividends, 1894	600,000 00	
Reserve for depreciation of insts.	123,785 07	
		3,123,785 87
Surplus account, December 31, 1894		$2,151,011 61

The following are the ledger balances on Dec. 31, 1894:

DEBTORS.		
Telephones	$1,209,787 77	
Real estate	959,926 86	
Stocks	38,268,455 95	
Merchandise and machinery	14,232 70	
Bills and accounts receivable	4,346,554 55	
Cash and deposits	760,776 08	
CREDITORS.		
Capital stock		$20,000,000 00
Debenture bonds, 1888		2,000,000 00
Bills and accounts payable*		1,107,949 92
Patent account profit and loss		10,228,571 33
Profit and loss		5,849,444 13
Reserve		4,222,756 92
Surplus		2,151,011 61
	$45,559,733 91	$45,559,733 91

* Of this amount $900,000 is for the dividends payable Jan. 15, 1895, to stockholders of record, Dec. 31, 1894.

The following statistics are compiled from the report:

	Jan. 1, 1886.	Jan. 1, 1895.	Increase over 1894.
Instruments in use	353,518	582,506	16,015
Exchanges	747	867	29
Branch offices	428	572	1
Miles of wire on poles	100,332	232,008	17,332
Miles of wire on buildings	10,043	14,525	1,967
Miles of wire underground	3,417	148,285	27,610
Miles of wire submarine	254	1,856	219
Total miles of wire	114,046	396,674	43,194
Total circuits	112,067	212,074	6,183
Total employes	5,438	11,094	673
Total stations	137,750	243,432	6,246
Extra-territorial and toll lines:			
Miles of pole lines	30,697	49,324	2,597
Miles of wire	41,745	180,557	26,451

The estimated number of exchange connections daily in the United States, made up from actual count in most of the exchanges, is 2,088,152, or a total per year of about 670,000,000. The number of daily calls per station varies in different exchanges from 2½ to 24, the average throughout the United States being 8½, which shows an increase of 6¼ per cent. from last year in the average use made of the telephone by each subscriber. The average cost to the subscriber varies, according to the size of the exchange and character of the service, from less than 2 to 10½ cents per connection.

The average daily number o toll connections is 38,324, or a total per year of about 12,000,000.

Electricity Direct from Coal.

In a paper read before the electrical section of the Franklin Institute, Prof. A. H. Bucherer discusses the work of Borchers from the standpoint of the energy theory. He first shows why Borchers had no right to expect from the reaction $2\,CO + O_2 = 2\,CO_2$ an amount of electrical energy that would be equivalent to the heat of combination; for although with many primary cells the E. M. F. as calculated from the heat of combustion does not materially differ from the actual E. M. F., yet with a reaction so vastly different from those of ordinary cells as the one utilized by Borchers, the assumption of equivalency is not permissible. The author deduces the Helmholtz equation establishing the relations subsisting between heat of formation, E. M. F. and temperature co-efficient. In proceeding to calculate the E. M. F. obtainable from the electrochemical combination of CO with oxygen, he first points out that the maximum amount of work obtainable from a chemical reaction is a definite quantity and is entirely independent of the kind of energy into which the chemical energy is transformed, so that if we can find this amount in mechanical units or any other units we need only express these units in equivalent electric units to obtain the desired amount of electrical energy, and if one electrochemical equivalent is concerned in the reaction the electrical energy is numerically equal to the E. M. F. To find this E. M. F. for the oxidation of CO it is most convenient to consider the work done by the expansion of the gases CO and O in the process of reaction. Deville finds that at 3,000° Celsius carbonic acid is dissociated into CO and O to an amount of 40 per cent. Prof. Bucherer calculates from this that at 0° Celsius and atmospheric pressure the fraction of dissociated CO_2 is $\frac{1.58}{10^{34.86}}$ and it follows that whenever CO and O combine at 0° Celsius and atmospheric pressure, this process is equivalent to the passing of CO and O from atmospheric pressure to the exceedingly small partial pressures with which they are present in the reaction products. Consequently, if they perform a maximum amount of work while reacting on each other, we know from the laws of gases that this mechanical work of expansion is proportionate to the absolute temperature and to the logarithm of the ratio of initial and final pressures. If 56 grams of CO and 32 grams of O react, the work is

$$W = 2RT \log._e \frac{1}{p_1} + RT \log._e \frac{2}{p_1} = RT \log._e \frac{2}{p_1{}^3} \text{ calories.}$$

Here p_1 means the partial pressure of CO. Evidently this partial pressure is $\frac{1.58}{10^{34.86}}$ atmospheres, therefore

$$W = RT \log._e \frac{10^{104.58}}{2} \text{ calories.}$$

The work done by 1 electrochemical equivalent expressed in electrical units which is numerically equal to the E. M. F. is obtained by dividing this value by 4 × 23039 and we obtain:

$$E = \frac{1{\cdot}98 \times 273}{4 \times 23039} \log._e \frac{10^{104.58}}{2} \text{ volts} = 1.41 \text{ volts.}$$

This value holds for 0° Celsius; for 18° we have 1.406 volts, whereas the heat of formation would furnish the value 1.476.

The author further shows that if in a supposed reversible electrochemical system the E. M. F. obtained differs appreciably from the theoretical value, then the action which is expected to furnish the electric energy cannot take place. Borchers only obtained 0.5 volt, hence the combination of CO with O could not furnish the current he observed, and it follows that the E. M. F. obtained was at the expense of the solvents used for absorbing the gases. To say, as Borchers and Ostwald did, that already 30 per cent. of the potential energy of the coal could be converted into electric energy, while the steam engine converted much less, is, therefore, a grave error. The above calculation of the E. M. F. is the first one ever made for a real chemical reaction.

Steel and Iron for Field Magnets.

BY LEWIS T. ROBINSON.

The curves showing permeability of some excellent mild steel samples, published in your issue of March 16, by Prof. Jackson, certainly warrant his conclusion that for dynamos using a high field density steel is much superior to iron as a material.

However, his sample of good wrought iron possibly approaches the best. Iron of this quality is, no doubt, obtainable, perhaps some is slightly superior to it, but because a magnet is simply made of wrought iron does not always signify that it is better than steel. The best wrought iron may be better than the best low steel, but taking the average iron, this is probably the reverse.

A number of examinations of wrought iron samples have led to the conclusion that the general run of commercial wrought iron of American make is about represented by Table I; also that there is much which is vastly inferior to this.

TABLE I.

$\mathcal{B}$	$\mathcal{H}$	μ
4,000	3.03	1,320
6,000	4.05	1,480
8,000	6.2	1,290
10,000	9.71	1,030
12,000	16.9	710
14,000	33.3	420
16,000	133.5	120

Steel also varies considerably, but a few founders are paying special attention to producing good dynamo castings, and selling the same on their magnetic merits, if not exactly on magnetic specifications showing tests made on their product. The castings furnished are pretty close to their representations, sometimes better.

Forges and rolling mills are generally giving their attention to producing material suitable for mechanical purposes, but knowing nothing of its magnetic properties beyond the fact that dynamo builders buy it, and it must be all right.

To show that information of this kind can be very misleading, Table II. gives results condensed from a recent test on some sheet iron sold as being especially suitable for armature cores. It is apparent at once that it is of inferior quality for such uses.

TABLE II.

$\mathcal{B}$	$\mathcal{H}$	μ
4,000	8.5	470
6,000	9.3	554
8,000	14.8	540
10,000	22.2	450
12,000	40.0	300
14,000	93 3	150

The only purpose of this note is to call attention to the fact that all wrought iron will not develop a curve like the classic sample of Hopkinson, which is sometimes regarded as a fair basis to start from in judging of the comparative merits of a particular steel. Iron like this is scarce, indeed.

Electricity at the New York Navy Yard.

THE great extent to which electricity is employed in the new warships of the United States Navy would naturally lead one to infer that at the New York Navy Yard, where the principal naval electrical depot is located, there would be an extensive electrical establishment. This, however, is far from being the case, owing doubtless to the parsimony of Congress in its appropriations for other than the most pressing necessities of the naval service. Even in the electric lighting of its great workshops, the navy yard is behind the meanest private establishment, notwithstanding the pressure brought to bear on each successive Congress by the Secretary of the Navy for appropriations necessary to purchase and install a plant of the necessary character and capacity.

The machine shops aboard all of the larger men-of-war afford facilities for ordinary electrical repairs, thus relieving the yard shops to some extent. Aside, however, from repair work and the calibration of instruments, an important function of the yard electrical department is in the inspection and testing of electrical naval supplies and machinery, the exigencies of the service requiring that nothing shall pass into use until its reliability has been thoroughly established by the most rigid tests or inspection.

The electrical machine shop, dynamo room and the balance room are in Building No. 8. In the machine shop are lathes, shapers, milling machines, etc., driven ordinarily by a small steam engine. A 12-kw Edison dynamo is belted to the line shaft which transmits power to the machine tools, and under ordinary circumstances this dynamo furnishes current for lighting the shops and testing rooms. In case it becomes inexpedient for any reason to run the steam engine, the lighting circuit and dynamo are connected up with the Navy Yard street mains, the dynamo then being used as a motor to drive the machinery.

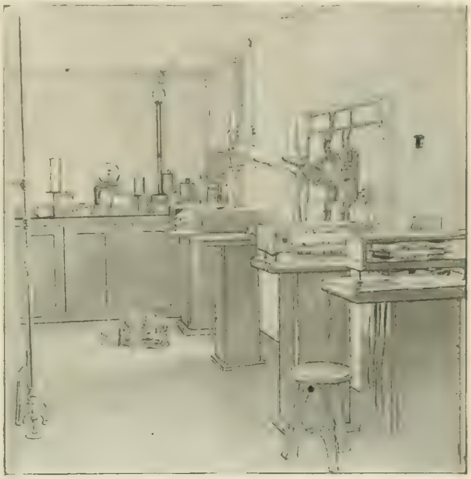
The current for heavy testing is supplied by the direct connected equipment imported from abroad, consisting of a Siemens generator of 80 volts and 400 amperes capacity, and a 40-hp Belliss double cylinder vertical engine.

Siemens Dynamo and Belliss Engine.

For lighter work a smaller outfit is used, consisting of a 2-kw General Electric dynamo direct driven by a Case engine. Both of these equipments, as well as the machinery above mentioned, are placed on substantial foundations entirely separate from the floor and foundations of the building so as to avoid transmitting any jar or vibration to the balance room.

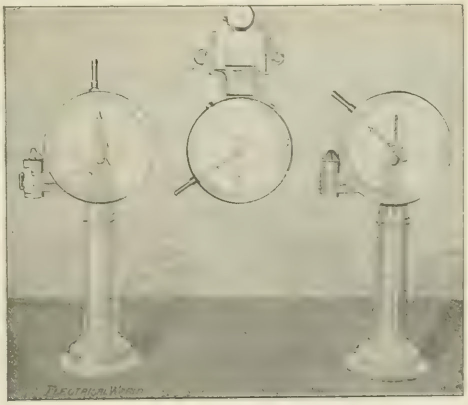
The balance room is fully equipped with Thomson balances, a Cardew voltmeter, d'Arsonval reflecting galvanometer, Wheatstone bridge, etc., for testing and calibrating voltmeters, ammeters, etc., and standardizing resistances.

In Building No. 7 are the store room, and the lamp and cable testing room. The latter is provided with all necessary apparatus for making photometrical and insulation tests, both of which are very rigidly carried out. Ten per cent. of each lot of lamps is tested, and in the event that 30 per cent. of the lot fails to come up to specifications the entire shipment is rejected. The insulation test consists in immersing the wire in salt water 24 hours, then submitting it to heat at 200 degrees F. seven hours a day for seven days, and finally giving it another salt water bath for 24 hours. Wire intended for 110-volt circuits is tested between each bath and the baking under a pressure of 300 volts, and is rejected unless the insulation shows a minimum resistance of 1,000 megohms per nautical mile throughout the series of tests. The baking is accomplished by placing the coil of wire in the centre of an oven, the walls, floor and roof of which are covered on the interior with steam pipes. The coil of wire is supported on blocks so as to avoid contact with the hot pipes.



Balance Room.

Among the multitude of supplies, instruments, etc., in the store room are to be found direct-connected marine electric lighting sets, electric projectors, and electric engine signaling apparatus. The latter interesting device, made by Elliott Bros., London, is shown above, and its function is to transmit signals from bridge to engine room on board ship, replacing the gongs and pull wires commonly used for that purpose. The mechanism in the engine room is a duplicate of that on the bridge. In practice the officer on the bridge pulls the handle over to the right or left, according to the direction in which he wishes the vessel to be propelled, until the pointer attached to the handle indicates the speed at which it is desired to run the engines. The needle of the engine room appa-



Engine-Signaling Apparatus.

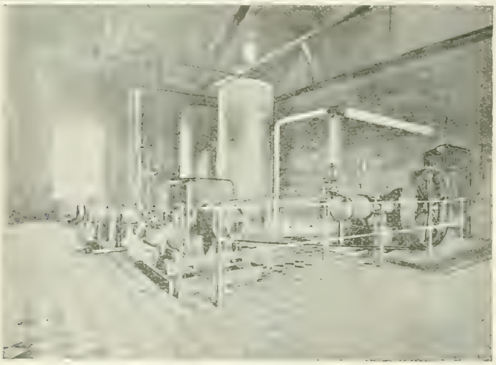
ratus moves in synchronism with the lever on the bridge, pointing out the speed and direction desired. The signal is acknowledged from the engine room by moving over the handle there until its pointer coincides with the signaling needle, which has the effect of moving the needle of the apparatus on the bridge exactly as the needle in the engine room was moved. Thus both engineer and pilot have a constant indication of the speed and direction of the engines.

Much credit is due to Lieut. C. E. Roller, U. S. Navy, and his corps of able assistants for the excellent results they have been able to accomplish with an insufficient equipment and restricted funds.

A Combined Electric Lighting and Water Works Plant.

In a paper recently read before an electrical society of Cologne, Germany, Mr. Max Luhn described an interesting installation, consisting of a combined electric and water works plant, which has been recently laid down at St. Lazarus, a small suburb of Posen, having a population of 3,000.

These works have been running only about a year, but the wisdom of the step taken is already clear, for the town has developed most remarkably, and a large number of families has moved there from Posen, in order to secure better and cheaper lighting as well as excellent drinking water. Building operations are being very actively carried on in St. Lazarus, and the fact that the electrical machines are being run to their full capacity only a few months after their installation testifies to the great favor in which the new lighting system is held.



Figs. 1 and 2.—Pumping Station.

After borings had been made in a piece of land belonging to the town, with results which assured an abundant supply of excellent water, the town council called for bids for an electrical plant and water works. After a thorough examination of the plans of the competing firms the contract was awarded to the Helios Company, and work was begun in the fall of 1893.

The piece of ground in which the four artesian wells are bored lies at the highest point of a hill which rises above the whole surrounding country, and the pumps had therefore to be placed in a shaft 6.5 metres deep.

The whole plant may be divided into four parts: boiler house, engine room, pump shaft and accumulator room. Two Cornish steam boilers are set up in the boiler house; each of the furnaces contains six Galloway tubes, and the working pressure is 90 pounds. One boiler suffices for running the electrical machines and the pumping plant, while the second boiler is held in reserve. A chimney 110 feet high will be able to take care of still another boiler, which it is intended to set up this spring.

In the boiler house is a feed water heater of two cubic metres capacity, which uses the exhaust steam from the pumps and engines. The feeding is generally done with a Worthington pump, while an injector is held in reserve.

Next to the boiler house is the large engine room, in one corner of which is the pump shaft, 6.5 m deep and 5.5 m in diameter. At the bottom of this shaft stand two pumps, which can each deliver 30 cubic metres per hour. One of these is a compound steam pump, while the other is driven by an electric motor with toothed rack gearing. In the shaft are also two reservoirs, consisting of large air pressure chambers, 9 metres high and 1.5 metres in diameter. These take the place of an expensive standpipe.

In the engine room is a 50-hp steam engine, which drives a dynamo of corresponding power by means of a belt direct from the fly wheel. The engine has a single horizontal cylinder, and is non-condensing; under favorable conditions of steam consumption it delivers 50 effective horse power at 190 revolutions per minute. It is provided with all the modern improvements, and particular stress is laid upon thoroughly reliable and automatic lubrication of all its parts. An extremely sensitive governor regulates the entrance of steam and keeps the speed constant under the most varying loads.

The engine driven dynamo is designed for the charging of accumulators, and its electromotive force can be increased to suit the varying demands upon it. The peculiar construction of the dynamo, and especially of the armature, insures almost absolute safety of operation, so that for the time being no reserve set of machines has been put in. As a matter of fact, since the beginning of operations on March 15, 1894, there has not been the slightest disturbance in the machine plant.

On the wall of the engine and dynamo room is placed the white marble switchboard, on which are mounted the few pieces of apparatus necessary for the whole plant. Next to the switchboard is an electric meter which registers the whole current entering the distributing network of conductors for the town. Beside this meter there is a smaller switchboard, from which branch out five circuits for street lighting.

At the left side of the switchboard is an automatic regulator, which keeps the voltage constant at the feeding point situated in the middle of the town.

At either side of the entrance to the pump shaft is a "Burckhardt Weiss" air compressor, driven by electricity. These compressors serve to increase the air pressure in the reservoirs when necessary. The highest working pressure in the water mains is five atmospheres, used only in case of fire. The ordinary pressure is three atmospheres.

Next to the engine room is the accumulator room, which contains a battery of 136 cells. This battery is capable of feeding 200 16-cp incandescent lamps for seven hours, and in case of fire breaking out at night can also supply current to run the electromotor pumps and the compressors, while the stoker is calmly getting up steam.

Feeders run from the central station to the middle of the distributing network, which is carried out on the three-wire system. The arc lamps for street lighting have separate circuits, which are switched in and out from the central station. All the conductors are carried overhead on chemically treated (creosoted) wooden poles with porcelain insulators. On the same pole line are carried telephone wires, connecting the engine room with the office of the town council, and signal wires, by means of which, in case of fire, the engineer, who sleeps in the central station, can be notified from a fire alarm apparatus situated in the principal street. The arc lamps for street lighting are hung on ornamental wooden poles 10 metres high. A cast iron arm carries the lamp, which can be lowered for the renewal of carbons.

The central station is operated in the following manner:

By day, while the consumption of water is comparatively great, the water supply is taken care of by the steam pumps, while the accumulators are charged by the dynamo. When the latter operation is finished, and also in case there is a large demand for water in the early morning before getting up steam, the electromotor pump is run with current from the storage battery. With the beginning of twilight the current for lighting is supplied by the dynamo, and at 11 o'clock at night, after the arc lamps for street lighting have been cut out, the machinery stops running, and the storage battery furnishes whatever current is needed. In case of fire breaking out at night, the engineer is awakened by the alarm bell, and he immediately puts the electromotor pump, as well as one compressor, in operation. This arrangement is of especial importance, and the town has already had an opportunity of convincing itself of the reliable working of the whole plant on the occasion of a fire which broke out at a very early hour in the morning.

By the employment of automatic apparatus for regulating current, and automatic lubrication for all the moving parts of the machinery, the attention needed by the plant is reduced to a minimum, and the whole station is most easily run by only one engineer and one fireman. Even after the second set of machines to supply the increased demand is put in, no more men will be needed.

The whole arrangement of the plant allows operations to be conducted to the greatest advantage, so that with current at three pfg. (0.7 cent) per 100 watt hours, and water at 16 pfg. (3.8 cents) per cubic metre, the town gets its service very cheaply. In fact, after the Posen freight depot has been connected with the water mains, in order to supply the locomotive boilers, the income from the sale of water will cover all expenses, and the income from current will be clear profit.

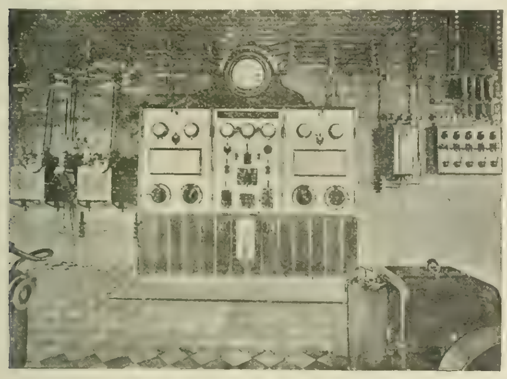


FIG 3.—SWITCHBOARD.

The town will, perhaps, reduce the charges for water and current in the future as its object in running the plant is not to make money, but to further the development of the place.

The favorable results reached in St. Lazarus have induced the neighboring suburb of Wilda to erect similar works, and last fall the Helios Company was given a contract to build a plant there of double the extent of the one in St. Lazarus. Owing to more favorable conditions of water supply, the engines in Wilda will be condensing, and even better results are expected than in St. Lazarus.

Another interesting plant which the Helios Company is building at Strasburg, in West Prussia, combines a slaughter house with an electric central station. The boiler plant and water supply are common to both, and in this case the attendance and running expenses are also reduced to a minimum.

It may here be stated that a great many of the smaller towns and villages are considering the question of light and water supply in the systems just described, and that a number of similar plans will be carried out in the near future.

Another Danger in the Use of Acetylene.

Besides forming an explosive compound when in contact with copper or brass pipes it appears from a recent discussion in Manchester, England, that the gas is easily decomposed by a shock, such as the firing of a percussion cap, and, therefore, it would be too dangerous to store this gas in the condensed state in steel cylinders as has been proposed.

Gas Batteries. I.

BY C. J. REED.

The gas battery as a possible means of transforming energy of fuel directly into electrical energy seems at present to be the most promising, or at least the most attractive, of the very few roads to the practical solution of this important problem.

The experiments described below were undertaken for the purpose of determining to what extent and under what conditions hydrogen and fuel gases generally may be made to combine at low temperatures with oxygen in a gas battery. In order to determine this it is evident that we must use only electrodes and electrolytes that under the conditions of the experiment do not themselves undergo any chemical changes resulting in the ultimate formation of by-products other than the products of oxidation of the fuel gas itself. There are two reasons for this:

1. If other reactions take place in the cell it may be difficult to detect the electrical effect of a very slight reaction between the gases or to distinguish it from the effect of a reaction between other components of the cell.

2. If the components of the cell react chemically either upon one another or upon the gases employed, by products are necessarily formed that require regeneration. This kind of a solution of the problem we already have in the ordinary primary battery.

I believe it will be found necessary also to exclude a two-fluid cell, as it is very difficult (in my experience it has been impossible) to find any two different electrolytes that will not act as a primary battery and give considerable electromotive force when separated by a porous partition, each electrolyte being in contact with an incorrodible electrode, such as platinum or carbon. I have found several hundred such cells that give a very high electromotive force. This subject will be treated of later in a separate communication, and for the present it will suffice to give a single illustration.

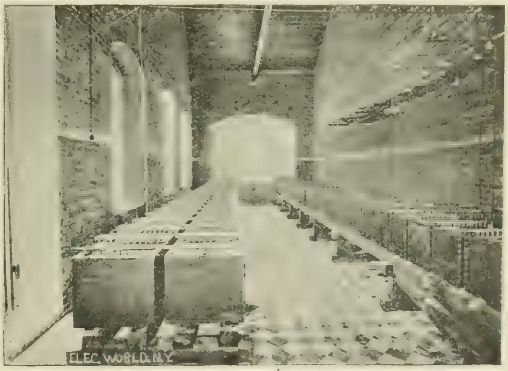


FIG. 4.—ACCUMULATOR ROOM.

Two carbon electrodes, one in contact with a mixture of potassic permanganate ($KMnO_4$) and dilute sulphuric acid (H_2SO_4), the other in contact with a mixture of potassic sulphide (K_2S) and sodium thiosulphate ($Na_2S_2O_3$), the liquids being separated by a porous partition, give an electromotive force of 1.84 volts.

In view of these considerations I decided to examine the reaction of hydrogen and each of the more common fuel gases upon oxygen in contact with dilute sulphuric acid and a pair of incorrodible electrodes.

Experiment 1.—Oxygen and hydrogen with electrodes of platinum foil.

Each electrode was 2 44 inches long, 0 5 inch wide and 0 001 inch thick (62x12.7x0.025 mm). At the middle of one end of the foil a piece of platinum wire 0.4 mm in diameter was soldered with pure gold Each electrode was inserted in a glass tube 14 mm in inside diameter and 140 mm long. The wire passing out at one end was sealed through the glass at a distance of 10 mm from the end of the foil.

Two such tubes after being thoroughly cleaned were filled with dilute sulphuric acid of specific gravity 1.125 and inverted in a beaker of the same solution. The apparatus was mounted as shown in Fig. 1.

Two platinum wires, C and C', were inserted under the tubes and an electric current was passed through these wires until the tube, *T*, was filled with hydrogen to a point about 10 mm above the lower end of the foil. The wire, *C*, was then withdrawn from beneath its tube and left in the solution, the current still continuing, until the oxygen in *T'* was at about the same level as the hydrogen in *T*.

The wires, *C* and *C'*, were then removed and the tubes were heated by the flame of a Bunsen burner until the gases were expanded nearly to the mouths of the tubes. This heat was continued for about ten minutes and at the same time the beaker was heated on a sand bath to the boiling point, to destroy ozone and hydrogen peroxide.

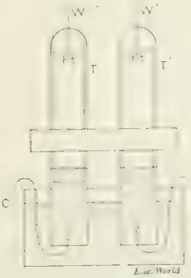


FIG. 1.

After the apparatus had cooled to the temperature of the room (20° C.), the height of the liquid was marked on the outside of each tube. The terminals, *W* and *W'*, were then connected to a Weston voltmeter having a resistance of 356 ohms, each division of the scale being 0.02 volt. Upon closing the circuit there was a throw of the needle reaching almost exactly one-half a division, indicating .01 volt. The needle returned instantly so nearly to zero that no deflection could be detected with certainty. There seemed to be a barely perceptible deflection indicating about .0005 volt. The circuit was opened for about five seconds and on closing again a similar instantaneous throw of the needle to half a divison of the scale was obtained. This could be repeated indefinitely.

Admitting that a constant current was maintained through the voltmeter with an electromotive force of .0005 volt, the total resistance of the circuit being about 360 ohms, we have, at most, a current of only $\frac{.0005}{360} = .1.39\text{x}10^{-6}$ ampere and an output of $.0005\text{x} 1.39\text{x}10^{-6} = 6.95\text{x}10^{-10}$ watt, as the discharge rate of the battery.

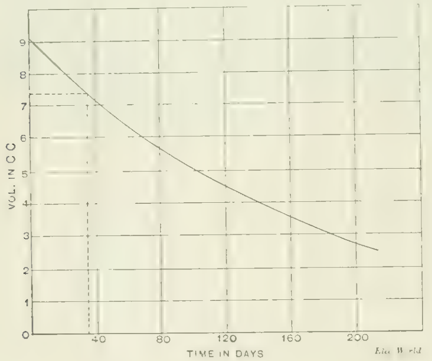


FIG. 2.

This means that a battery having a discharge rate of one watt would require about 1,440,000,000 such pairs of electrodes, or a total of 24,400,000 square feet of platinum foil .001 inch thick, or about 2,030 cubic feet of platinum! It is hardly worth while to calculate its weight.

Notwithstanding the small output of this cell, it was short-circuited and allowed to stand for five weeks to determine whether there was any alteration in the volume of the gases.

The volume of the hydrogen between the solution and the top of the platinum foil was about nine cubic centimetres, its weight about .0008 gram.

Assuming that we have a true voltaic cell consuming hydrogen and oxygen and capable of maintaining an output of $6.95\text{x}10^{-10}$ watt when the resistance circuit is 360 ohms, it will evolve its energy and consume its chemically active material more rapidly on a circuit of low resistance than on one of high resistance. This cell will, therefore, on short circuit evolve more than $6.95\text{x}10^{-10}$. But on short circuit the total resistance was only 6 ohms and $W = C^2 R$. Hence, the current is greater than $\sqrt{1.16\text{x}10^{-10}} = .0000107$ ampere. This current would consume 9 cm³ of hydrogen in about 89 days, provided the active surface remains constant.

But owing to the form of the cell the active surface of foil exposed to the gas diminishes as the volume of gas diminishes and (neglecting the surface of the small platinum wire) the solution would reach the top of the foil only in an infinite time. The curve in Fig. 2 shows the relation between the volume in cubic centimetres and the time in days of the discharge, on the assumption that at the beginning the volume is 9 cm³ and the current .00001 ampere.

An inspection of the curve shows that if the circuit were closed through a resistance of 360 ohms the volume of hydrogen should diminish to less than 7.4 cm³ in 35 days, or nearly .046 cm³ per day during this period. But as the cell was short-circuited it should have oxidized the hydrogen much more rapidly.

Four observations were recorded at the end of seven, eleven, eighteen and thirty-five days, as follows:

Seven days. Volume of gases unchanged. Circuit was opened and wires were connected to the voltmeter. Deflections were obtained exactly like those obtained on the first day of the experiment. Cell was again left on short circuit.

Eleven days. Volume of hydrogen apparently slightly increased. Volume of oxygen perceptibly diminished.

Eighteen days. Volume of hydrogen perceptibly increased. Volume of oxygen distinctly diminished.

Thirty-five days. Volume of hydrogen increased about 2½ per cent. Volume of oxygen diminished about 4 or 5 per cent.

In preparing to take a reading of the voltmeter, and before the volumes were marked, air was accidentally admitted into the tubes and no further observations were made.

The results obtained, however, are sufficient to show that the change in the volume of the gases was not such as would be produced by the combination of oxygen and hydrogen; but such as should be expected from the operation of Dalton's law of solubilities. Air would pass into the hydrogen tube faster than hydrogen would pass out, and air would pass into the oxygen tube slower than oxygen would pass out.

The conclusion, therefore, seems reasonable that the electrical energy of this cell, if there is any at all, is from some other source than the combustion of oxygen and hydrogen.

Influence of Carbons on the Candle Power of the Arc Light.

BY WILBUR M. STINE.

My attention has been called to a letter by Mr. B. H. Blood in your issue of March 9 on a recent article by the writer bearing the above title in THE ELECTRICAL WORLD for Feb. 23. He is entirely in error in the interpretation of the premises laid down in the article referred to. The argument throughout this article is based on the *luminosity* of the *electric arc* between *carbon points*, no reference being made to the light emitted by the incandescent ends of the carbons themselves. It was in this sense that the expression "the candle power of the arc lamp depends upon the amount of the carbon vapor which it contains" was employed. But the phrase "arc lamp" occurs toward the close of the article, after the main argument was established. It would, doubtless, have added much to the clearness of the article to have omitted the use of the term "lamp" altogether. Undoubtedly the expression is open to criticism, and has led to ambiguity of meaning.

Prof. B. F. Thomas, in the discussion of the paper by Mr. L. B. Marks before the N. E. L. A. at Cleveland, stated that at the usual angle of maximum intensity of illumination, 45 degrees, he had found a variation of over 50 per cent. in the candle power of carbons burned at fairly uniform watts. This is in confirmation of numerous tests already published, showing the influence which carbons exert on the candle power. In the original article it was the writer's aim to present some of the causes for this wide variation based on experimental data. In order to avoid going over ground already so well covered, attention was entirely directed to the arc itself, purposely excluding all reference to the incandescent ends of the carbons as sources of light. The knowledge on this subject is so full and generally known that it seemed useless to again present it. There was also an additional reason for this, as will be explained below.

The percentage of the total illumination which can be attributed to the electric arc alone is still an open question, and one on which radically different opinions are held. It must evidently remain such until definitely settled by experimental evidence. A very notable paper on this subject was presented by Elihu Thomson in 1891, before the N. E. L. A. He then stated, "In regard to the ideas put forward as to the nature of the electric arc there is a wide divergence. These views are remarkable for their general inaccuracy or crudity, and have evidently been handed down with modifications. Few of those who have written about the electric arc, at least in the text books, seem to have had the courage to look at the arc, or they have 'seen it through a glass darkly, and not face to face.' It would require too many and lengthy quotations to give these various views. In most of them the light of the arc is attributed to intensely heated carbon particles transported by the current from one pole to the other. In most of them the *idea* of *carbon vapor* as a possible factor seems never to have arisen. Others attribute the arc to the heated air between the carbons which carries carbon particles, some of which are burned." Then follows a quotation in support of this statement (see original article in THE ELECTRICAL WORLD, February, 1891). To this may be added another quotation, "The light is produced by the incandescence of the carbons at the point of separation." * (a)

In this same notable paper Prof. Thomson points out the existence of what he termed "carbon vapor" in the arc, and attributed to it a considerable share in the production of the total illumination.

We find in the most recent authority on this subject the following: "It has been estimated that in the continuous current arc lamp 5 per cent. only of the total light emitted is due to the arc, a proportion of 10 per cent. is furnished by the negative carbon, and the rest, or 85 per cent., by the positive carbon." † (b) This, it will be noted, is only an estimated opinion, and is not based on experimental data.

If a number of carbons be burned under similar conditions, and they are looked at through colored glass, the arc will be seen to be decidedly more pronounced in some cases than in others, depending upon the conditions laid down in the original article. In some cases the arc is so pronounced in brilliance that it would seem to contribute more than 5 per cent. to the total illumination.

In the original article the term carbon vapor was employed in the same sense as used by many writers on luminous flames. The term vapor in its strict scientific sense means gas near the point of saturation. In its ordinary use it refers to matter in an exceedingly fine state of separation, approaching somewhat closely to the free molecular separation of a gas. In this sense the term is strictly applicable to the free incandescent carbon, which imparts the chief luminosity to flames, and which is equally applicable to the attenuated incandescent carbon in the electric arc. A highly luminous electric arc consists then of true gaseous carbon, but feebly luminous, and incandescent carbon vapor.

The electric arc when viewed through a glass is seen to be broader at the positive end than at the negative. It is so situated with reference to the crater, which *vicinity* is doubtless the chief source of light, that it would be more marked at the angle of 45 degrees than on the horizontal. There is reason to believe that its illuminating power, both at the maximum and horizontal points, is a larger factor, with proper carbons, than is usually admitted. It is, however, so difficult of isolation that its luminous value may be for some time longer only a matter of opinion.

No reference in the original article was made to the incandescent ends of the carbons for the reason that their variations in luminosity are mainly conditioned by the same causes which influence the lighting power of the arc itself. Here, as in the arc, the quantity and quality of the light depends upon the emissive power of the substance heated to incandescence. A poor carbon yields a blue, feebly luminous arc of gaseous carbon, whose emissive power is low. Then those conditions which enrich it with carbon vapor and increase its illuminating power will at the same time increase the emissive power of the carbon ends. It then matters little which side of the question is discussed since the results are the same in both cases. The main question of practical value is what quality of carbon will yield the highest total candle power. Should future experimental data not support this view of the influence of the arc on total illumination the conclusions as to the quality of the carbons must undoubtedly obtain.

Prof. Thomson also states the very interesting account which Davy himself gives of his classical experiment. Davy's description is as follows: "When pieces of charcoal about an inch long and one-sixth of an inch in diameter were brought near each other (within the thirtieth or fortieth part of an inch) a bright spark was produced, and more than half the volume of the charcoal became ignited to whiteness; and by withdrawing the points from each other a constant discharge took place through the heated air in a space at least equal to *four inches*, producing *a most brilliant ascending arch of light*, broad and conical in form in the middle."

Electrical Condition of Buried Conductors Due to Leakage Currents from Electric Railways—III.

BY W. STUART SMITH.

The effect of a wire from track to pipe was occasionally seen at points outlying the line of the road where the passage of a car past a wired point would cause the pipe to become momentarily + to a horse or cable track which was normally + to the pipes. Those points are of no special interest, but a very important and peculiar region was that along the Mission street track from 14th to 24th streets. The Mission track had been prepared for use as an electric road, but the system was not then in operation. Before crossing the San Francisco & San Mateo track at 14th street the Mission track was + to the pipes, but as soon as 14th street was crossed the pipes along Mission street at once became considerably + to the track and continued so with varying readings, but never a reversal until about 24th street, when reversals began to occur, and at 26th street the track had again become permanently + to pipes, after which the potential of the track rapidly rose to seven or eight volts + to the pipes. This bonded track crossed the S. F. & S. M. track again at 29th street. It was much better bonded than the other road and formed a shorter path from the crossing at 14th street to the crossing at 29th than the S. F. & S. M. track. Moreover, the latter road was not bonded across a cable road on Valencia street, which consequently produced a total break in the ground circuit. Under these conditions it might have been expected that the Mission track would carry the current across the hypotenuse of the triangle formed by the S. M. road, and hence would be + to the pipes instead of the reverse, as was found. Measurements made at the crossing showed that there was several volts potential difference between the two tracks immediately at the crossing, showing no metallic connection between the two, and the dry dirt did not permit the passage of current.

A wire from S. M. track to pipes passed current to the latter and the current received down town would naturally tend to flow through the pipes in this region, thus raising their potential above the track as shown.

Another point of considerable peculiarity was at Valencia near 26th. There is a cable road on Valencia as far as the junction with Mission street, and this track was everywhere + to the pipe except for a short distance near 26th, where the water pipe was permanently + and gas varied ±. This is an isolated point in which the relations are the exact reverse of those found for long distances on both sides, and it is more peculiar, as it is not on the line of an electric road and hence cannot be explained by any consideration of wires to pipes and broken bonds in track. It seemed impossible to offer an explanation of this reversal, but a later study of the pipe systems gave the key. The explanation will be given when the second series of tests is being considered.

As it was known that the San Mateo road was heavily wired to water pipes at frequent intervals it was supposed that these pipes would be + to the gas pipes generally, unless the latter were also wired to track. As the gas was frequently found + to water it was at first supposed those pipes must also be wired, but as stated above this was found not to be the case.

It is generally supposed that water pipes are more liable to corrosion than gas pipes, owing to better conductivity, but generally both systems are practically of the same conductivity owing to the fact that the pipes cut no figure in the conductivity, this being entirely determined by the joints. In fact if there is any difference in conductivity it is in favor of the gas pipes (at least in San Francisco, owing to the generally smaller resistance of the joints). Though water pipes are no better conductors than gas pipes, yet as the former only were wired to track they might be expected to be + to gas, owing to the resistance between the two systems preventing free passage of current with consequent equalization of pressure.

Nevertheless, it is found that gas is as frequently + to water as water is to gas, showing that though one system may receive the current from the track yet it is quickly divided between the two, how quickly is shown by the fact that gas is frequently + to water not more than half a block from a point where water is wired to track (even 50′ is sometimes sufficient to produce a reversal of relations). The study of the conditions beneath the surface shows that such distribution of current between the systems takes place because in many cases the mains in crossing each other come almost, if not quite, in contact, and the services from one system everywhere come very close to, and in some cases lie directly upon, the other main. Generally there will be two such service crossings (one from each system) in every 25′ or 50′, and thus throughout the entire network of pipes there are points of low resistance where current can pass from one system to the other. The effect is as though the systems were wired together at frequent intervals and the tendency is to equalize the pressure between systems and prevent a heavy passage of current at any one point on account of a small passage of current at many points.

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* (a) Electric Light Installations. Salomons, p. 159.

† (b) Industrial Photometry. Palaz-Patterson, p. 234.

That the current passing at any one point is small is shown by the fact that though many places were examined no signs of electrolytic action could be found anywhere. A certain minimum current is necessary to overcome the chemical affinity of the moisture or salts found in the ground, and if this amount is not reached no corrosion can accrue no matter what the potential may be. The fact that even when one system of pipes comes to a terminus and must pass its current to the other system the potential difference is generally not much greater than is everywhere found between the two systems shows how efficient the service crossings are in distributing the current between the systems.

The reason for gas pipes being + to the water so near a point where the latter is wired to the track is now obvious. When the current passes from track to pipe it is quickly distributed between the systems, and the greater drop of potential over the joints of the water pipes causes the gas to be +. Then the passage of current is the reverse way until a resisting joint in gas causes water to become +, and thus the see-saw of relation takes place throughout the entire area of influence.

The companies were advised that generally no danger need be feared on account of these potential relations, but if a point was found where service or main corroded on account of them the remedy would be to wire the systems together at that point. The distribution is so rapid that a wire from track to one system is in all respects equivalent to a wire to the other.

Mr. Farnham's original paper said the conductors were in a dangerous condition when they were + to the ground, and this is probably true with a conductor located, as was his telephone cable, so that the only points where current could pass were where it touched the ground in the manholes, but in these tests it was found that with the far more complicated conditions that exist in a network of conductors entirely buried in moist earth the results found do not warrant the assumption that a potential relation showing the pipes + to the ground is necessarily dangerous. Mr. Farnham found that in all places far removed from the power house with — of dynamos to rails the ground was + to his conductor, and, indeed, in the case of a conductor arranged as was his telephone cable, any other result was not to be expected, and even in the case of a pipe system forming conductors lying entirely in moist earth it might be supposed that where the track was + to the pipes ground would also be + on account of a passage of current from track to pipes through the ground, but these tests show that generally the contrary is the case, and in most places, except on the extreme lower reaches of a road or where one system comes to a terminus and passes its current to the other, the pipes are generally + to the ground whatever the relation between track and pipes may be. Of course if the test is made between the surface ground, near the track, and the pipe the ground will be +, but if the test be made between the pipe and the ground alongside the pipe is generally +, and in regions outlying the line of the road it makes little difference whether the ground contact is made 1′ or 100′ from the pipe, the pipe is generally + about the same amount at either distance and either towards or away from the power house.

The cause is evident when once the fact of drop of potential everywhere in the pipes is recognized. There is a continual tendency for the current to leave the pipes and pass through the ground to points ahead on the same pipe. Generally this current is far too small to have any possible effect, but if a very highly resisting joint was encountered in a pipe which was carrying considerable current a considerable potential difference might be set up between two points only an inch or two apart and very serious corrosion occur. The remedy would be to wire across the joint.

The ground tests were generally made by driving a bar into the ground in the hole dug to expose the pipes.

When the gas pipes came to dead ends and passed current to the water pipes the gas pipes were generally + to the water pipes and to the grounds, and in such regions water pipes were sometimes + to ground and sometimes —. If gas was + to water to any considerable amount the ground was apt to be + to the water pipe, showing the passage of an appreciable amount of current from gas to water. This was the case in all the region from one to two blocks west of Guerrero, from 14th street to 30th, the gas pipes only extending that distance west of Guerrero except along 18th street.

At the upper end of 18th street gas came to dead ends. Very generally water was + in that region during the first tests because the current entering the pipes must come down 18th and go south in order to reach the power house, and current entering water pipes would in part go to the gas pipes instead of the reverse, as is the case toward 30th street as above mentioned.

(To be continued.)

Action of a Single-Phase Synchronous Motor—II.*

BY FREDERICK BEDELL AND HARRIS J. RYAN.

The phase position of the motor with respect to the generator is represented exactly by the phase positions of their respective E. M. Fs. The relative phase position of these E. M. Fs. was determined by graphical construction, as in Fig. 5. The generator and motor E. M. Fs. and their resultant being known, their position is determined by a construction analogous to the parallelogram of forces. In Fig. 5, ab represents the direction and magnitude, taken in any convenient scale, of the generator E. M. F.; ad, the motor E. M. F., as taken from the magnetization curve; ac, the resultant E. M. F. The magnitudes of the E. M. Fs. being known, their relative positions are thus determined. The angle between the resultant E. M. F., ac, and the current, being determined as described above, ag may be drawn to represent the current. The diagrams, Nos. 1-22, are thus constructed:

The angle bad measured backward (or clockwise) shows the phase position of the motor armature with respect to the generator armature, and it should agree substantially with the disc reading of the phase indicator.

The energy in watts delivered by the generator to the circuit is equal to the product of the impressed E. M. F. (E) and of ae, which is the component of the current ag in line with the impressed E. M. F.

The energy in watts transformed into mechanical power by the armature is equal to the product of E' and of af, the component of the current ag in line with E'. This product must be negative in value, showing energy consumed and not produced, for the machine to run as a motor. The mechanical power developed is expended in driving the Edison machine on open circuit, and in journal friction, hysteresis and foucault currents. The iron losses increase as the field excitation in increased. The difference between the watts delivered and the watts transformed into mechanical power is equal to the RI^2 losses of the armature circuit. Thus from the fifth observation (see Diagram 5,) we have:

$$\text{Watts input} = 41.5 \times 3.85 = 160.$$
$$\text{Watts mechanical power} = 29.7 \times 5.0 = 148.$$
$$\text{The } RI^2 \text{ losses} = 160 - 148 = 12 \text{ watts.}$$

No measurements were made with a motor field current above six amperes, on account of the possibility of springing the armature shaft; it is to be supposed that the motor would run synchronously beyond this point.

The results are shown in Fig. 10, and in the diagrams Nos. 1-22. In Fig. 10, curve C shows the armature current for different field excitation; the current becomes less and less as it comes into phase with the impressed electromotive force, and then increases as it takes a position in advance of the electromotive force. That there is a point of minimum current and a maximum power factor has been shown by Mr. Mordey, in a curve like C, Fig. 10. Mr. Steinmetz has determined curves analytically, plotting them from a quartic equation, showing the relation between armature current and motor E. M. F. He assumes a constant reactance and the absence of armature reactions. His theoretical curve for no load (where no load means the absence of friction and of all energy expenditure) meets the X-axis at a sharp point which would show that when the motor was doing absolutely no work the armature current would actually be brought to zero, for a particular value of the field current. His curve for light load corresponds approximately with curve *C*. It is, however, constructed for a constant load, whereas the load in the present investigation became greater as the hysteresis losses increased with the excitation.

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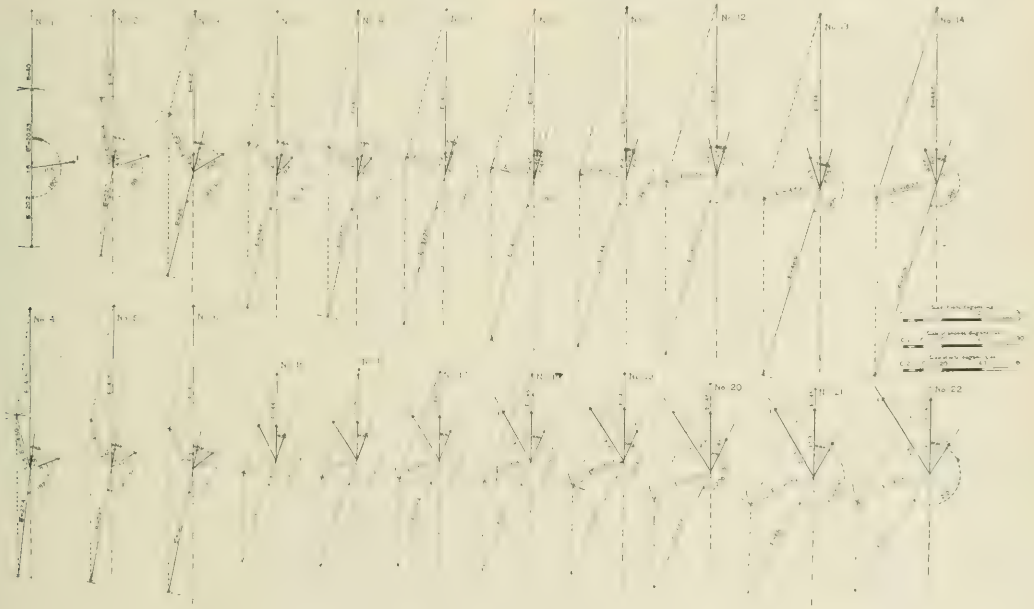
* Condensed from the *Journal* of Franklin Institute, March, 1895.

The increase in the generator E.M.F. on account of armature reactions, although the speed and excitation were constant, is shown in curve *D*, Fig. 10. That armature reactions have the opposite effect in the motor, as mentioned earlier in this paper, is shown by curves *F* and *G*, which represent, respectively, the E.M.F. observed at the brushes of the motor, and that obtained from the curve of magnetization. With a small field excitation, the armature current, which is a lagging current with reference to the generator E.M.F., is one of advance with reference to the motor E.M.F.; and the armature reactions are, therefore, such that the E.M.F. at the brushes of the motor is greater than that obtained from the curve of magnetization. With a larger field excitation of the motor, the armature current is one of advance with reference to the generator E.M.F., and a lagging current with reference to the motor E.M.F., which causes the E.M.F. at the brushes of the motor (curve *F*) to be less than that obtained from the magnetization curve, as shown in curve *G*. The rise in the generator E.M.F., due to armature reactions, corresponding to this decrease in motor E.M.F., due to the same cause, is shown in curve *D*, as already explained. These curves have not been corrected for the fall of potential due to the impedance of the armature; but the results are quite striking and are in accordance with the explanation given in the early part of this paper, to the effect that the armature reactions in the generator and motor assist in the self-regulation of the plant. The gradual change in armature lag is shown by curve *K*.



POLAR DIAGRAMS, NOS. 1–22.

In diagrams, Nos. 1-22, the current, represented by the heavy arrow *I*, lags behind the generator E.M.F. when the field excitation of the motor is weak. The motor thus produces the effect of self-induction in the circuit.

As the excitation is increased, the current comes more and more into phase with the E.M.F., and finally comes into phase with it. The armature current is now a minimum. A further increase in the field excitation advances the armature current ahead of the E.M.F.; that is, the motor now acts the same as a capacity or condenser, in a circuit, this capacity effect increasing as the field excitation increases.

In a recent paper on "Some Advantages of Alternate Currents," Prof. S. P. Thompson lays particular stress on this condenser action of an over-excited synchronous motor, and emphasizes the fact that synchronous motors may advantageously be operated in parallel with transformers, to overcome the effects of self-induction. We have experimented at length upon the action of condensers in parallel with transformers, and the advantages to be obtained by this system of operation. Inasmuch as the transformer tends to make the current lag, and the condenser tends to place the current in advance of the E.M.F., it is possible to obtain such a balance between the two that the line current will be in phase with the electromotive force. Under these circumstances a certain amount of power is transmitted with a minimum current. The polar diagrams, in the present paper, show conclusively that the condenser action of over-excited synchronous motors will enable them to be operated in the same way as were the condensers in the paper referred to.

The changes in the magnitude and direction of the armature current, as the field excitation changes, are clearly seen in Fig. 11. The current for the first observation (compare diagram 1) for the weakest field excitation, has the position I_1. As the field excitation increases, it takes successively the positions indicated by points, coming into phase with the E.M.F., and finally in advance of it, as shown in the position I_{22}, corresponding to the last observation (see diagram 22). The heavy arrow I_6 represents the current for one particular observation. The locus for the armature current is obtained by drawing the curve through the successive points. With a constant E.M.F. the distance of any point of this curve above the horizontal would be proportional to the power given the motor. With a constant E.M.F. and constant power supplied to the motor, the curve would be a horizontal straight line. The rise in the curve at the left is due to the increased power, necessary in this case, as the field current of the motor is increased. The irregularity in the curve at the right is due to the instability of operation during the first few observations.

In constructing the polar diagrams, the values of θ, the angle of lag of the motor armature, as obtained by the readings of the phase indicator, were not employed. From the diagrams constructed as described above, the value of the armature lag was obtained and agreed closely with the armature lag as shown by the phase indicator. The accuracy of the work and the correctness of the reasoning were thus completely verified by the phase indicator readings.

The polar diagrams, here shown for the first time, thus simply show the complete action of the synchronous motor.

Electrodynamic Machinery—XXX.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

154. During the rotation of the armature of a dynamo-electric machine through the flux produced by its field magnets, electromotive forces are not only generated in the conducting loops on the armature by the successive filling and emptying of its loops with flux, but they are also generated in all masses of metal revolving through the flux; in other words, the iron in the armature core and the copper of the conductors will be the seat of E. M. Fs. Though these E. M. Fs. may be locally very small, yet, since the resistances of their circuits are generally exceedingly small, the strength of the currents set up may be very considerable.

Such currents are generally known as *eddy currents.* They are necessarily alternating in character, their frequency depending upon the speed of revolution and upon the number of poles.

Not only is the energy expended in eddy currents lost to the external circuit, since they cannot be made to contribute to the output, but such currents also unduly limit the output of the armature, by raising its temperature, independently of the increase of temperature due to the passage of the useful armature current through the conducting loops. Losses of energy due to eddy current are of the type $I^2 R$ (in watts), I being the strength of the local current in amperes, and R the resistance of the local circuit in ohms.

155. It is evident that a dynamo machine can never be designed so as to be entirely free from eddy currents, for conducting loops must be placed on the armature, and in nearly all the types of practical dynamo machines iron armature cores are employed.

All that can be done is to reduce these losses as far as is commercially practicable. In the case of the iron core, for example, the advantage arising from its use, namely, the decrease in the reluctance of the magnetic circuit, can be retained, provided the material of the core is made continuous in the direction of the magnetic flux paths.

156 If a piece of metal be revolved in a magnetic field, it will enclose magnetic flux. A distribution of E. M. Fs. will be established in it according to the rate at which the enclosure takes place, and depending upon the shape of the piece. These E. M. Fs. will produce eddy currents in the moving metal. The rate of expending work in eddy currents will be in direct proportion to the conductivity of the material. A piece of revolving copper will have much more work expended in it by eddy currents than a piece of lead or German silver. If, however, we divide the mass of metal into a number of segments or smaller portions, the total E. M. F. at any instant will be divided into a number of parts, one in each segment, and the resistance of each segment to its E. M. F. will be much greater than the resistance of the entire mass. The energy wasted in the mass will therefore be reduced. For this reason the iron core of the armature is divided into sheets or laminæ, in such a manner that the sheets afford a continuous path to the magnetic flux, but no circuit is provided for eddy currents across the sheets. The magnetic flux is conducted through the entire length of the sheet, but the circuits of the eddy currents are all in the cross sections of the sheet. The division of the armature core does not, therefore, increase the magnetic resistance, or reluctance of the armature, but enormously increases its resistance to eddy currents.

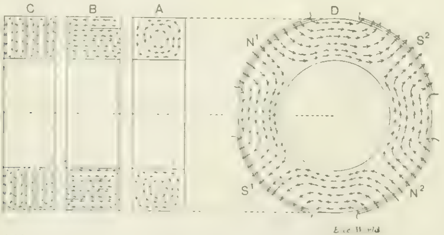


FIG. 142.—DIAGRAM ILLUSTRATING EFFECTS OF LAMINATING ARMATURE CORES UPON EDDY CURRENTS.

Fig. 142 represents at D, an armature core of solid iron capable of being revolved in a quadripolar field N^1, S^1, N^2, S^2, the arrows indicating the general directions of the flux paths. The cross section of the armature is shown at A, and the arrows represent diagrammatically the distribution of the eddy currents set up in the solid mass of iron during the rotation of the armature. At B, the cross section is represented with laminations parallel to the axis of the armature, as, for example, when the armature core is composed of a spiral winding of sheet-iron ribbon. Here the eddy currents are limited to the cross section of each band or lamina. The magnetic flux, however, has to penetrate all the discontinuities between the bands, in order to penetrate to the deepest layer, as shown in Fig. 8, unless the flux be admitted to the armature on its sides.

At C, the armature is laminated in planes perpendicular to the axis, or is built up of sheet discs. Here the eddy currents are confined, as in the last instance, to the section of each disc, but the flux passes directly along each sheet.

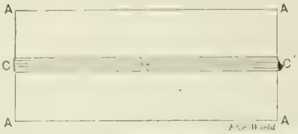


FIG. 143.—DIAGRAM INDICATING THE TRANSPOSITION OF A MULTIPLE ARMATURE CONDUCTOR.

While, therefore, the methods of construction indicated at B and C are equally favorable to the suppression of eddy currents, B, tends to increase the reluctance of the armature, and to magnetically saturate the outer layers of the core, with a corresponding sparsity of flux in the inner layers.

157. Taking a single lamina of the armature core, it is clear that if the intensity in the core is, say, 12 kilogausses, each square centimetre of cross section in the lamina is linked with 12 kilowebers, first in one direction and then in the opposite direction, as the armature moves from one pole to the next. The value of the E. M. F. round the cross section of the lamina, considered as a loop, depends upon the speed with which the linkage takes place, and, therefore, on the intensity [illegible], the speed of rotation and the number of poles. The average E. M. F. in a lamina rotating at a given speed through a quadripolar field of intensity $\mathcal{B} = 12{,}000$, would be four times as great as when passing through a bipolar field of intensity $\mathcal{B} = 6{,}000$. The rate at which an E. M. F. of e volts expends energy in a resistance of r ohms being $\frac{e^2}{r}$ watts, the average wasteful activity in eddy currents depends upon the square of the speed of magnetic reversal in the core, and also upon the square of the intensity. If, then, we double the speed of revolution in an armature core, we quadruple the eddy-current waste of power. The higher the intensity of magnetic flux in the armature and the more rapid the reversal, the more important becomes the careful lamination of the armature, but the eddy current loss in armature cores is usually very small when the plates have a thickness not exceeding 0.02″.

158. As we have seen, eddy currents are not limited to the iron core of an armature, but are also set up in the conductors wound on the armature.

In this case eddy currents are set up in their substance by revolution under the poles, but the conditions differ slightly in detail. A Gramme-ring armature, for example, has no eddy currents set up in the conductors except upon the outer surface of the armature, since the flux passes through the wire at the outer surface and not through the wire on the inner surface. Similarly, a drum armature has no eddy currents set up in the wire upon the ends of the drum, if we may neglect such leakage flux as may pass through the ends of the core. Again, the amount of eddy-current loss will depend upon the distribution of the magnetic flux over the surface of the armature. If the flux entering the armature terminates sharply at the edge of the pole pieces, so that the wire suddenly enters or suddenly leaves a powerful magnetic field in the air gap, the rate of change of the flux enclosed in the substance of the wire will rapidly vary, inducing a brief, but powerful, E. M. F. in its substance, and the total expenditure of energy by eddy currents will be considerably greater than if the gradient of magnetic intensity in the neighborhood of the polar edges is less abrupt and the E. M. F. smaller in amount but more prolonged.

159. The eddy-current loss for a given size of machine is apt to be considerably greater with low pressure than with high pressure armatures, since the former require few massive copper conductors, while the latter require many separately insulated conductors. The plan is, therefore, frequently adopted of winding low-pressure smooth-cored armatures with multiple conductors, each main conductor being composed of a cable of separately insulated wires. Even when this is done, an additional precaution

is necessary, namely, to transpose the conductors or twist them through 180 degrees, half way across the armature surface, in order to prevent any pair of wires from acting as a loop for the generation of E. M. Fs. This is illustrated diagrammatically in Fig. 143, where the multiple conductor CC^1, consisting of five insulated wires, laid over the surface of the armature core *AAAA*, is reversed in the centre, so that the advancing wire at one end becomes the receding wire at the other, and vice versa.

It is sometimes found that the insertion of a sheet iron cylinder of the form outlined in Fig. 144, closely fitted into the polar bore, and forming a tube within which the armature revolves, greatly diminishes the waste of energy in eddy currents.

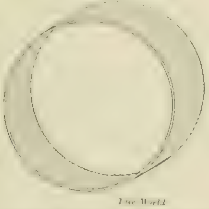


FIG. 144.—IRON CYLINDER OR BUSHING FOR FIELD CORE.

This is for the reason that the edges of the pole pieces are removed, and the flux through the entrefer gradually varies between zero and full intensity as we advance round the field. The effective area of the polar surfaces is for the same reason increased. The objection to the introduction of such a cylinder lies in the magnetic leakage it introduces, for if *A* be the cross section of the soft iron sheet in square centimetres, the flux it will carry direct from pole to pole will be roughly 20,000 *A*, webers, and this flux has to be provided for through the magnetic circuit of the field frame in addition to other leakage and the useful flux through the armature.

160. When the armature conductors are buried beneath the surface of the iron, as, for example, when they run in the deep grooves of tooth-cored armatures, practically no eddy currents are produced in them, for the reason that the space they occupy is almost free from the flux established by the field. A tooth-cored armature may, therefore, be considered as an armature in which the eddy currents are confined to the iron laminæ of the core. This feature constitutes one of the advantages of tooth-cored armatures.

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(To be continued.)

A Large Electric Locomotive.

In the March number of the *Transactions* of the American Institute of Electrical Engineers is a description by Dr. Cary T. Hutchinson of a large electric locomotive which has just been finished by the Baldwin Locomotive Works. This locomotive has eight drivers connected rigidly by side bars, making a wheel-base of 16 feet, the length over all being about 30 feet. The weight is 133,000 pounds uniformly disitributed on the eight drivers, giving 16,700 pounds on each driver. There are four motors, one on each axle, the motors being built directly on the axle without springs of any kind between the armature and the axles. The machine has a capacity, on a four hour test, of 1,000 hp at a speed of 35 miles per hour. The regulation is the series parallel, the motor being: 1st, all in series; 2d, two series by two in parallel; 3d, all four in parallel. There is also a resistance intended for use on first position in starting. The lowest speed, without resistance, is about seven miles per hour.

A test recently made at the Baldwin Locomotive Works showed an efficiency of more than 92 per cent. when operating 1,000 hp. The motors are designed so that they will work without sparking with full current in the armature at one-half normal field strength. That is to say, they will operate at any speed from 35 miles per hour up to about 65 miles per hour at the same power, the drawbar pull varying inversely as the speed. At speeds below 35 miles per hour the drawbar pull is constant, the power, therefore, being directly proportional to the speed. The smoothness and absence of vibration was very noticeable in the test referred to. The entire machine was supported on four jacks, without bracings; when running with full torque, there was scarcely any shaking.

Electrical Power Transmission—XIX.

BY LOUIS BELL, PH. D.

Every electrical system has a definite period of oscillation determined by its particular properties. If we could apply an instantaneous electromotive stress to any point of it the effect would be that the resulting strain would travel back and forth with a definite frequency until its energy would be completely exhausted by doing work on various parts of the system. The action resembles that which takes place when we strike the end of a long rod with a hammer. An impulse is sent out at a rate depending on elasticity, density, and so forth, travels to the end of the rod, is reflected, and so goes on swinging back and forth until the energy is frittered away. This corresponds to electric oscillations on open circuit.

The two properties of an electrical system which determine its vibration period are its self-induction, which we have seen is analogous to inertia, and its capacity, which resembles elasticity in the dielectric, capable of taking up and returning energy. Resistance, like intermolecular friction in the rod just referred to, determines the rate at which the vibrations will die out by yielding up their energy to the system, but has ordinarily an almost negligible effect on the vibration period.

This period in an electric circuit is to a close degree of approximation given by the following formula:

$$T = .00629 \sqrt{L\ C} = \frac{2\ \pi}{1,000} \sqrt{L\ C}$$

In this *T* is the natural time period of the circuit expressed in seconds, *L* is the coefficient of self-induction in henrys, and *C* the capacity in microfarads. For example, suppose we are dealing with a circuit of which the capacity is two microfarads and the self-induction one henry. Let it be arranged as in Fig. 29. For simplicity the inductance and capacity are shown localized and in series as would happen if a line ran through a group of series transformers and thence into a cable. If the line were open circuited beyond the cable we might find a very severe strain on the cable insulation. The period of this line would be .00887 second, about 113 cycles per second. If this should chance to be the frequency of the generator it would be in resonance with the line, and each wave of E. M. F. sent out by the generator will add itself to another wave just starting out in the same direction. A period later these two added E. M. Fs. would be reinforced by the next generator wave, and so on indefinitely.

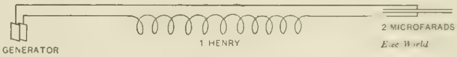

FIG. 29.

The only thing which prevents the resultant voltage from rising indefinitely is the effect of resistance in causing each wave to die out gradually as it continues its oscillations so that only a limited number of waves can add materially to the resultant E. M. F. across the terminals of the capacity.

In a given circuit the relation between the initial voltage and the voltage of resonance can be easily determined to a fair degree of approximation. It is, neglecting minor reactions

$$E' = \frac{n\,L}{R}\,E.$$

In this equation E' is the E. M. F. of resonance, *n* the frequency, *L* the self-induction in henrys, *R* the ohmic resistance, and *E* the initial voltage. Applying this formula to the case just discussed and assuming the resistance of the line to be 15 ohms and the initial voltage to be 2,000 we find $E' = \frac{113 \times 1 \times 2,000}{15} = 15,066$ volts.

A very moderate line voltage may thus in a resonant line give rise to a pressure quite capable of rupturing any ordinary cable or causing serious trouble on an overhead line, to say nothing of greatly increasing the danger to persons and property. If the working pressure were 10,000 or 15,000 volts the E. M. F. of resonance might rise to an appalling amount.

Fortunately this theoretical value is in practice generally much reduced by hysteretic losses and Foucault currents in any iron-cored coils in circuit, waste of energy in the dielectric and other minor causes of damping the electrical oscillations, even when resonance is complete. Still, dangerous rises in voltage are very possible. When the frequency of the applied E. M. F. differs somewhat from the natural period of the line, resonant effects can evidently still take place, but in a rapidly lessening degree; when the oscillations are strongly damped by the presence of iron the total resonant rise is generally diminished, but it varies less rapidly as the resonant frequency is departed from.

A resonance curve shows that the rise of voltage extends over quite a wide range of variation of capacity, but is large over but a small range. The shape of such a curve necessarily varies widely, as the resonance is more or less damped by resistance, iron-cored coils and so forth; but we may be quite sure that the maximum resonance will occur at not far from the point indicated by our equation for the vibration period of the circuit, and that the maximum E. M. F. of resonance will usually be somewhat less than that given by the theoretical equation.

(To be continued.)

Protection from Primary Voltage.

To the Editor of The Electrical World:

Sir: Noting the demand of your correspondent from Montana in your issue of March 23 for a particular device for use in conjunction with transformers I heartily recommend him to purchase modern types of transformers, most of which are so well designed and constructed as to insure him against the trouble he has experienced with the older types and render a protector unnecessary, providing the installation is made in a proper manner.

The writer had a protector made which was effective, consisting of an automatic main line switch, usually placed in the secondary as near the transformer as possible. This switch was opened by the action, when energized, of one or both of a pair of high resistance electromagnets, one being connected so as to ground through the magnet one side of the line, and the other the other side. By this arrangement a comparatively high resistance path is established to earth and across the mains of the secondary. With a magnet that was sufficiently energized to open the switch the leakage on a 50-volt circuit was about eight watts, and those used for 100-volt secondaries about 12 watts. This switch could easily be designed to put on a short circuit through earth as it is opened, and insure the destruction of the transformer or blowing out of primary fuses. With less than half the P. D. of the primary lines (1,000 volts), the switch operated instantly.

So much for a protector, but is it not much better to dispense with extra devices where possible? The money required to procure and install such devices had better be spent in overhauling old transformers and bringing them up to the present standard, or better, in buying new ones. Either one thing or the other will have to be done in the near future even with a protector. The improvement in efficiency of modern transformers over those made a few years ago will in many cases justify the change. I certainly will in all stations where current is maintained continuously on the lines.

Those who prefer to overhaul their transformers now in use which develop the trouble referred to will get the protection they seek in the type of transformers which have the primary wound over the secondary, by removing the primary winding, thoroughly insulating the secondary, preferably with several layers of micanite cloth, held in place by thin linen or similar fabric, being sure to have the outer surface of the secondary well covered with at least two thicknesses of the micanite and that it "break joints" in order to avoid a weak place where a puncture might occur.

The Thomson winding is decidedly the best for this type, and consists of winding the primary in two coils, side by side, on the secondary in such a manner that the two ends of the primary coil come on the outside. The vertical space between the two sections of the primary should be well separated by linen and micanite. To prevent lightning being conducted from the primary to the secondary where the windings are necessarily separated by but a short space, Prof. Thomson places half the winding of the primary so as to act as an effective choke coil between the outside primary line and the turns of the secondary coil.

In transformers where the primary and secondary coils are placed side by side careful insulation of each coil separately and a liberal use of mica between the two will give good results.

That great care should be taken to insure permanent separation of the wires leading from coils to cut-out, so as to have protection from accidental contact with the transformer case, as well as in completing the installation, is understood to be necessary. It is vitally essential that all parts of transformers accessible inside and out should receive the most conscientious inspection, and tested before being put in service, whether new or old.

New York, N. Y. J. I. Ayer.

Induction Alternators and Motors.

To the Editor of The Electrical World:

Sir: I have only just become aware of Mr. Dobrowolsky's interesting paper* on the new alternators of the Allgemeine Elektricitäts Gesellschaft, and wish to state that alternators of the type described have been built by the Stanley Electric Manufacturing Company under patents granted to Mr. Stanley and myself for a couple of years. The joint capacity of the generators now in service amounts to 7,500 kilowatts. I am glad to find our choice of a type confirmed by such a distinguished engineer as Mr. Dobrowolsky.

Even more interesting to me than the description of the alternators is the passage of the paper in which Mr. Dobrowolsky points out the magnitude of the lagging component of the current in induction motors, and its deleterious effect on the regulation of the generator. We have been calling attention to this for a long period, but we have been as one crying in the wilderness. The accession of such a recruit as Mr. Dobrowolsky is a great pleasure. The method of controlling the ill effects of lagging currents advocated by Mr. Dobrowolsky, the reduction of armature reaction to a minimum, is one as to which we are in hearty accord with him, and we have always insisted upon it. The only fault I would find with the method is that, while good, it is not sufficient. I hope yet to find Mr. Dobrowolsky an ardent advocate of the use of condensers.

I see by a later issue of the Elektrotechnische Zeitschrift† that I must also extend congratulations to Mr. Arnold, of Oerlikon, as a convert to the induction alternator. John F. Kelly.

Pittsfield, Mass.

The Blackening of Incandescent Lamps.

To the Editor of The Electrical World:

Sir: In Mr. Tolomei's article in your issue of March 30, on "The Blackening of Incandescent Lamps," I notice the statement that a microscopical examination of the deposit shows the presence of minute yellowish crystals, the chemical nature of which the author does not give. In view of the fact that most forms of fibre used in the manufacture of filaments contain some silica, it seems probable that these crystals are carbide of silicon or "carborundum." The conditions are much the same as in the furnace used by the Carborundum Company, where the reaction is $C + Si\,O_2 = Si\,C + 2O$, the Si C being vaporized and condensing in the cooler parts of the furnace as yellowish semi-transparent crystals. If this reaction takes place in the incandescent lamp it of course leaves the free oxygen to attack the filament, thus further weakening it. Should further investigation prove this hypothesis to be correct, it would certainly suggest the importance of a fibre free from silica, or even perhaps the chemical treatment of the carbonized filament before mounting, in order to remove the silica. B. H. Blood.

Washington, Pa.

The Relative Values of Central Station Storage Systems.

In a communication received from Mr. Nelson W. Perry, a reply is made to certain strictures of Mr. Herbert Lloyd, contained in a note under the above caption in our last issue. Mr. Perry states that in the preparation of his paper read at the Cleveland Convention of the N. E. L. A., and criticised by Mr. Lloyd, all available information was gathered as to the original cost and expense of the maintenance of central station storage battery plants both here and abroad, and that most of his conclusions were based on figures given by the storage battery company of which Mr. Lloyd is the general manager.

Referring to Mr. Edgar's statement in regard to the battery plant purchased by the Boston Edison Company, Mr. Perry considers that Mr. Edgar's explanation was accepted by every intelligent central station man at the Cleveland meeting as proving that the only place for a battery plant in central station service is in taking care of the peak of the load line.

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* See Digest, March 9.

† See Digest, this issue.

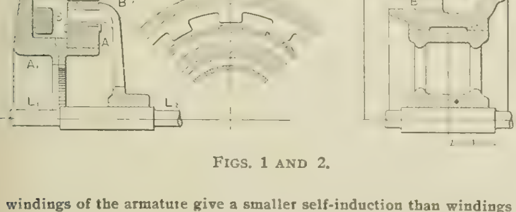
DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors, or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 922 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French, or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Unipolar Induction and Alternators with Stationary Windings.—A paper of some length by Prof. Arnold is reprinted in full with numerous illustrations in the "Elek. Zeit.," March 7. In discussing unipolar induction he refers to Faraday's views (Exp. Res., vol. 1, §218-230), in which it is stated that the lines of force of a revolving magnet remain stationary; he describes some simple experiments consisting in revolving a magnet with and without a copper covering, the actions in all of which can be explained under the assumption that the lines of force revolve with the magnet; another proof is that if several parallel magnets are revolved together around a common axis the lines of force will evidently revolve with the magnet; he describes some further experiments. Under the assumption that the lines of force move with the magnets he discusses the various dispositions of the magnets in alternators, showing that the lamination need to extend only as far as the lines of force from the armature projections are not evenly distributed, and it is only in that part that hysteresis and Foucault losses will take place; he shows the advantages of enclosing the conductors partly or completely in iron and of using twice as many poles on the armature as on the field. He gives an illustrated description of the Klimenko machine and shows why the Mordey alternator, which is of this type, is a great improvement on it; in this, as in all the other types to which he refers, both the armature and the field magnet wires are stationary, the iron alone revolving; he discusses and describes various other machines of this type giving their advantages, among them he includes the Stanley machine. The fact that two continuous surfaces of a magnetic circuit can move relatively to each other without causing Foucault currents enables one to use a single field coil for multiple field magnets; to this class belongs the machine of Elihu Thomson; a still simpler arrangement is shown in the Thury machine, illustrated in Fig. 1, which will explain itself; of this form he speaks very highly including its mechanical construction; it is claimed that the good qualities of this machine are due to the favorable magnetic disposition; the small losses due to hysteresis and Foucault currents enable one to use a very strong magnetic field; the length of the magnet winding is less and therefore its resistance and self-induction are a minimum; the surface windings of the armature give a smaller self-induction than windings in half or completely closed spaces; such machines may be easily connected in parallel and are especially applicable for running motors; the excitation requires only 1 per cent. and for large machines only ½ and ⅓ per cent.; the difference between the exciting current at no load and at full load does not exceed 5 per cent. for large machines; the efficiency is therefore 93 to 94 per cent. Fig. 2 shows an Oerlikon 60-kw machine in which the principle is the same, but it is carried out differently; it is specially suited for vertical shafts. He discusses theoretically the outputs of all alternators with single field exciting coil as compared with those having multiple excitation; he concludes that with the same induction in the air space the output of a multiple alternator with the same number of windings, width of pole, length of armature and surface velocity, will be the square root of two times as great as one having a single exciting coil; this difference, however, can with the same losses be equalized by higher induction in the air space, a slightly greater width of pole, and a greater magnetic induction, besides which a higher velocity is allowable, and for these reasons the two forms would be about equal; for multiphase alternators the case is different, the output of a single coil alternator can be made twice that of an equally heavy multipolar machine of the same efficiency and equally reliable. The smaller amount of radiation of the stationary coils is a disadvantage in this form. In practical construction single phase machines with a single coil will contain somewhat more iron and those with double (?) coils will be lighter, but for smaller outputs they are more expensive; with multiphase motors there will be a gain in lightness in both cases. His conclusions are that it cannot be denied that single coil machines are a great improvement both in simplicity and in reliability.



FIGS. 1 AND 2.

Niagara Dynamos.—In a communication to the Lond. "Elec. Rev.," March 15, Mr. Brown gives a brief illustrated description of the design which he submitted to the Niagara Company and enumerates his claims of priority. He claims to have had in view the idea of an exterior rotating field magnet which at that time he did not consider a novel feature of design and gives a reference of a published description in 'L'Ind. Elec.," May 25, 1892. The subject is also discussed by Mr. Hancock and Messrs. Fell and Wilding.

Regulations of Motors.—A system is described and illustrated in the "Elek. Anz.," Feb. 7, in which the field and the armature windings are double and so arranged that they can be variously connected by means of a convenient switch whereby the speed may be altered between wide limits without changing the position of the neutral axis, which would require an adjustment of the brushes.

Constancy of the Rotary Magnet Field.—"Elec. Power" for March contains an article by Mr. Rittenhouse; theoretical reasoning leads to the conclusion that a rotary magnet field should fluctuate in intensity; the article describes experimental investigations to determine this. Dobrowolsky claimed that his three-phased system was superior to the two-phased system of Tesla as these fluctuations were greatly reduced; others have maintained that theoretically such fluctuations do not exist; the fallacies in this reasoning as pointed out by Prof. Pupin are explained; that two harmonically varying forces differing by 90 degrees and acting at a constant point of application will produce a constant resultant is well known, but that two magnetomotive forces may thus be combined is not so evident; the parallelogram of forces cannot be applied to the discussion of a rotary magnet field; it has nothing to do with the resultant magnetomotive force; to establish this conclusion two rectangular coils were constructed, placed at right angles and having two-phased currents passing through them, the field being explored with a compass needle and also with a coil connected with a telephone; the principle of the conservation of energy has no connection here, nor is it a question merely of kinematics. He describes experiments made with the method of resonance analysis as suggested by Prof. Pupin which showed "that rotary magnetic fields produced by two and three phase machines exhibit no fluctuations whatever, and it would seem therefore that the theory maintaining their constancy has been substantiated; but since it has been shown that this theory starts with wrong premises it follows that the causes for the constancy of the rotary magnetic field must be sought, not in any theoretical considerations modifying the theory cited above, but in the assumptions from which thus far every theory has started." A distinction must be drawn between uniformity of rotation and that of intensity; theoretical fluctuations in the magnetomotive force are simply fluctuations in intensity and do not pass through zero, the magnetizing effect of which is totally different from that produced by an alternating current having the same mean value. Experience has shown that iron under ordinary circumstances practically maintains a mean value when subjected to pulsating forces, which is sufficient reason for the non-appearance of fluctuations in the magnetic induction of the rotary magnetic field, although fluctuations exist in the impressed magnetomotive forces.

LIGHTS AND LIGHTING.

The Electric Arc.—Mrs. Ayrton's paper is continued in the Lond. "Elec.," March 15. Altering either the current or the length of the arc changes the shapes of the carbons and the visible arc, in some cases very considerably; records of these changes were therefore taken after the arc had acquired its steady value for all different currents and lengths of arc they were drawn directly from the enlarged image of the arc; a large number of these are given. There is a white spot always present on the top of the negative, the light from which is apparently quite as intense as that given out by the crater, although much less in quantity; the area of this bright spot increases with the current, but at a much smaller rate than the area of the crater. There are bright spots on the negative carbon which are either boiling carbon, tar or syrup used in the course of manufacture. From the set of drawings of the carbons it is noticed that in all the figures for short arcs of about 0.5 mm, the negative carbon is quite pointed, and as the arc gets longer the negative becomes blunter, thus the tip of the negative is more pointed the shorter the arc and the greater the current. The point depends on the carbons being nearer together and is believed to be caused solely by the carbon deposited from the positive; when the arc is very short and the current large enough to cause hissing, the deposit takes a mushroom form; the deposition is often rapid enough to cause the negative carbon to grow longer instead of shorter; with large currents the negative is somewhat more pointed but in a different way, it has no little extra tip on it and it is therefore believed to be due to the burinng away of the carbon; most of the heating of the negative takes place from the outside, and when the current is small the heat is small; with large currents, however, the tip is longer and more slender. The positive carbon tapers more with a short arc than with a long one for the same currents and has a longer but less pointed tapering part for a large current than for a small one. The positive carbon is consumed in two ways, by volatilization and by burning in combination with air; the former can only take place at or near the surface of the crater and therefore the shaping of the carbon must depend on the burning in combination with air; the positive becomes less pointed as the current increases because the tip burns away much faster than the sides; the point is longer, however, the larger the current because the increased amount of volatile carbon extends further up the sides; when the arc is short the volatile carbon spreads out farther causing the carbons to burn away farther than when the arc is long. In some additional illustrations of the carbon points it is shown what alteration will take place when the current is suddenly changed from a higher to a lower value or the reverse. Another set shows the arc with solid carbons, from which it is seen that the visible arc is larger with a solid than with a cored positive; in another set the positive carbons are solid and the negative cored showing that the latter burn away farther down than under the reversed conditions. Four large shaded drawings are given of the arc under different conditions, special attention being given to the outlines of the purple part, the shadow and the green outside part; the balls of boiling carbon are also shown. The use of cored positive carbons instead of solid changed the size and color, and in the long arcs the form of the visible part of the arc.

Alternating Current Arc Lamp.—A translation of the article abstracted in the Digest, March 23, is given in abstract together with the illustrations, in the Lond. "Elec. Eng.," March 15.

Incandescent Lamps.—Mr. Armagnat in "L'Ind. Elec.," March 10, makes some suggestions regarding the degree of incandescence of lamps. The luminous intensity of a lamp is the product of two factors, the surface of the filament and its intrinsic brightness; the ratio of these factors affects the quality of the lamps; he discusses the question of the degree of incandescence as defined by Mr. Crova, which he says may be taken as characteristic of a lamp, but it has not been proved that there is always the same ratio between the degree of incandescence and the temperature, when the nature of the filament varies, but as it is possible to determine this constant, it becomes a very useful quantity; he describes several methods by which it may be measured, one of them being with the aid of the Le Chatelier optic pyrometer which measures the brightness and not the intensity in candles; this instrument or one based on this principle may be used in studying incandescent lamps; it enables one to determine exactly the temperature of a filament and therefore its probable life. In the present lamp factories the standardizing of the lamps is accomplished by bringing them up to their candle power and measuring the volts and amperes; with the use of the pyrometer another method is possible, namely to bring the lamps all up to the same temperature and find the watts per candle power under these conditions; which of these two processes is the best he leaves for specialists to decide but he believes that it is best to define the temperature or the degree of incandescence.

Exhausting Lamp Bulbs.—A new patented process is briefly described in the "Elek. Anz.," March 10; the bulb is filled with a liquid such as a hydrocarbon, which readily boils at low pressures; the unsealed bulb is then placed in a vessel from which the air is partially exhausted which causes the liquid to boil thereby carrying the air with it; it is claimed that exceptionally good vacuums can thus be produced.

Automatic Lighting of Ships in Danger.—A system is described and illustrated in the "Elek. Anz.," March 10, in which magnesium lights are placed on the masts arranged so as to be ignited by a current from a dry cell through floating contacts placed in the bottom of the vessel and arranged so as to close if water enters the vessel; the circuit may also be closed by the officer on the bridge; the same circuit may also contain alarms.

POWER AND HEAT.

Electric Casting Process.—The Slavianoff process is described in a lecture by Mr. Lohmann abstracted in "Zeit. f. Elect. u. Electrochem.," Feb. 15, and in the "Elek. Anz.," Feb. 28. It is a system of fusion by means of the arc, like in the Bernados process only that both electrodes are of metal the movable pole being made of the metal which is to be fused; the arc which forms between the movable pole and the piece of metal to be repaired, causes the metal to melt and drop on the piece to be mended; a bank of some material must be made around the place where the metal is to be cast, to confine it to the proper limits. The advantages over the Bernados system are that as the metal is melted the process is applicable in a large number of cases; the efficiency is greater and the metal which is deposited is not so hard. In order to keep the arc the same length the movable pole, in the form of a rod, is adjusted automatically by the aid of a series coil which feeds it automatically. It has been in use for a number of years in Berlin. A commutator is placed in the circuit for changing the direction of the current; as the heat at the positive pole is about twice as great as that on the other, either one of the two pieces may be heated more than the other by a commutation of the current; with cast iron the commutation also has a chemical effect as the melted metal may be made a hard, a white, a soft, or a gray cast iron as desired; pulverized glass is placed on the surface to prevent oxidation by the air during the melting process, it is an expensive casting process but is applicable in such cases where the expense plays no part, as for instance in repairing a complicated casting or on board a ship; small castings may also be made in this way. A German railway company has used this system for repairing flywheels, steam cylinders, connecting rods of locomotives, etc. Some further information is given in the "Elek. Anz.," March 7; the current required is said to be about eight amperes per square mm of the metal electrode the diameter of which is made about six to ten mm; the metal should be heated first to a red heat in order that the drops of molten metal do not chill too quickly; in casting steel or iron, ferro manganese is added, which has the property of reducing iron oxide; copper and its alloys may also be cast by this process; with copper and steel the metal to be repaired is made the positive pole.

Treatment of Castings.—According to "L'Elec.," March 16, in the Wikstroem process the metal is cast in a slightly inclined trough enclosed in a vessel containing compressed air and a strong electric current is passed through the metal lengthwise, thus submitting it simultaneously to the action of the compressed air and the electric current which raises its temperature; what the objects are is not stated, but apparently the idea is to cool it slowly under compression.

Transmission of Power in Shipyards and on Board Steamers.—A paper by Mr. Wallace is abstracted at some length in the Lond. "Elec. Eng.," March 15; it deals with the transmission of power for comparatively small distances of 300 to 400 yards and in general with the advantages of driving machines in shipyards by means of electric motors; a table is given showing the power required for various tools used in shipyards; with electrical transmission 25 pounds of dry steam will give one electrical hp at the motor; the cost of fitting up a yard electrically should not greatly exceed the cost of the old system.

Transmission of Power in Italy.—In a communication by Mr. Azari in Lond. "Engineering," March 15, he states that three projects have recently received concessions from the government, one involving a waterfall of 47,000-hp., part of which is to be transmitted to Milan, another of 20,000-hp to be transmitted to Turin, and another of 7,000-hp to Biella.

Turbines for Electric Installation.—An illustrated description is begun in the "Elek. Anz.," Feb. 24, of several installations erected by a German firm.

Blast Furnace Motor Gas.—An article by Mr. Booth is published in the Lond. "Elec. Rev.," March 15.

Elastic Couplings.—A translation of the communication by Mr. Bablon, mentioned in the Digest, Feb. 9, is published in the Lond. "Elec. Rev.," March 15.

Friction of Belting and Shafting.—Mr. Woodward in a communication to the "Eng. Mag." for April refers to a statement in a recent article by Prof. Anthony (see Digest, Feb. 16), in which it is said that "the loss by friction of shafting and belting is constant whether the machinery it is intended to drive is in use or not." Mr. Woodward thinks he is justified in saying that this statement is incorrect and that while there is continual loss due to the shafting, the loss increases as the load on the machines increases and is therefore greater when the machines are running than is shown by the table and diagrams in that article; he gives a diagram showing the results of a test confirming these views; the increase in the sum of the belt tensions causes increased bearing pressure and increased loss by friction. To this Prof. Anthony replies that he meant that the losses were continuous and not that they were invariable, while in electrical transmission almost the whole of the transmission losses ceases with the stopping of the machine; he believes, however, that the pressure produced by a belt on the bearings is nearly independent of the load as the tension on one side diminishes as much as that on the other increases and he thinks, therefore, that the general statement is warranted that the friction of all belting and shafting that continues to run when the load is off is practically constant.

Water Powers of the Western States.—The "Eng. Mag." for April contains an article by Mr. Allan describing a number of water power installations and waterfalls in the Western States with the aid of a number of picturesque illustrations.

Power Distribution.—A brief abstract of the recent paper of Mr. Boucherot, mentioned in these columns some time ago, describing the transmission plant at the works of Weyher and Richmond, is published in the "Prog. Age," March 15.

Heat Distribution.—The Yaryan system of heat distribution from electric central stations is described and illustrated in the "Elec. Eng.," March 27.

Portable Storage Battery Outfit for Organ Motor.—An outfit is described briefly and illustrated in the "West. El.," March 30.

TRACTION.

Electric Railway Statistics for Europe.—"L'Ind. Elec.," March 10, publishes its third edition of the statistics for Europe up to the 1st of January, 1895; it consists of a long table published in the form of a supplement, containing tabulated data concerning each railway, and is the most complete summary which has been published. In the past year the number of lines has increased from 43 to 70, the length from 305 to 700 km, the power from 10,650 to 18,150 hp and the number of motor cars and locomotives from 538 to 1,236. Germany is at the head of the list with 366 km of tracks, the city of Hamburg alone having 180, France being second with nearly 100 km. Of the total number of roads 53 use the trolley system, three the underground conductor, eight the central rail, and four accumulators. The number of lines are distributed as follows: Germany 22, England 13, France 11, Switzerland 8, Italy 4, Austria 4, Belgium 3, Spain 1, Norway 1, Roumania 1, Russia 1, Servia 1. The largest amount of power is used on the City & South London line, 1,200 kw, the Liverpool line comes next with 900 kw; the maximum grade is 10.5 per cent. on the ordinary road and 25 per cent. on rack and pinion roads. There are no less than 28 lines under construction representing a total length of 200 kw. In conclusion a summary of the statistics of the previous year are given for comparison.

Transportation Across Rivers.—A system is illustrated and described in the "Elek. Anz.," March 3, which has been projected for traffic across a navigable river at Hamburg. It consists of a light, high suspension bridge, which forms the tracks from which are suspended cars which are slightly above the level of the water; these suspended cars are operated electrically; the bridge is high enough to allow sailing vessels to pass underneath; two cars are estimated to carry 6,000 passengers per hour in both directions and 40 to 50 carts and carriages, the transit being made in one minute. In case of a fog passengers can pass over the bridge by means of two elevators, there being no other approaches.

Suspended Railway.—The Mueller and Deitrich system, described briefly in the Digest, Feb. 16, is described and illustrated in the "Zeit. f. Elect. u. Electrochem.," Feb. 15; in this system the car is suspended from a single rail to one side of a point above its centre of gravity.

Electric Rudder.—A simple form which can be attached to any boat is described and illustrated in the "Elec. Eng.," March 15; the electric motor is connected to the propeller through a pair of bevelled gears; it weighs when complete about 45 pounds; with 85 pounds of accumulators the boat is said to run eight hours at a speed of five to six miles an hour.

Canal Towage.—The electrical system used on the Bourgogne canal, which has been fully described in these columns, is described briefly in Lond. "Engineering," March 15; the returns of the outlay are not very high, but it is stated that the plant is less troublesome to work than the steam tugs formerly used, and the speed is somewhat greater.

Light Railway.—In Dr. Preller's serial on electric cable railways in Lond. "Engineering," March 15, he gives a description with large illustrations, of the Stans railway, in which the trolley system is used.

Geneva.—The railway in Geneva is described and illustrated in "L'Energie Elec.," Feb. 16, including illustrations of the Thury motors.

Boston Subway.—A brief illustrated description of this subway through which street cars will pass in the crowded districts of the city is given in the "St. Ry. Gaz.," March 23.

Surface Contact Systems.—In the continuation of Mr. Sachs' article in "Elec. Power" he describes and illustrates a number of surface contact systems.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Central Station in France.—The table of summaries from "L'Ind. Elec.," abstracted in the Digest, March 9, is given in full in the Lond. "Elec.," March 15.

Paris.—Some of the statistics in the recent article in "L'Ind. Elec." regarding various companies in Paris are given in Lond. "Elec. Rev.," March 15.

Electrical Engineering in France and England.—Mr. Leonard's recent Institute paper is discussed editorially in the Lond. "Elec.," March 15.

Darmstadt.—A report of some length giving the operating expense and data of this accumulator station is published in "Elek. Anz.," March 3 and 7.

Zurich.—In "L'Ind. Elec.," March 10, Mr. Ritter gives a brief account with some data of the working of the station at Zurich.

Reducing the Cost of Electric Light.—In an article by Mr. Perry in the "Eng. Mag." for April he discusses some prevailing misapprehensions regarding the coal consumption and shows that at least one of the prolific causes of lack of economy in central station practice is the extremely variable load. "These increased costs due to variable load are not well understood even by those presumed to be fairly well posted;" he recommends storage and encouraging the use of currents during the daytime by reducing the price during those hours.

Municipal Ownership of Public Corporations.—The "Eng. Mag." for April contains an article by Mr. Francisco on this subject in which he strongly opposes municipal ownership.

Control of Public Service Corporations.—The "Eng. Mag." for April contains an article by Mr. Foote in which he advocates municipal control in preference to public ownership, participation in profits or franchise price.

Electricity as Applied to Mining.—The recent paper of Mr. Corlett read before the Northern Society of Electrical Engineers, England, is published in abstract in the "Eng. and Min. Jour.," March 23.

Life of Electrical Apparatus.—According to "Elec. Power" for March the Local Government Board of England, in connection with the subject of loans to municipalities, arrives at the following conclusions regarding the probable life of various electrical appliances: meters 5 years, accumulators 8, arc lamps 10, boilers and insulating mains 15, engines and dynamos 20, bare copper mains and culverts 40, and buildings 60.

Underwriters.—"Elec. Power" for March contains an article by Mr. Haskins on "Electricity, the Underwriter's Friend;" he describes the present condition of insurance regulation and inspection and urges the employment of better inspectors and better apparatus.

Inspection of Meters.—A copy of the bill introduced into the New York Assembly providing for electric meters and their inspection is reprinted in the "Elec. Age," March 23.

Logansport Municipal Lighting Plant.—A description is published by Mr. Kammuyer in the "Elec. Eng.," March 27. It is a combined water power and steam plant and it is believed that it bids fair to prove a profitable venture for the city.

WIRES, WIRING AND CONDUITS.

Insulators in Conduits.—In an editorial in the Lond. "Elec.," March 15, the use of glass insulators in conduits and the fact that their use has been discontinued is referred to; it is stated that the positive and middle conductor quickly dry off any dampness, but this does not occur on the negative side where it is believed the condensation may exceed the dissipation. This selective action is not clear; no corrosion worth mentioning is found. Experienced engineers state that the positive and the middle will mend themselves but the negative will earth itself and will not mend; it seems possible that there may be a surface tension effect as in the Lipmann electrometer which causes the film of moisture near the positive to retract. It recalls an experiment of Lord Armstong's in which a cotton thread was placed so as to connect the water in two glasses; with an induction coil allowing only the break spark to pass, the water, if pure, will rapidly travel across the thread with the current, while the thread will move in the opposite direction. It suggests the possibility that the rise in insulation between two conductors on glass or stoneware is not due to electrolysis of moisture or to its dissipation by the heat so much as to this unexplained withdrawal from the positive and it may not be unaccompanied by any material rise in insulation at the negative.

Sodium in Electric Conduits.—The Lond. "Elec.," March 15, calls attention to an extract from THE ELECTRICAL WORLD, July 6, 1889, in which a case occurring in Boston with the Edison three-wire system is cited, and it is stated that the current had formed considerable quantities of metallic sodium throughout a mass of concentrated lye; "there was sodium enough present to make a fair display of fireworks when thrown into a pool of water." In the same issue a correspondent describes the conditions which he found by inspecting the scene of the recent explosion. Stoneware insulators are discussed by Mr. Fairfax.

Conduit Systems.—The Hoerde system, described in the Digest last week, is described with the aid of a number of cuts in the "Elek. Anz.," Feb. 10.

Renting House Wiring.—According to "Elek. Zeit.," March 7, the companies owning the central stations in Berlin have decided that they will undertake the construction of the wiring in private houses which are to be connected with the central station, at their own cost, the conditions being as follows: the consumer is to pay a rent which will cease at the end of ten years' use; the consumer binds himself for the payment of this rent for at least three years; he guarantees to keep the wiring in order and to insure it against fire; the consumer must obtain the consent of the landlord; he must agree not to use the wiring except for current from the station nor to allow others to use it; the company agrees not to remove the wiring as long as the rent is paid promptly and to allow it to remain after the rent has been paid for ten years; the rent will depend upon the number of lamps and is as follows: per incandescent lamp 75 cents per year, per arc lamp $2.50 per year, but the total must represent at least $15 a year; they will rent arc lamps for $2.50 per year; the rent for wiring for power must be determined for each special case. It is believed that this arrangement will meet with great favor.

Law Regarding Conductors.—The Lond. "Elec. Rev.," March 15, gives the substance of the bill recently discussed in France relating to conductors other than for telegraph and telephone purposes.

Paper as an Insulator for Electrical Conductors.—The article by Mr. Bishop (see Digest, Feb. 2) is continued in "Elec. Power" for March. He discusses the qualifications of paper for use in high potential conductors; he describes briefly the process of manufacture and gives the principal properties; it does not decompose by heat, is indestructible by dampness, time and electrolysis; it does not shrink or lose its pliability, is inelastic, almost imcompressible and weighs from one-third to one-fourth that of rubber insulation; it is flexible and strong, but will not bear the same amount of rough handling and pounding as a rubber compound, but no matter what treatment it receives the conductor will always remain concentric with the lead sheath; such cables depend absolutely on their lead covering for protection against moisture; the process of manufacture secures a uniformity throughout and is a positive security against admission of adulterating or harmful foreign matter; no case of a burn-out or blow-out has ever been known with such cables arising from causes inherent in its manufacture or material. He gives the electrical qualities which are as follows: No. 6 B. & S. wire, insulation .0156-inch not compounded with oils, insulation resistance 9,600 megohms for 650 feet, it broke down at 9,000 to 10,000 volts; after immersion for a day in boiling water the insulation fell to 33 megohms and it broke down at about 7,200 volts; a second cable was 1,200 feet long like the above and compounded with resin and resin oil; it had an insulation resistance of 4,070 megohms and could not be broken down with any voltage at disposal at the time; after immersion as before it fell to one third megohm and broke down at 7,500 volts; this shows that the ordinary galvanometer test applied to electric light and power cables or at least to paper cables is useless and misleading; the reason why rubber compound will give way is that it is not homogeneous and will expose weak spots even in the best made cables; the capacity of paper cables is about one-third to one-fifth that of other kinds, the cost is about one-third and the weight about one-third.

ELECTRO-PHYSICS AND MAGNETISM.

Energy Movement in the Motion of Separating Electrified or Gravitating Particles.—A Physical Society paper by Prof. Minchen is abstracted briefly in the Lond. "Elec. Eng.," March 15. The object of the paper is to trace out the equi-potential surfaces and lines of flow for two electrified points or gravitating particles, and then to consider the paths along which the "energy cells" move when the charged points or gravitating particles either move toward or away from one another.

Electrification of Air.—An illustrated article by Lord Kelvin and Messrs. MacLean and Gault on "Electrification of Air and Other Gases by Bubbling through Water and Other Liquids" is begun in the Lond. "Elec. Rev.," March 15; it includes a number of illustrations of the apparatus.

Potential Differences between Metals and Electrolytes.—A paper by Mr. Rothmund from the "Zeit. Phys. Chem.," and abstracted in the journal of the Chemical Society, is noticed briefly in the Lond. "Elec. Eng.," March 15.

Capacity.—In the Lond. "Elec.," March 15, Dr. Silvanus P. Thompson discusses Prof. Nipher's views on capacity.

Waves and Vibrations.—The first of a series of lectures by Lord Rayleigh is abstracted in the Lond. "Elec. Rev.," March 15; he refers to waves in general but not in particular to electrical waves.

Multiple Resonance.—A paper by Mr. Bjerknes in the "Weid. Ann.," vol. 54, page 50, is abstracted briefly in the "Elek. Zeit.," March 7; the conclusions appear to be the same as those mentioned in the Digest, March 23.

Scientific Foundations of Electrical Engineering.—A paper by Mr. Baily is reprinted in the Lond. "Elec. Eng.," March 15; he discusses the accuracy of electrical measurements, the use of too elaborate hypothetical problems, etc.

Physical Work of von Helmholtz.—An abstract of a Royal Institution lecture by Prof. Ruecker is published in the Lond. "Elec.," March 15.

Spectrum of Argon.—The Royal Society paper by Mr. Newall is reprinted in the Lond. "Elec. Rev.," March 15.

Effect of Self-Induction and Capacity on Magnetism.—A paper by Mr. Fromme from the "Weid. Ann.," vol. 54, page 1, is abstracted in "Elek. Zeit.," March 7; he discusses the self-induction and electrostatic capacity of coils of wire and their effect on the magnetic properties; it is supplemental to the paper mentioned in the Digest, Oct. 13; the self-induction and capacity of a coil affect the magnitude of the "permanent moment" in opposite directions.

Permanent Magnets Used as Compasses.—The Lond. "Elec. Eng.," March 15, contains a communication from Mr. Smith in which he describes some observations which show that the variations in the deflection of a needle are sometimes due to peculiarities of the needle; he discusses a theory of the earth's magnetism.

What Is Electricity?—A few additional paragraphs forming a continuation of the article on this subject by the late Prof. Van der Weyde are given in the "Elec. Rev.," March 27; it was the last manuscript which he wrote.

Table of Magnetic Values.—A translation (without acknowledgment) of the article by Mr. Cushman mentioned in the Digest, Feb. 23, is published in "Elec. Power" for March; the original appeared in "L'Ind. Elec.," Jan. 25.

ELECTRO-CHEMISTRY AND BATTERIES.

Researches with Carbon-Iron Cells.—A short article by Mr. Schmitz in the "Elek. Zeit.," March 7, describes some recent experiments. Nitrate of potassium and sodium were melted in an iron crucible and a positive pole of carbon was inserted, the iron forming the other pole; carbons made of charcoal, anthracite coal and "gas coal" (bituminous?) should not be used as they ignite in connection with the saltpeter which wastes the greater part of the latter; the ignition takes place suddenly; the energy of combustion (?) may be increased by the addition of borax; with graphite there was neither a chemical reaction nor an appreciable current; the experiment with cored carbons was more promising, they do not ignite in pure saltpeter, even at 800° C., but at 400° to 500° there was a rapid evolution of the gas which increased appreciably on closing the circuit; the voltage was about one, and the current although small was constant; the carbon was the negative pole, therefore representing the zinc in the usual salts; the solution remained clear and the iron of the crucible was not attacked appreciably nor was there a deposit formed upon it; the evolution of heat due to the combustion of the coal was very slight and it was necessary to supply heat to the crucible, while with charcoal and gas coal the combustion of the carbon supplied sufficient heat to keep the electrolyte fused. It follows that the combustion of coal in saltpeter can be accomplished in two ways: like the combustion of coal in air in which heat is produced, and like the combustion of zinc in a battery in which electricity is produced; according to the constitution of the carbon the reaction will be mainly in one or the other of these ways; as the unnecessary consumption of the saltpeter in the second process is avoided there is a possibility of success in this direction.

Borchers' Battery.—The "Zeit. f. Elect. u. Electrochem," March 1 (edited by Dr. Borchers), in referring to the recent criticism concerning this matter, states that in his original article Borchers remarked that the results obtained cannot yet be considered favorable, but that they are sufficiently so to encourage further research, this statement is claimed to show clearly that further improvements were necessary but his critics, it is claimed, have judged his work from an entirely different standpoint.

Ferro Cyanide Accumulators.—Dr. Platner in the "Elek. Anz.," Feb. 24, describes some more or less successful experiments with such accumulators. The ease with which metals can be deposited from their cyanide compounds encourages an investigation of this subject. If a zinc and a carbon electrode are placed in the concentrated solution of pure ferri cyanide of sodium, then ferro cyanide of zinc will be deposited as a powder and ferro cyanide of sodium will be formed, but this system is not recommended as the solution is expensive and the deposit does not adhere well. Experiments with ferri cyanide of potassium gave no results as it contains free alkalis, but when these are precipitated with hydrofluoric acid the action at once begins; the same can also be accomplished by adding Turnbull's blue; the zinc deposit is much better than with the sodium salt; the voltage is 1.05 to 1.15, the maximum current density is 1.2 amperes per square decimetre; the voltage remains constant to the end of the discharge. He gives the complete chemical reactions in this accumulator. To prevent the zinc deposit from falling off the plate may be covered with some woven material. Experiments with corresponding manganese and cobalt compounds as also with other ferro cyanide metals give practically the same results.

Electrolysis of Gold.—An Institution paper by Mr. Keith is reprinted in the Lond. "Elec. Eng.," March 15; the first part is published in the Lond. "Elec. Rev." He speaks of the Rae process which has figured in recent patent litigation and states that it failed for two reasons, the imperfect knowledge of the inventor and the impracticability of causing the particles of gold to remain long enough in contact with the anode to be acted upon electrolytically; he gives the electrolytical equivalents and a general insight into the subject. Regarding the solving action of the cyanide solution he states that if a leaf of gold is placed on the surface it will readily dissolve, while if immersed it will dissolve but slowly, showing that the presence of oxygen is necessary; some figures regarding the dissolving action are given; methods of introducing oxygen are discussed; he believes the action of the oxygen is due to its strong electronegative relation to gold in a cyanide solution and he therefore tried various materials which are also electronegative, among them carbon, iron and mercury; the use of the latter improved the cyanide process; it is introduced by adding a small quantity of potasio mercuric cyanide at the rate of two ounces per ton of solution; he discusses this improvement at some length; the solution may be used uninterruptedly, the mercury simply facilitating the dissolving of the gold, the mercury itself being redissolved again; the solvent must be kept in motion through the mass; extremely weak solutions may be used. He describes the process in which gold is precipitated by means of zinc, also the electrolytic processes of Siemens and Halske recently described in a recent paper by Von Gernet which he discusses at some length, describing in detail the vat, which is made of wood, and the anode, which consists of sheets of iron, and the cathode, of sheets of lead; also the current density. He then describes his process in detail; from 2 to 10 pounds of cyanide are used for each ton of water to which 2 to 10 ounces of a soluble salt of mercury is added; the average current density is 0.06 ampere per square foot; the cathode is made of a copper amalgamated with mercury; between the cathodes are placed various cells filled with a half saturated solution of an ammonium salt such as chloride of sulphate, into which is placed zinc or iron connected to the other pole of the source; the required E. M. F. is not greater than half a volt; about 21 cents per ton can be saved by using this process. The "Zeit. f. Elect. u. Electrochem.," March 1, published some additional information regarding the Siemens and Halske process in the form of a supplement to the recent description of Mr. Gernet; costs and other data are given as also a comparison of this system with the MacArthur Forrest system.

Conductivity of Electrolytes.—A paper by Mr. Fanjung is abstracted briefly in the Lond. "Elec. Rev.," March 15; he determined the conductivity of various organic acids and salts at different degrees of concentration and at different pressures; he found that pressure caused a decrease in electrical resistance which, however, is not constant.

Electrolysis of Copper Sulphate.—A paper by Mr. Chassy from the "Comptes Rendus," vol. 119, page 271, is abstracted briefly in the Lond. "Elec. Rev.," March 15. He discusses the electrolysis of copper sulphate while hot, under which condition a violet red deposit is thrown down.

Laboratory for Electrolysis.—A description by Mr. Nissenson is given in the "Zeit. f. Elect. u. Electrochem.," March 1, of the laboratory for electrolytic operations connected with a metallurgical establishment in Germany.

Analyses by Electrolysis.—A paper by Mr. Classen, from the "Ber. der Deut. Chem. Gesellchaft," vol. 27, page 2,060, is recommended in the Lond. "Elec. Rev.," March 15; he describes how to fit up a model laboratory for chemical analyses by electrolysis.

Electrolytic Reduction of Aromatic Nitro-compounds.—A summary of different processes is given in the "Elek. Anz.," Feb. 24.

Kation.—In reply to the recent statement of Dr. Waddell (see Digest, March 23), Mr. Portheim in the Lond. "Elec.," March 15, shows that the word may just as well have arrived from another Greek word, and it should then be spelled "Kathion."

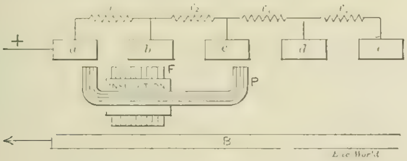
Aluminum.—Messrs. Blackwell, Sons & Co., Liverpool, England, in a communication to the "Eng. Mag." for April, state that aluminum will be made by a process of fusion at considerably less cost than can be done by the electrolytic process; it will be made from the Irish Hill bauxite very shortly at a cost which will "beat all competition."

Electricity Direct from Coal.—In a paper on this subject read at a recent meeting at the Franklin Institute by Prof. Bucherer, he showed that an important correction must be made in calculating the E. M. F. produced by the cold combustion of gases; that of the union of carbon monoxide with oxygen he shows is 1.406 instead of 1.476 as calculated directly from the heat of formation. The complete paper will be published in the Franklin Institute Journal for April; a full abstract is published in another column.

Electrolytic Reduction of Paranitrobenzoic Acid.—A paper by Messrs. Noyes & Clement, in the "Tech. Quart." for October (just received), describes the reduction product of this electrolysis which was found to be paramidophenolsulphonic acid.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Rheostats.—The Vedovelli system, which has been in successful use for some time, is described and illustrated in "L'Ind. Elec.," March 10. The object is to obtain a less sudden variation in the resistance of an ordinary step-by-step rheostat; with the present arrangement one obtains with n contact blocks the same number of steps in the resistance as with $(2n-1)$ blocks in the ordinary method. The device is shown in the adjoining figure, in which F is a contact block making connection with the ends of the resistances a, b, c, d, e, and the rail B; the block F carries with it a bridge piece P, which, however, is insulated from it. In the position shown it connects block a with c, the current entering at a will therefore pass through the first and second resistance in parallel, leaving the block b through the contact piece F; in the next position on the right the bridge piece P will not make contact with any of the blocks and the current will then pass through the first resistance only; there will therefore always be one intermediate value between those which would be obtained without the bridge piece.



Photograph Photometry.—"L'Ind. Elec.," March 10, contains an article by Mr. Guillanne in which he discusses the hypothesis of Janssen based on the fact that the action on a sensitive plate is proportional to the illumination and the time of exposure and therefore to their product, the same effect would then be obtained when the product is the same; he shows from the experiments of Capt. Abney ("Proc. Roy. Soc.," vol. 54, p. 143) that this hypothesis of Janssen is based on incorrect assumptions; for very short exposures the action is less than proportional to its duration; regarding the illumination itself, below a certain limit the action decreases more rapidly than the excitation; prolonged action increases the capacity of the deposit less and less. He believes that it might be possible to introduce the necessary correction factors.

Apparatus for Measuring Phase Difference.—The "Tech. Quart." for October (just received) contains an article by Mr. Derr in which he describes an apparatus for measuring phase difference. In most methods it is assumed that the currents are sinusoidal but the present method is applicable to the measurement of currents of any form whatever and can be used under ordinary conditions. The apparatus is a modification of that of Dr. Puluj (described in Digest, Dec. 23, 1893, and Feb. 3, 1894) which consists of a pair of electromagnets each carrying a flat steel spring at the open end of its core, a mirror being mounted on the spring; a beam of light is reflected from one mirror to the other and thence on a screen; alternating currents are sent through the coils and the spot of light will form an ellipse from whose dimensions the phase difference can be calculated; the objections to this method are enumerated and are claimed to be overcome by the modified method devised by Mr. Derr. In this the two electromagnets are placed side by side and the two beams reflected from their mirrors are received on a revolving, prismatic mirror from which they are reflected on to the screen on which they will form sine curves which, however, bear no resemblance to the original wave form. A time lag of one wave behind the other will be shown by lateral shifting of the images, and represents the difference in phase; to measure it, the angle through which one of the magnets must be turned to bring the images together is measured, as also the further angle through which the same magnet must be turned to move one image laterally through one wave length, that is, until the wave apex o the one is brought to coincide with the preceding one of the other; the first value represents the portion of the wave length by which they are separated and the second gives the value for the whole wave length, the phase difference is therefore 180 multiplied by the ratio of these values, as the vibration frequency is twice that of the current. As these angles are small they are measured by the aid of a long pointer; metallic mirrors should be used in preference to those of glass, as the latter give double images; he gives the results of measurements of the lag between the branches of a three-phase cicruit showing a good agreement with the theoretical values. The advantages of this method are: any source of periodic current may be used whether sinusoidal or not; slight changes in the E. M. F. do not affect the measurements; constancy in the speed of the revolving mirror is unnecessary; the approximate value of the lag and the quadrant in which it lies can be seen at once; the apparatus is simply and easily constructed.

Cable Testing Arrangement.—In the "Elec. Eng.," March 27, Mr. Loewenherz decribes and illustrates a convenient method, the object of which is to enable one to make capacity and insulation tests without changing the connections; the method is that of Mr. Thompson and is somewhat similar to that described in Mr. Webb's book on cable testing.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Automatic Telephone System.—The system of Messrs. Bonnard & Piat in which a subscriber can connect himself with any other without the aid of an operator at the central station, is briefly described and illustrated in "Elek. Anz.," Feb. 28; the number of subscribers does not seem to be limited.

Microphone.—The Mercadier & Anizan form described in the Digest, Feb. 2, is illustrated and described in the "Elek. Zeit.," March 7.

Telephone.—The Morlé & Porché system is described and illustrated in "L'Elec.," March 16. Several systems are illustrated and described in the "Elek. Anz.," Feb. 14 and 21.

Telephone Message Scale.—The "Elec. Eng.," March 27, discusses the recent statement that there is a protest against the new scale of charging of the Metropolitan Company and states that instead of there being a protest against it there is a rapidly growing feeling in favor of it.

Telephone Controversy in New York State.—A summary of the legislative contest is given in the "Elec. Rev.," March 27.

Long Distance Telegraphy and Telephony.—In "Elec. Power" for March Mr. Maver gives some reminiscences of early experiments in simultaneous telegraphy and telephony using the Van Rysselberghe system.

Microphone.—The Jacques long distance vibrating microphone is described and illustrated in the "Elec. Eng.," March 27.

Fire Alarm.—The Walter combined fire alarm and police signal system is described and illustrated in the "Elec. Eng.," March 27.

MISCELLANEOUS.

Purifying Carbon.—The following recipes are given in "Elek. Anz.," March 3, for carbons which are intended for arc lights, batteries and electrolysis. After pulverizing, it is mixed with chloride of potassium in the ratio of 18 to 1 of the latter after which concentrated sulphuric acid of 1.8 is poured over it at the rate of 2 pounds of acid to 11 pounds of graphite; it is important to avoid bringing in contact crystals of chloride of potassium with concentrated sulphuric acid as it will cause an explosion; the mixture is heated until vapors cease being generated; the chlorine generated will form soluble salts with the metals contained as impurities. The silicates are extracted by means of a fluoride of sodium. Electrodes which have lost their active property through long use can be rendered active again by this treatment except that they need not be pulverized. A similar but less effective process is to make the carbon plates anodes (that is connect them with the positive pole) in a concentrated solution of chloride of sodium and pass a current through them.

Educational.—The discussion of the subject of labor saving apparatus as an instrument of education is continued in the Lond. "Elec.," March 15, in a communication by Prof. Cornu, who may be taken as representing French physical science. His experience has taught him that there can be no such thing as abbreviated instruction, it must either be complete or it is not instruction at all; he shows the difference between understanding the nature of a voltmeter and the nature of a watch, time is not an unknown and complex idea like that of a volt; professors who wish to preserve "the old but good methods of instruction think it advisable to set their students to making galvanometers and suitable shunts without asking them to make either watches, weights or divided rules;" the technical professor considers that a voltmeter measures a pressure, which idea is enough for him and he has no need to trouble himself about what a volt is. He discusses the apparatus in Prof. Ayrton's paper; the tendency which was felt by certain members of a physical society was that the character of technical instruction is condemned to drift farther and farther away from its point of origin and to abandon as useless for practical purposes the scientific bases which are the true foundation of practical applications. It is an error to think that there are two sources of instruction, one scientific and the other technical, one complicated and the other abbreviated, one addressing itself to the intelligence and the other founded on blind practice; he believes that there is only one method of instruction, that by which the student passes from the known to the unknown, from the simple to the complex, consisting in building up a new notion on an idea already familiar; that which distinguishes technical from scientific instruction in the nature of the arguments employed and the style of the proofs made use of; if under the pretext of being practical, simplification is sought at the expense of fundamental notions, the economy of time and trouble will only be apparent and often dangerous.

An article in the "Zeit. f. Elect. u. Electrochem." by Mr. Wilke recommends the introduction of technical schools in which the student of electrical engineering can obtain that practical education which he now gets by serving some time in an electrical establishment, at the same time obtaining the necessary instruction in theoretical matters and drawing. The same suggestions are made in a paper by that author reprinted in abstract in the "Elek. Zeit.," March 7.

Lethal Effects of Electrical Currents.—A paper by Dr. Jones from the "British Medical Journal" is reprinted in the Lond. "Elec. Rev.," March 15; he discusses the subject of the fatal effect of electrical currents, giving the results of a number of observations, many of which have been described before.

Incubator.—An electrically regulated and heated incubator is described and illustrated in "Elek. Anz.," March 3.

Acetylene.—According to the "Eng. and Min. Jour.," March 23, another danger in the use of this gas was pointed out in a recent discussion in Manchester, Eng.; it was stated that the gas is easily decomposed by a shock, such as the firing of a percussion cap; the danger is increased very greatly when the gas is compressed into a liquid and stored in cylinders, in which form it has been proposed to use it.

Tesla's Laboratory.—In a short article in the "Eng. Mag." for April Mr. Martin discusses the nature and significance of the event of the burning of Tesla's laboratory; he mentions briefly that the most advanced form of the oscillator had been used to light the laboratory for months.

Transformer Efficiency.

The interest taken in the "Packard" transformer shown running with the case full of water at the Cleveland Convention of the National Electric Light Association will make further data on the subject acceptable to central station men and electricians in general. The water test clearly demonstrates the excellence of insulation. The efficiency test given below was made at Cornell University by Prof. Harris J. Ryan, and, of course, is absolutely disinterested, as well as of the highest authority.

Size.		—Voltage—		—Efficiency—				Regulation from full to no load.
Lts.	Watts.	Prim.	Sec'd.	Full load.	¾	½	¼	
30	1,500	1,000	50	94.7	94.2	92.4	87 0	2.1
100	5,000	1,000	100	96.5	95.8	95.4	90.4	1.7

The transformers tested were of the standard make of the Packard Electric Company, Warren, Ohio, and the results obtained are highly creditable to the manufacturers.

An Important Electrical Enterprise in Mexico.

An interesting and important electric power installation is now under construction for the Cia. Anonima de Transmission Electrica de Potencia, located in the State of Hidalgo, some 100 miles north of the City of Mexico.

The water is taken from the Arroyo de Regla, a mountain stream having a minimum supply of 1,500 cubic feet per minute. A natural rock dam at a point in the canyon impounds the water sufficiently to admit of its being diverted by a cut through the bluff into a canal, which follows mostly the contour of the mountain—a distance of one and one-half miles. This involved the cutting of seven tunnels, aggregating a total length of 1,200 feet through solid rock.

From the terminus of the canal the water is carried to the power station through 1,700 feet of 30-inch pipe, which affords a vertical head of 800 feet; the pipe is of varying thickness to correspond to the pressure at various points on the line, the lowest portion being made of steel three-fourths of an inch thick. The pipe line discharges into a receiver 40 inches in diameter by 75 feet long, with which the wheels are connected by lateral branches. This is made of flange steel plates three-fourths inch thick, tested to 700 pounds water pressure, and weighs upwards of 50,000 pounds

The power station consists of five Pelton wheels, 40 inches in diameter, of capacities of 400-hp each; these are direct connected to the same number of 12-pole, three-phase generators running at a speed of 600 revolutions and delivering the current at a pressure of 700 volts. There are also two 24-inch Pelton wheels, speeded at 1,700 revolutions for running the exciters. The step-up transformers are wound for a ratio of 1 to 15, making the line potential a little over 10,000 volts at the generator end. There are three transformer sub-stations in which air blast transformers are to be used. Pelton differential governors are attached to each wheel for the purpose of regulation.

This station is to supply power to the mines of the Rio del Monte company—one of the most extensive mining organizations in the world, and employing upward of 8,000 men. The power is to be used for operating mining machinery, such as stamp mills, crushers, pumps, hoists, ventilators, etc. The mines of this company are said to be the richest in Mexico, and are located within a radius of 20 miles, the maximum distance of power transmission being 23 miles, and the mean distance about 18 miles. Various other mines in the vicinity will also be supplied with power from this station, and the city of Pachuca also furnished with light. A market for the entire power being thus afforded at highly remunerative rates, the financial success of the enterprise is assured; in fact, it is claimed that the entire outlay of some $300,000 will be returned to the company in two years' time, from the saving effected in fuel heretofore required in carrying on their various operations.

This enterprise originated with, and is being carried to completion under the direction of Senor R. M. de Arozarena, an accomplished engineer resident of the City of Mexico, and also a director of the company.

The Pelton Water Wheel Company, of San Francisco and New York, have the contract for the hydraulic part of the work and the Thomson-Houston International Company, of New York, for the installation of the electrical machinery. The plant is expected to be in running order in about 90 days.

The Reno Rapid Transit Plan.

The proposal of the Rapid Transit Commission to build a four track tunnel under Broadway has not only brought out considerable opposition from the owners of the sidewalk vaults, but has also set to thinking the various owners of pipes, electric subways, etc., whether or not it is going to be possible to make suitable provision for them in the proposed construction of the street's sub-surface. The plan suggested by Mr. J. W. Reno, Mills Building, New York, as illustrated in the cut, proposes to avoid the condemnation of the vault area, which the commission estimates will add $5,000,000 to the cost of the line, and at the same time to furnish commodious pipe and wire subways in convenient position with reference to the buildings, so that the surface of Broadway will never in the future have to be torn up to admit of the making of pipe and wire connections or repairs to the same.

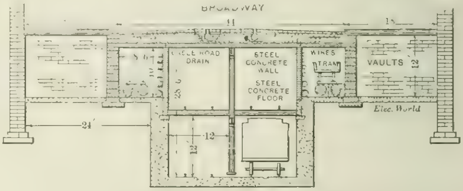


FIG. 1.—RENO TUNNEL SYSTEM WITH PIPE GALLERIES, CHAMBERS STREET TO 34TH STREET.

The electric wire subway is shown occupying space which otherwise would be useless, and by admitting of frequent access to the ducts from the pipe gallery beneath, will insure their always being dry and well ventilated. The unoccupied space in each gallery can be utilized as shown by a small electric "tram," which would be useful in collecting high class freight and express matter along the line and delivering it to the nearest stations.

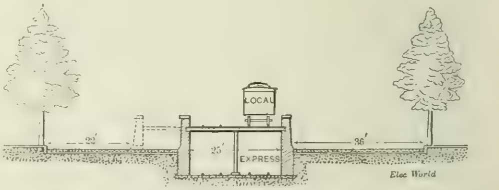


FIG. 2.—RENO PLAN COMPARED WITH "WIDE" PLAN, AT TUNNEL AND VIADUCT APPROACHES ON BOULEVARD.

All these various conveniences ought to add materially to property values along the line and, if well known, would undoubtedly disarm any opposition of the property owners.

In the tunnel proper the local trains, whose platforms are only 12 feet below the street, will be carried, as shown, upon a substantial floor of steel beams and concrete upon which the rails can be suitably cushioned to prevent noise and vibration. The heavier and faster running express trains will, of course, have their road bed on terra firma, and at such a distance from the buildings that there will be no possibility of vibrations reaching their foundations.

Fig. 2 shows the simplicity of the Reno plan compared with the proposed "wide" tunnel at the 125th street viaduct approach, which latter plan would there be a serious encroachment upon the roadways.

The Sacramento-Folsom Power Transmission Plant.

GATE MECHANISM.

The perfection of a system, by means of which power may be economically transmitted over long distances, and which suddenly broadened the field of critical effort, is now receiving practical and successful illustration in many places in this country, and our readers are familiar through our columns with the excellent work done at Taftsville, Conn.; Concord, N. H.; Hartford, Conn.; Columbia, S. C., and elsewhere. One of the best and most recent examples and one of the most interesting is the plant, nearly completed, which the Sacramento Electric Light & Power Company is constructing at Folsom, on the America River, where one of the largest water powers in California will be utilized. It is the more interesting in that the scope of the scheme, which at the commencement of the hydraulic work in 1866 was limited in its range, has been almost inconceivably widened by the alliance between water power and electricity which modern invention has brought about.

VIEW OF DAM FROM BELOW.

The work as at first conceived embraced a dam across the America River, near Folsom, and the utilization of the water, primarily for power purposes, and secondarily for the irrigation of the surrounding country. The plan was modest in its proportions, and remained so for many years, but the introduction of electricity immediately magnified it into a grand scheme contemplating the utilization of about 5,000 hp for transmission purposes, and 1,200 hp for use in the state prison located by the side of a special state power house.

The first step was taken in 1866 when the foundation for the dam was laid. Some years later the California state government contracted with the power company, and in exchange for water power privileges and certain grants of land for prison buildings, agreed to supply convict labor. In 1888 a new contract was effected, the size of the dam and canals as indicated in the original plans were greatly increased, and under these new plans the work, pushed forward vigorously, is now rapidly nearing completion. The dam is a massive structure of granite laid with Portland cement. It is 650 feet long, 89 feet high in the centre, 87 feet wide at the base, 25 feet wide in the crest, and contains about 48,590 cubic yards of solid masonry. It is provided with a heavy wooden shutter or flashboard six feet high, which at high water is lowered into a recess in the crest of the dam.

At each side of the dam is a massive granite bulkhead, in which are three head gates operated by hydraulic machinery, each head-gate being 16 feet wide. The West Side Canal is not yet completed, but is designed to be 40 feet wide at the top, 30 feet wide at the bottom, and six feet deep. It is intended principally for irrigation purposes.

The East Side Canal is completed from the dam to the site of the power house, a distance of about two miles. It is 50 feet wide at the top, 40 feet wide at the bottom, and 8 feet deep, having a capacity of about 87,000 cubic feet of water per minute. The canal is divided into three sections and follows the bank of the river for about two miles. It is constructed partly of masonry, partly formed by cuts in solid rock, and partly by earth cuts and fills. Just before it reaches the power house of the Sacramento Electric Light & Power Company it has been widened into an immense basin to hold the logs of the America River Land & Lumber Company, which company is about to erect at this point a large saw mill, to be operated entirely by electricity.

The power house of the Sacramento Electric Light & Power Company is situated at the extreme end of the canal on the west side of Folsom, where a fall of 55 feet is available at high water. Here an immense cut in solid rock has been made about 60 feet deep, 100 feet wide, and 150 feet long, from which a channel 40 feet wide leads to the river. In this cut the foundations for the machinery and the granite walls, piers and arches of a two-story building have already been laid, and the structure is progressing rapidly. At the power house the canal makes a sharp turn at right angles and widens out into a fore bay 150 feet long, 100 feet wide and 12 feet deep, forming a settling basin for debris. It is divided into two distinct parts by a wall provided with suitable gates so that one side may be cleaned out while the other is in operation. From the lower end of each section of the fore-bay a sluicing canal, normally closed by gates, leads to the lower river, and through this the sand and debris will be carried away and kept from the wheels.

The contract for the entire mechanical and electrical equipment was awarded to the General Electric Company in September, 1894. The contract for the hydraulic apparatus was let to the S. Morgan Smith Water Wheel Company. This apparatus will consist of four pairs of McCormick horizontal-shaft turbine wheels, enclosed in steel cases having steel inlet pipes eight feet in diameter and double discharge tubes. The governors used will be of the Faesch-Picard type, and will be supplemented by heavy fly-wheels on the water wheel shaft. Each pair of wheels will have a capacity of 1,260 hp at 300 revolutions per minute. They embody all that is latest and most improved in hydraulic practice, and are of larger capacity than any hitherto constructed in this country, with one exception. They will be operated under a head of 55 feet. The hydraulic plant also includes two special horizontal wheels for the exciters. The water after having passed the turbines will be discharged through tunnels under the power house into irrigation canals for distribution over the country south and east of Folsom.

The generators will be four in number, and of the General Electric three-phase alternating current type, furnishing current at 800 volts potential. The armature shafts will be directly connected to the shafts of the wheels by means of flange couplings. Each generator will have a capacity of 1,000 hp, and will weigh about 30 tons. They will be the largest three-phase generators yet constructed. The wheels and generators will be located on the first floor of the building 16 feet above the level of the water in the tail race, but will not occupy the same room. Between the wheel room and the generator room a heavy masonry wall has been built. The openings through which the turbine shafts will pass will be small, and the wall will serve to protect the electrical machinery from the possible entrance of water. The water wheel regulators will be in the dynamo room, and the operator will thus have full control of the hydraulic machinery while in sight of the electrical instruments on the switchboard. Both dynamo room and wheel room will be provided with traveling cranes.

In the second story of the power house directly over the dynamo room, sub-station step-up transformers will be installed, of the standard type used by the General Electric Company in such plants. In these transformers the E. M. F. will be raised to 11,000 volts, and connections to the line will be made through marble switchboards equipped with the necessary switches and fuses.

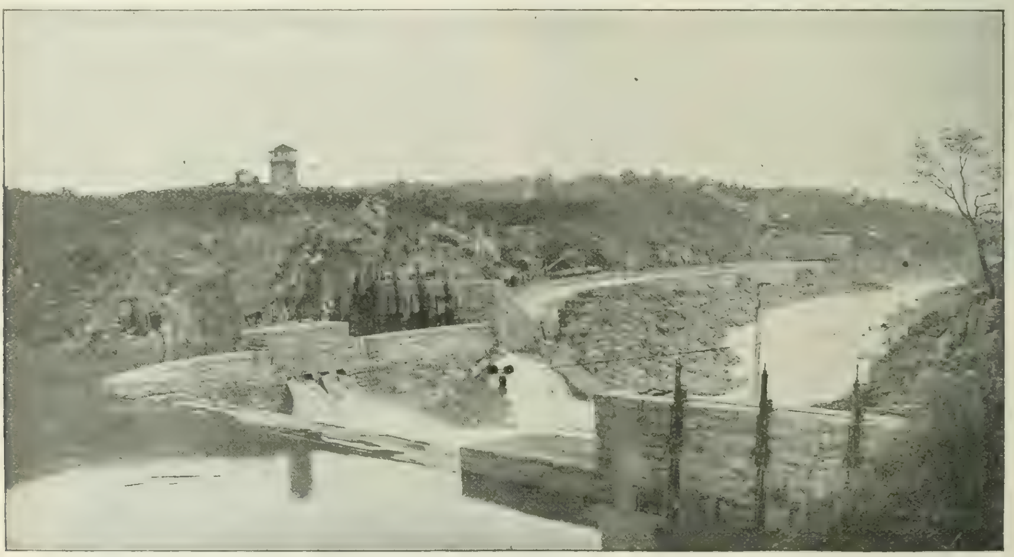
Special provision to prevent shut-down by accident or unforeseen contingency has been made in the pole line, which will be in duplicate from the Folsom power house to the Sacramento transformer sub-station, and will run along the line of the Sacramento & Placerville Railways as far as the city. For this purpose 2,600 40-foot round cedar poles, 16 inches in diameter at the butt, are used, and each will carry two cross-arms for the two circuits. Each circuit will consist of three bare copper wires supported on double-petticoat porcelain insulators especially designed and made for this installation at the porcelain factory of the General Electric Company, at Schenectady. Each insulator is subjected before shipment to a test of not less than 25,000 volts, alternating current. Each three-wire circuit can carry the output of one dynamo, and any dynamo can be thrown on any line, though they will all be normally operated in multiple.

The sub-station at the end of the transmission line will be a fireproof two-story brick building, divided into four parts, namely, the step-down transformer room, the motor, railway and arc dynamo room, the shop and testing room and the store room.

In the transformer room transformer switchboards will receive the terminals of the 10,000-volt transmission lines and enable the attendant to operate different combinations of the transformers. The step-down transformers, of the air-blast type, will vary in size according to the duty required of them, and deliver current at the secondaries at 125, 250, 500, 1,000 and 2,000 volts for incandescent lighting and motor service.

In the main room will be three 300-hp three-phase synchronous motors, of the standard General Electric type, directly connected to a line shaft. This shaft will be provided with clutch pulleys to drive several 500-volt continuous-current railway generators and a number of arc dynamos.

The incandescent lighting, commercial arc lighting and stationary motor work in the central portion of the city will be handled by a low tension modified Edison three-wire system, feeders from the secondaries of the step-down transformers supplying current to a network of mains. The motors will be of the three-phase induction type, and can be connected to the mains at any point. The street and private arc lighting will be done on the constant current series system, while outlying motors will be operated from higher potential lines with individual transformer reduction, or will be high potential synchronous motors.



View from Above Dam

A New Automatic Engine.

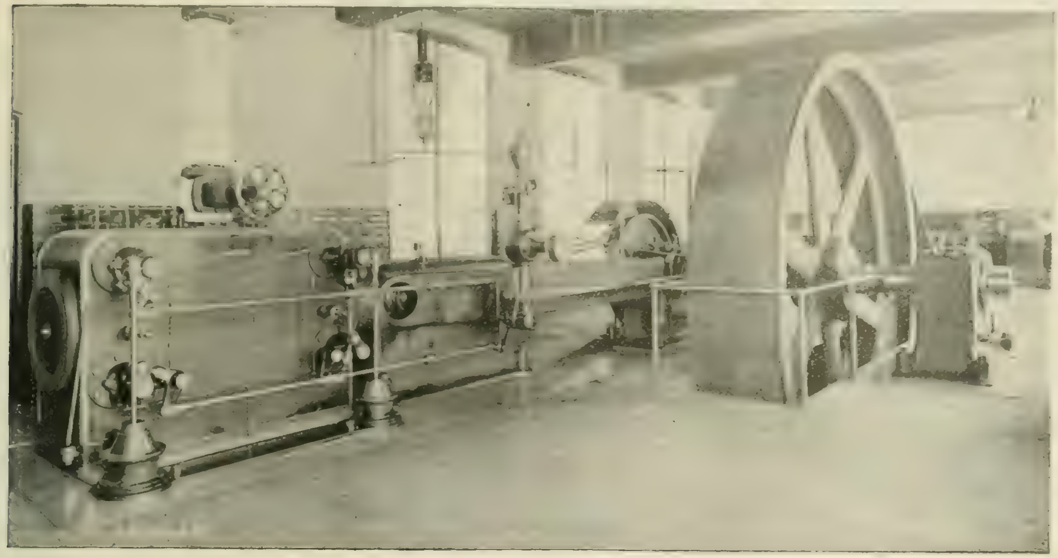
We illustrate in the accompanying engravings a new automatic four-valve releasing gear engine now being placed on the market by the Rice & Sargent Engine Company, Providence, R. I. Fig. 1 illustrates a 20x42-inch engine recently built for a Pawtucket (R. I.) manufacturing company, and Fig. 2 shows in cross section the valves, which are of the Corliss type.

Much care has been spent in the design to make all the parts heavy and strong in order to meet modern requirements. The bed-plate is designed with box sections. The guides are bored and the end of the bed-plate faced to fit the cylinder at one end of the boring bar, the guides and pillow blocks having broad foundation bases. The shaft is extended through the out-board pillow block in order to permit the engine to be converted into a double engine or cross-compound later on when increase of load requires. The pillow block is fitted with four-part full babbitted boxes with wedge adjustments for the side boxes and chain oilers for continuous lubrication. The greatest of care has been exercised throughout to maintain efficient lubrication. The connecting rod has a phosphor bronze box at the cross-head end, and full babbitted boxes at the crank end, the adjustment being provided for by wedges and screws at both ends, thus preserving the length of the rod constant under wear. The cross-head end is of the solid end type and the crank end fitted with a block and bolt on the lower side to facilitate the removal of the boxes. The cross-head is of the box pattern with babbitted ends and gibs and wedge adjustment.

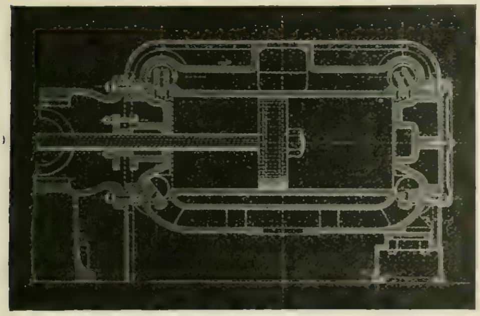
The cylinder is provided with four double-ported Corliss valves as shown in cross-section in Fig. 2 and with steam or exhaust chests, the latter being separated from the barrel of the cylinder by an air space to prevent cylinder condensation. The exhaust valves are brought well up into the cylinder so as to reduce the clearance.

The valve gear is a new form of releasing gear having separate eccentrics for the steam and exhaust valves, thus enabling a ready adjustment to be made suitable for any condition of running. The cut-off, controlled by the governor, has a range from zero to three-fourths stroke. The exhaust valve arrangement obtains the wrist-plate motion directly on each bonnet without the use of a separate wrist-plate, and also brings less strain upon the exhaust bonnets.

The steam valve arrangement consists of a rocker journaled on a fixed bushing projecting from the bonnet, which bushing surrounds and carries the valve stem. A regular rocking motion is imparted to the rocker by means of a link which connects a pin at the lower end of the rocker to the eccentric. The rocker is provided, about midway of its length, with a bearing hub for holding the driving toe, the hub being cut away to provide for the forwardly projecting portion of the driving toe, and to allow the free vibration of the same on its pivot. A pivot spindle, forming part of the driving toe, has a free fit in the hub and passes through to the rear, and at the rear end of this spindle is keyed the cam lever, which is carried obliquely upward behind the rocker, and is a free fit between two rollers which are held upon the pins projecting in front of the trap lever, the latter being pivoted on the bonnet, concentrically with the valve-stem, and provided with an arm which is connected by means of a link to the governor. The valve lever is keyed to the valve stem and has a branch arm carrying the pin from which connection to the dash-pot is made for closing the valve. The valve lever projects downward at an angle of about 45 degrees, when in mid-position, and carries from a lug in the rear, a latch, which is engaged by the driving toe of the rocker, to open the valve. The latch is held in its position by its own weight, the front portion of the latch resting against the face of the lug and receiving the thrust of the toe for opening the valve. The upper part of the latch extends backward over the lug and is provided with a cylindrical turning point or pivot, on which the latch may be raised when the driving toe passes under it on the urn movement of the rocker. The centre of the pivot of the latch is considerably above the line of pressure on the latch, so that the latter will be prevented from rising while at work, and a large amount of wear on the engaging surfaces has to take place before the latch can jump out of its engagement. This is an important feature of the gear, as by it the builders are enabled to use a light gravity latch, without the use of springs, and at the same time the latch is automatically locked in place when at work. The cam lever has a short incline about midway of the length of the cam, thus dividing it into two parts, each of which is a segment of a circle, so arranged that its centre will coincide with the centre of the valve stem when that segment is held between the rollers; so that in operation there will be no change in the relation of the cam lever and the attached driving toe with the rocker, except when the incline of the cam passes between the rollers.



A New Automatic Engine.



Sectional View of Cylinder and Valves.

At the beginning of the forward movement of the rocker the outer portion of the cam lever will ordinarily be between the rolls and the driving toe raised to its engaging position with the latch. As the rocker advances and opens the valve, the incline of the cam enters between the rollers, causing the driving toe to be depressed sufficiently to release the latch, and the valve is immediately closed by the dash pot. On the return movement of the rocker the incline of the cam returns between the rollers and raises the toe for subsequent engagement with the latch, and as the toe comes back to its first position the latch is raised by contact with the upper side of the toe and then drops in front of the toe for engagement again.

It is obvious that the angular position of the trip lever, which is controlled by the governor, will regulate the amount of opening of the valve and the proportion of the engine stroke when steam is admitted to the cylinder. Both latch and toe are provided with hardened steel plates, each with eight edges which are available for wear.

The governor, of the well-known high speed Porter type, runs at a high velocity and is extremely sensitive. Connecting rods from the governor to the valve gear are taken by a yoke with pins on both sides, so that all strains on the governor will be central and cannot cramp the same. The yoke also connects to a controlling vessel for steadying the governor, and weights may be added to change the speed of the engine while running. A "stop motion" is provided, which will immediately stop further admission of steam to the cylinder if the governor should be disabled.

The dash-pots are a new form of vacuum pot. They have a constant internal displacement and do not take in or discharge air at each stroke, and they are absolutely noiseless and free from vibration when cushioning.

A new form of rotary clutch for disconnecting either set of steam or exhaust valves, for operating by hand, is used. This consists of a steel tube with a long slot on each side containing notches which fit corresponding teeth projecting from the valve rod inside. The tube is rotated by a ball handle, the weight of which holds the clutch in or out.

The Lombard Water Wheel Governor—A Correction.

In our description last week of the water wheel governor manufactured by the Lombard Water Wheel Governor Company, Boston, a typographical error caused the last sentence of the article to read "Under a variation in load from 57 to 76 hp in one minute the speed of the water wheels is reported as varying $2\frac{1}{10}$ per cent." This should have read, "Under a variation in load from 57 to 446 hp in one minute, etc." A glance at the diagram would at once disclose the discrepancy between the statement in the text and the actual performance of the governor. By referring to the curve it will be seen that the variation in speed for average changes in load runs about $\frac{3}{10}$ of 1 per cent. which is much better than steam engineers are willing to guarantee for engine governors. It is perhaps superfluous to say that the case considered was an abnormal one, the selection being made with a view to showing the efficiency of the Lombard governor under the most unfavorable circumstances.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, March 30, 1895.

ELECTRICAL STOCKS reacted slightly this week, General Electric having declined 1¼ and American Bell 5. The report concerning an understanding between the Westinghouse and General Electric Companies as to patents and market prices has not been contradicted, and belief in its authenticity has taken firm hold. It is said that the patent litigation of these great corporations has aggregated $1,000,000 per annum recently, and that the abolition of this means an increase in net results of over 2 per cent. on the combined capitalization.

EDISON ILLUMINATING, of New York, will shortly provide for needed extensions of business by the authorization of a consolidated mortgage securing $15,000,000 of 5 per cent. bonds. Of this amount $4,312,000 will be used to retire first mortgage 5s now afloat. The new mortgage will provide that the total issue of bonds shall at no time exceed the outstanding volume of stock.

METROPOLITAN TRACTION declined sharply, contrary to the predictions of its friends that an advance was to be expected. This is ascribed to large speculative holdings that come on the market with every rally of a few points, for which there is considerable "gunning." There is nothing unfavorable in the operating results to justify a drop; the earnings are increasing right along, and a fine outlook for larger receipts is reported.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	96¾	97½
" " " Brooklyn	100	..	108
" " " Boston	100	..	..
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	..	30½
General Electric	100	35½	35⅝
General Electric, pref	100	..	70
Westinghouse Consolidated, com.	50	35½	36
" " pref	50	52	52½

BONDS.

	Par.	Bid.	Asked
Edison Electric Ill., New York	100	..	106⅝
Edison Electric Light of Europe	100	75	85
General Electric Co. deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

	Par.	Bid.	Asked
†American Bell Telephone	100	..	192
American District Telegraph	100	..	45
American Telegraph & Cable	100	89¾	91¼
Central & South American Telegraph	100	117	120
Commercial Cables	100	130	140
Erie Telephone	100	51	51½
Gold & Stock Telegraph	100	105	..
New England Telephone	100	71	72
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63½	..
Western Union Telegraph	100	88⅝	88⅞

ELECTRIC TRACTION STOCKS.

	Par.	Bid.	Asked
Baltimore Traction	25	15¼	15½
Binghamton RR. com	100	100	..
Brooklyn Traction	100	9	11
" " pref.	100	..	53
Buffalo St. Ry	100	66½	69
Cleveland City Ry.	100	68	70
Cleveland Electric Ry.	100	59	60
Chicago City Ry	100	305	315
Columbus St. Ry	100	46	49
Consolidated Traction of N. J	..	30	33
Electric Traction, Philadelphia	50	78½	79
Long Island Traction	100	7	7⅛
Louisville St. Ry. com.	100	37	39
" " " pref.	100	87	88
Metropolitan Traction, Philadelphia	100	90	90⅜
New Orleans Traction	100	15	18
" " pref.	100	56	60
North Shore Traction	100	..	..
" " pref.	100	74	83
People's Traction $30 pd	25	54½	55⅛
Philadelphia Traction	50	89	89¼
Rochester St. Ry	..	38	..
Union Ry. (Huckleberry)	100	112	115
West End, Boston	100	61	61½
" " pref	100	87½	88
Worcester Traction	100	..	13
" " pref	100	77	80

BONDS.

	Par.	Bid.	Asked
Buffalo St. Ry. 1st con. 5s	100	101	..
*Binghamton Railroad Co. 5s	100	99	100
*Columbus St. Ry. 1st 5s	100	9	..
Rochester St. Ry. 1st. 5s.	100	95	97
*Union Ry. 1st. mtge 6s.	100	105	108
*Westchester Electric 1st. mtge. 5s.	100	98	101

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* With accrued interest.

† Ex-div.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD.
253 BROADWAY, NEW YORK, April 1, 1895.

MR. J. M. CUMMINGS, inventor of the well-known conduit, is in the city on business, and wears the genial smile characteristic of a manufacturer whose product is in heavy demand. The order recently received by the Cummings & Engleman Company from the Niagara Falls Hydraulic Power Company will cover over 30,000 feet of conduit.

J. H. BUNNELL & CO., 76 Cortlandt street, have put in handsome walls and ceiling of pressed steel, the design of which is very ornamental. Other improvements have also been made, and the interior of the store presents a strikingly handsome appearance. The headquarters of this progressive concern give no indication of anything like dull times.

MAXWELL M. MAYER, manufacturer of the iron-clad dynamo illustrated in our columns last week, removed his office some time since from 136 Liberty street to 411 107th street, New York, where his factory is located. In our article referred to, the old address was inadvertently given. Mr. Mayer has excellent facilities for turning out high grade work at short notice.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, March 30, 1895.

THE SENATE COMMITTEE on Street Railways in the Massachusetts Legislature has reported adversely on the petition to allow street railways to make contracts to carry United States mails or to carry freight, merchandise or express packages.

RAPID TRANSIT for Boston was practically inaugurated Thursday, the first spadeful of dirt being dug at the Public Garden end of the enterprise by Chairman Crocker of the Rapid Transit Commission. His Excellency Gov. Greenhalge assisted in the opening ceremony.

THE ELECTRIC HEAT ALARM COMPANY, of Boston, has always adopted most telling and effective methods to keep itself prominently before the public. The fertile brain and apparently inexhaustible energy of Mr. F. S. Palmer, its popular general manager, are always producing something in the line of credit to himself and profit to his company. His latest effort is in the form of a new catalogue of its heat alarm, fire alarm and thermostat systems, which is really a gem of beauty and neatness, the outside cover being in the form of a calendar which will guarantee unquestionably its preservation in the office or home.

BIBBER, WHITE & CO., the newly organized electrical firm, with offices at 620 Atlantic avenue, Boston, require introduction only because of their recent organization, all of the members composing it being well and favorably known. The executive head of the firm, Mr. C. E. Bibber, has already earned for himself an enviable reputation which he will undoubtedly fully sustain. The firm will have the sole selling agency of the wire and cable products of the Crofield Electrical Works, of Providence, R. I., and will also represent in New England the Cutter Electrical Manufacturing Company, of Philadelphia, whose specialties need no words of commendation.

General News.

TELEGRAPH AND TELEPHONE.

KINGSTON, N. Y.—The West Shore Telephone Company is rushing in telephones, and will be ready for business in a few days.

CARBONDALE, PA.—A telephone exchange company is to be organized. A. P. Trautwein, secretary of the Board of Trade, can furnish detailed information.

HARRIMAN, TENN.—M. L. Dame will give information regarding a complete equipment of 50 telephones to be purchased by the Harriman Co-operative Telephone Exchange.

ELECTRIC LIGHT AND POWER.

BENTON HARBOR, MICH.—Peter English has asked for a franchise to establish an electric light plant.

STATESBORO, GA.—W. D. Davis is contemplating the construction of an electric lighting plant in this town.

HARTFORD, CONN.—The extension of the electric light system is contemplated. Address the clerk of the council.

WINONA, MINN.—The city clerk will give information concerning the establishment of a municipal electric light plant.

GREENSBORO, N. C.—Bids will be received by A. M. Scales, city clerk, until April 28, for the electric lighting for this city.

DELAND, FLA.—An electric lighting system is to be established here in the near future. Address the clerk of the Council.

OGDENSBURG, N. Y.—The electric lighting of this city is contemplated. The town clerk can furnish detailed information.

NORWICH, CONN.—The erection of a municipal electric lighting plant is contemplated. Mayor C. A. Harwood can be addressed.

CHESTER, PA.—It is reported that the city is to be lighted throughout with electricity. The clerk of the Council can furnish details.

VERSAILLES, KY.—An electric lighting plant is to be built in this city in the near future. Address the mayor for detailed information.

McCOMB CITY, MISS.—The installation of an electric lighting plant is contemplated by Messrs. J. J. White, William Link and O. D. Quin.

ROCHESTER, N. Y.—Bids will be received for the lighting of the police station on Exchange street. Address the city clerk for details.

NEWBURYPORT, MASS.—The question of lighting the streets with electricity has been agitated. Address the clerk of the Council for details.

NORFOLK, VA.—An electric plant is to be built for the Portsmouth & Port Norfolk Railway. The most modern machinery will be introduced.

BLACKSTONE, R. I.—The residents of this town are agitating the question of an electric lighting system. The town clerk can furnish details.

BARDSTOWN, KY.—Address Arvil Arnold regarding estimates on an electric light plant, and estimates on lighting the city, with a 20 years' lease.

GOLIAD, TEX.— The Goliad Water & Light Company has applied for a franchise. W. E. Campbell, president of the company, can furnish information.

JAMESTOWN, N. Y.—The Council has been required to extend the electrical lighting system on several streets. The clerk of the Council can be addressed.

EVANSTON, ILL.—An electric light plant will be established, and an election held April 16 to vote on the question of issuing $38,000 of bonds for erecting same.

CLINTON, N. J.—Work will be commenced in the near future on the construction of the electric lighting plant. The clerk of the Council can furnish particulars.

BLOOMINGTON, ILL.—The Bloomington Electric Light & Power Company's plant, which was recently destroyed by fire, will probably be rebuilt in the near future.

KENSINGTON, MD.—The Common Council of this place is contemplating the lighting of the streets with electricity. Address the clerk for details.

TAMPA, FLA.—The purchase of an electric lighting plant for street lighting is contemplated by the city authorities. The clerk of the Council can be addressed.

THE FALL RIVER, (MASS.) ELECTRIC LIGHT COMPANY has petitioned for permission to establish its wires underground. The secretary can be addressed.

GOFFSTOWN, N. H.—An ordinance has been introduced authorizing the issuance of bonds for an electric light plant. For details address the clerk of the Council.

TAMAQUA, PA.—The residents of this place are contemplating the erection of an electric light plant. The clerk of the Council can be addressed for further information.

FAYETTEVILLE, N. C.—Authority was granted by the last legislature to establish an electric light plant. Bonds to the value of $10,000 will be issued for that purpose.

PARISH, N. Y.—Bids are to be advertised for the lighting of the streets of this village for a term of one year. W. B. Baxter, clerk of the Village Board, can be addressed.

GREEN ISLAND, N. Y.—A bill has been introduced authorizing the issuance of $20,000 worth of bonds for the purpose of establishing an electric light plant in this village.

WINCHESTER, MASS.—The establishment of a municipal electric lighting plant is contemplated by the town authorities. Address the town clerk for detailed information.

LIVINGSTON, ALA.—An electric lighting plant is to be established here. Bids for the construction of same will be received by W. R. Smith, secretary of the Commercial Club.

KAUFMAN, TEX.—The Kaufman Manufacturing Company is being organized for the purpose of building a woodenware factory. An electric lighting plant will be installed. H. J. Snow, of this place, is among those interested, and can be addressed.

TRENTON, N. J.—A bill has been introduced authorizing the construction and maintenance of a municipal electric lighting plant in this city. The city clerk can be addressed.

SHEBOYGAN, WIS.—Sealed proposals will be received until April 23 for lighting the streets of the city with electricity. John Schmitt, city comptroller, can furnish detailed information.

LOCKHART, TEX.—The Lockhart Electric Light Company is in the market for a 750-light incandescent dynamo. The secretary of the company can be addressed for detailed information.

NEW YORK CITY.—A seven-story apartment house will be erected at 28 West 23d street, and the building will be equipped for electric lights. Address W. J Merritt, 339 Boulevard, for information.

NEW YORK CITY.—The new five-story public school building, which is to be erected on Henry street, will be lighted by electricity. Address C. B. J. Snyder, 146 Grand street, for detailed information.

NEW YORK CITY.—A seven-story building is to be erected at 352 Fourth avenue and another at 185 West 97th street. Both will be lighted electrically. Louis Kern, 611 Broadway, is the architect.

PORT HURON, MICH.—The establishment of an electric light plant is contemplated, and a meeting is appointed for April 1 in reference to issuing for its construction bonds to the amount of $30,000.

KINGSTON, N. C.—It is reported that an election is to be held in the near future to vote on the question of lighting this town with electricity. The town clerk can be addressed for detailed information.

HUMBOLDT, TENN.—An election is to be held to vote on the question of issuing $15,000 worth of bonds for the construction of a water works and electric lighting system. The mayor can be addressed.

PITTSBURGH, PA.—Sealed proposals will be received until April 18 for the electrical work for the Fifth avenue high school building. Charles Reisfer, secretary of the Board of Education, can be addressed.

LOCKPORT, N. Y.—It is reported that at the charter election, to be held April 9, the citizens will vote on the question of establishing a municipal lighting plant. Address the clerk of the Council for details.

ATLANTA, GA.—Plans have been prepared by H. M. Atkinson for the lighting of the Exposition grounds with electricity. The plant will have a capacity of 500 arc lights, of 2,000-cp each, and 2,000 incandescent lights.

SEA CLIFF, L. I., N. Y.—The Franklin Electric Illuminating Company has been granted permission to erect poles and string wires in this village. The secretary of the company can be addressed for detailed information.

PHILADELPHIA, PA.—The Junger Maennerchor Hall is to be extensively enlarged and improved at an estimated cost of $30,000. An electric plant is to be installed. Louis Hummel is secretary, and can be addressed for details.

ROCHESTER, N. Y.—Address Edward Harris, 15 Rochester Savings Bank Building, concerning the erection of an electric plant capable of lighting the village of Charlotte, for the Grand View Beach Electric Railway Company.

GREEN ISLAND, N. Y.—A bill has been introduced authorizing this village to issue $20,000 worth of bonds for the erection, equipment and maintenance of an electric lighting plant. Address the town clerk for detailed information.

NEW YORK CITY.—The eight-story store building to be erected in this city for Messrs. Siegel, Cooper & Co., of Chicago, is to be wired and fixtured throughout for electric lighting. An isolated plant will probably be installed.

LAUREL, MD.—The plant of the Laurel Electric Light, Power & Heat Company was recently sold to Jos. Friedenwald and a Mr Miller, of Baltimore, for $7,000. The plant cost $14,000, and the purchasers were creditors in the sum of $5,000.

RIDGEWOOD, N. J.—Architect Charles E Keyser, 209 Main street, Paterson, has prepared plans for a stone residence for Mr. Wortendyke of Paterson, at a cost of $15,000. The structure will be wired and fixtured throughout for electric lighting.

MARIETTA, PA.—The Marietta Electric Light, Heat & Power Company has been awarded the contract to light the streets of this city. It has also been granted permission to use the streets for its lines. A. D Wike, of this place, is secretary.

NEW YORK CITY.—The 20-story office building which is to be erected for Henry O. Havemeyer, 117 Wall street, after plans prepared by G. G. Post, 33 East 17th street, is to be lighted throughout by electricity. An isolated plant will be installed.

CHATHAM, N. Y.—Sealed proposals will be received until April 8 by the Board of Trustees for lighting the streets of the village for a period of five years. Eighty-five incandescent lights will be required. W. B. Daley, village clerk, can furnish other details.

ASBURY PARK, N. J.—The Neptune Electric Company's plant was recently sold at auction to Mr. Geo. A. Smock, representing the Asbury Park Electric Light Company, the price paid being $60,000. The plant has been in receiver's hands several weeks and is mortgaged to the amount of $41,000.

WILLOUGHBY, O.—C. C. Jenkins clerk, may be addressed regarding the furnishing of apparatus, appliances, material, and erecting and completing an electric light and power plant according to plans and specifications on file in the office of J. S. Ellen, mayor. Bids will be received until April 17.

BROOKLYN, N. Y.—Plans have been prepared by Architect C. P. H. Gilbert, 18 Broadway, New York, for a two and one-half story brick addition to the Dutch Arms clubhouse. The structure will be provided with all modern improvements, and will be wired and fixtured throughout for electric lighting. Estimated cost $15,000.

OCEAN VIEW, VA.—Plans have been completed for an electric light and power plant to be built for the Norfolk & Ocean View Railway Company, Norfolk, Va., at a cost of $80,000. Two 250 hp engines and all necessary electrical appurtenances will be required. H. L. Page is secretary of the company, and can furnish particulars.

CHARLOTTESVILLE, VA.—The Jefferson Park Company, which was recently incorporated, has decided to begin work soon on the erection of its electric lighting plant. All the necessary machinery will be required for a plant of 2,000 incandescent lights capacity. F. B. Peyton, secretary of the company, can furnish further information.

THE ELECTRIC RAILWAY.

CHARLESTON, S. C.—A company is being organized to build an electric road from Charleston to Summerville.

MEDFORD, N. J.—The question of building a trolley line through this town is being agitated. The town clerk can be addressed.

NEW YORK CITY.—A bill has been introduced authorizing the construction of a street railway on Fifth avenue south of 24th street.

NEWBURGH, N. Y.—The construction of a trolley line is contemplated from this place to Walden. Address the clerk of the Council.

MEMPHIS, TENN.—A franchise has been applied for by Messrs. Gowdon, Proudfit and J. W. Allison to build a trolley line in this city.

BALTIMORE, MD.—The Baltimore Traction Company will extend its Edmondson avenue line to Orangeville in the eastern suburbs.

PITTSTON, PA.—The Pittston Suburban Electric Railway Company has applied for an extension of time of one year to complete its line.

COHOES, N. Y.—President Weldon has announced his intention of constructing an electric railway to connect Cohoes with Dunsbach's Ferry.

BRADDOCK, PA.—Preparations are being made to double track the Braddock & Turtle Creek line. Address the secretary of same for particulars.

BEVERLY, MASS.—A new power station is to be erected here for the Gloucester, Essex & Beverley Street Railway. The secretary can be addressed.

COHOES, N. Y.—The Cohoes City Railway Company will establish a power house on the Erie Canal. The secretary of the company can be addressed.

POTTSVILLE, PA.—A new trolley road is to be built from this place to Minersville, a distance of 10 miles. The clerk of the Council can be addressed.

DOVER, DEL.—It is reported that a new electric railway is to be built between this city and Milford. Address the clerk of the Council for detailed information.

DANVILLE, VA.—It is reported that the street railway line is to be extended to Reservoir Park. The general manager can be addressed for further information.

BLOOMINGBURG, N. Y.—The traction company of Middletown is contemplating the extension of its line to this village. The secretary can furnish details.

CARTHAGE, MO.—An electric railway 11 miles in length is to be built between this place and Webb City. President Calhoun can furnish further information.

BATH ON THE HUDSON, N. Y.—A franchise has been applied for by a new company to construct an electric railway. Village Clerk Wornham can give information.

PEEKSKILL, N. Y.—An electric road is projected from this place to Brewster via Carmel and adjacent villages. George M. Bailey is interested, and can be addressed.

LA SALLE, N. Y.—Work is to be commenced in the near future on the construction of the Buffalo & Niagara Falls Electric Railway to be built between the points named.

KANSAS CITY, MO.—An electric power plant is to be established here for the Independence dummy line at a cost of $20,000. The secretary of the road can furnish details.

ATLANTIC CITY, N. J.—New York and Atlantic City capitalists have formed a syndicate to build an electric railway from New York to Atlantic City. Capital stock is $4,000,000.

ALBANY, N. Y.—Right of way is being secured for the electric railway which is to extend between this city and Schoharie. The clerk of the Council can furnish information.

PHILADELPHIA, PA.—Penrose Ferry Trolley Company has been granted permission to build a passenger railway in this city. The secretary of the company can be addressed.

HARTFORD, CONN.—It is reported that the Montville Horse Railway Company is to equip its line with electricity. Address the secretary of the company for further information.

EAST GREENBUSH, N. Y.—A franchise has been applied for by the electric railway company to construct their line through this town. The clerk of the Council can be addressed.

ORANGE, N. J.—The Consolidated Traction Company has been granted the privilege of a switch at Main street and Lincoln avenue. The secretary of the company can be addressed.

DOYLESTOWN, PA.—A trolley line is to be built from this place to Philadelphia as soon as possible. The secretary of the Bucks County Street Railway Company can be addressed.

ERIE, PA.—An ordinance has been introduced authorizing the Erie Transit Company to lay tracks on certain streets of the city. The secretary of the company can furnish particulars.

MOHAWK, N. Y.—The Mohawk, Herkimer & Ilion Street Surface Railway has decided to equip the line with electricity in place of horses. The secretary of the company can be addressed.

SCRANTON, PA.—The Scranton Traction Company has applied for permission to double track its lines on Franklin avenue. President Nealis, of the Common Council, can be addressed.

PHILADELPHIA, PA.—The question of establishing a system of elevated roads in this city is being agitated. A bill has been introduced in the Senate authorizing the construction of same.

SHARPSBURG, PA.—The Millvale, Ætna & Sharpsburg Traction Company will begin work on its projected line as soon as the weather permits. Address the secretary for detailed information.

SOUTH ORANGE, N. J.—The South Orange & Maplewood Traction Company has applied for a franchise to construct a line over Springfield avenue. The secretary of the road can be addressed.

PORTSMOUTH, VA.—The management of the Portsmouth Street Railway will build a new electric power plant, to be provided with the latest machinery. Address the secretary of the road for details.

HARTFORD, CONN.—The Hartford Street Railway Company has asked for permission to run its line from Wethersfield Avenue station to the city hall. General Manager Crawford can be addressed.

PARKERSBURG, W. VA.—It is reported that the Park City Railway is to be purchased by W. R. Hura and others, who contemplate equipping same with electricity. President Gould can be addressed.

SYRACUSE, N. Y.—The Syracuse & East Side Railway Company has been granted permission to construct, maintain and operate a single track electric street railway through certain streets of the city.

TOLEDO, O.—We are informed that an electric railway is to be built from this city out into Williams County, for a distance of 45 miles. The clerk of the Council can be addressed for further information.

CLARKSVILLE, N. Y.—The question of building an electric railway from this place to Schoharie is being agitated. J. McNamara, of Albany, is interested, and can be addressed for detailed information.

PATERSON, N. J.—We are informed that the Paterson Electric Railway Company has decided to double track its line from this city to Passaic. The secretary of the company can be addressed for details.

BUFFALO, N. Y.—It is reported that the New York Central Railway Company is to equip its Niagara Falls branch of the line with the electric trolley system. The secretary can furnish further particulars.

MONTCLAIR, N. J.—It is reported that the Montclair Town Council will grant the franchise which was applied for by the North Jersey Traction Company. The secretary can be addressed for detailed information.

WASHINGTON, PA.—It is reported that the street railway is to be extended from its present terminus near the W. & W. station to the foot of Atcheson avenue. Address the clerk of the Council for particulars.

PHILADELPHIA, PA.—Work will be commenced shortly on the construction of the Delaware Valley Electric Railway. Capt. Rockwell, of the Rockwell Construction Company, Middletown, N. Y., can be addressed.

FALL RIVER, MASS.—The Globe Street Railway Company has petitioned for the franchise to maintain an underground system of electrical feed wires. F. S. Stevens, president of the company, can be addressed for details.

GREENBUSH, N. Y.—A meeting is to be held April 15 by the Board of Trustees to consider the advisability of granting a franchise to the Albany & Greenbush Electric Railway. Frederick R. Barnes can furnish particulars.

PATCHOGUE, L. I., N. Y.—It is reported that a trolley road 15 miles in length is to be built across Long Island from Port Jefferson to this place. O. T. Fanning, of the former place, is interested, and can be addressed.

MARSHALL, MO.—A syndicate of which W. G. Campbell, of Oakland, Cal., and W. M. Walker, of this place, are members, is contemplating the construction of an electric railway, 40 miles in length, between this city and Sedalia.

DEXTER, N. Y.—The Dexter & Brownsville Street Railway Company has applied for permission to construct, maintain and operate an electric railway between the points named. Wm. H. Winn, village clerk, can give information.

SYRACUSE, N. Y.—The Syracuse Street Railway Company contemplates the erection of a new structure to accommodate all the electric cars used on the lines. It will be two stories high and accommodate 60 cars on the ground floor.

READING, PA.—Work will be commenced immediately on the construction of the Reading & Womelsdorf Electric Railway, which is to be built between the points named, a distance of 14 miles. The secretary of the road can furnish details.

WETHEREDVILLE, MD.—The county commissioners of Baltimore County have granted a franchise to William J. Dickey, Charles W. Dorsey and others to construct an electric railway over the Wetheredville road from Windsor Bridge to this place.

ROCHESTER, N. Y.—An application has been made to the Common Council by the Rochester Railway Company for a franchise to construct a double track street railway through certain streets of this city. Address the secretary of the company for details.

ROCHESTER, N. Y.—The Rochester, Charlotte & Manitou Railway Company has purchased the old Grand View Beach Railway, which will be improved and operated. Michael Doyle and Valentine Fleckenstein are among the directors, and can be addressed.

STOUGHTON, MASS.—The Stoughton & Canton Street Railway Company has been organized for the purpose of building a line between the points named. The line will be about three miles in length. E. C. Monk is on the board of directors, and can be addressed.

WESTCHESTER, N. Y.—The Edenwald Street Railway Company, of East Chester, has applied for a franchise to construct a line from Wakefield to East Chester, and to this place, via the old Boston coast road. Address the secretary of the company for information.

MT. VERNON, N. Y.—The directors of the North Mount Vernon Railway Company propose to continue the line from here to New Rochelle and White Plains, and from New Rochelle to Tuckahoe. It will be several months before the active work of construction is commenced.

WILKESBARRE, PA.—The Wilkesbarre & Wyoming Valley Traction Company will issue $350,000 worth of bonds for the purpose of building a new line on the east end, double tracking the Nanticoke line, and building a new power and car house. Address the secretary of the company for detailed information.

TURNER'S FALLS, MASS.—A company has been organized with a capital stock of $40,000, for the purpose of building an electric railway from this place to Lake Pleasant and Miller Falls, a distance of five miles. A franchise is to be applied for, and work will be commenced as soon as possible. Address the clerk of the Council for particulars.

BLAISDELL, N. Y.—A company has been organized with a capital stock of $10,000, to be known as the Hamburg Railway Company. The purpose of the company is to construct, operate and maintain a street railway from this place to Woodlawn Beach. James E. Curtis, Frank B. Caldwell and others are among the incorporators, and can be addressed.

Trade and Industrial Notes.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, reports that it is finding a very ready sale for its new carbon open circuit battery, recently put on the market.

ARCHER & PANCOAST, manufacturers of electrical fixtures, have removed their headquarters from the corner of 20th street and Broadway to 18 and 20 West 25th street.

THE ELECTRIC POWER STORAGE COMPANY, manufacturers of accumulators, has removed its offices from the Havemeyer Building to its factory building, 166 Elm street.

W. D. JAMESON, general sales agent of the Gerson Telephone Company, has moved his office from 150 to 44 and 46 Broadway, New York City. Mr. Jameson reports business very good and the demand increasing for his telephone.

THE GOUBERT MANUFACTURING COMPANY, New York, makers of the Goubert Feed Water Heater and Stratton Steam Separator, has lately removed its Pittsburgh office from 403 Lewis Building to 1012 Carnegie Building.

J. C. HOBART, the well-known manager of the Triumph Electric Company, Cincinnati, O., recently made a very successful business trip to Xenia, O., where he received the contract for installing the electric plant of the Willberforce University.

THE MERRILL MANUFACTURING COMPANY, 126 Liberty Street, New York, has issued a neat illustrated catalogue descriptive of its pneumatic pumps and air compressors. Mr. F. H. Merrill's ingenious method of elevating water by means of compressed air is fully described in the book.

THE WASHINGTON CARBON COMPANY, of Pittsburgh, Pa., manufacturer of Helios cored carbons, reports that these well-known goods are continuing to give absolute satisfaction, and that companies using them say that they are even better than the foreign product which stands so high.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., reports the sale through Messrs. H. B. Coho. & Co., its New York contractors, of one 30-kw and two 50-kw direct-connected generators of the new type for Grace Chapel, 17th street, New York City. Armington & Sims engines will be used.

THE RICE & SARGENT ENGINE COMPANY, of Providence, R. I., reports sales up to March 16 of a 300-hp tandem compound to Pembroke Mills, Suncook, N. H.; a 200-hp engine to the Lawrence Lumber Company, Lawrence, Mass., and a 75-hp engine to the Oakdale Manufacturing Company, of Providence, R. I.

THE INDIANAPOLIS ELECTRIC COMPANY, of Indianapolis,, Ind., reports a steady growth in its telephone business. Over 100 telephones of another make have been displaced up to date by this company's instruments. The company's work has thus far been chiefly in the direction of equipping railway telephone lines.

MR. T. J. MURPHY, of T. J. Murphy & Co., 136 Liberty street, New York, has applied for patents on some of his new devices, notably his method of mounting switchboards, which dispenses with all iron uprights, cross pieces and frame work. His patent applications also include some of his numerous designs for slate-lined boxes.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, has just issued a circular of its improved Hunnings telephone and American telephone switchboard, which sets off these articles to advantage. Its switchboard is a very neat and artistic device, and certain advantages in its battery telephone are claimed over any other on the market.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has secured the contract for the new power house of the Metropolitan Electric Company, Reading, Pa. The company is building a warehouse, 120 feet square and 12 stories high, for James Everard, New York City. This building has a steel frame, and will be entirely fireproof.

DALE, FARRELL & CO. is the style of a new firm of electrical and mechanical engineers and contractors, with headquarters at 70 Trinity place, New York. The firm will do manufacturing, and has a factory for that purpose at 214-218 William street. Mr. F. J. H. Dale, the senior member, is an engineer and draughtsman of many years' standing, and Mr. P. H. Farrell is a practical tool maker.

THE HARRISON SAFETY BOILER WORKS, of Philadelphia, has issued an illustrated pamphlet catalogue descriptive of the Cochrane separators, of which the Harrison Company is the manufacturer. The information presented is very complete, detail drawings and explanations being given of each form of separator. Many strong testimonials as to the excellent service experienced with these separators are reprinted in the catalogue.

THE STANDARD TOOL COMPANY, of 146-150 Centre street, New York, is distributing a unique advertising card, upon the face of which is an imitation oyster shell bearing the inscription: "Perhaps there is a pearl in this oyster." Raising the shell, which is secured at the upper end only, discloses a miniature twist drill under which is the statement "Not a pearl, but a gem in its way." The device is a very taking one.

THE LUKENS IRON & STEEL COMPANY, of Coatesville, Penn., reports the receipt of an order for 6,000 tons of open hearth steel plates to be used in the construction of the cantilever bridge across the East River at Blackwell's Island, New York City. The Lukens Company has also received large orders for boiler steel from Cramp & Sons, the Philadelphia shipbuilders, for the new Clyde line steamship, and from the Pennsylvania Railway Company, the Lehigh Valley Railway Company, the Schenectady Locomotive Works, and others for boiler and firebox steel.

THE WALKER MANUFACTURING COMPANY, Cleveland, O., reports the following contracts closed between March 1 and 22: Burhorn & Granger, 136 Liberty Street, New York City, two 25-kw direct-coupled lighting generators; F. E. Snow, receiver Adrian City Electric Belt Railway Company, Adrian, Mich., one 60-kw belted generator and three 25-hp single equipments; Union Depot Railway Company, St. Louis, Mo., 41 double car equipments, 30 hp steel motors; Pittsburgh Traction Company, Pittsburgh, Pa., one double car equipment, 30-hp steel motors; Pittsburgh, Crafton & Mansfield Passenger Railway Company, Pittsburgh, Pa., one double car equipment, 50-hp steel motors; Federal Street & Pleasant Valley Passenger Railway Company, Pittsburgh, Pa., two double car equipments, 30-hp steel motors; Suburban & Rapid Transit Street Railway Company, Pittsburgh, Pa., one double car equipment, 25-hp steel motors; Schuylkill Electric Railway Company, Pottsville, Pa., four double car equipments, 25-hp steel motors; Chicago City Railway Company, Chicago, Ill., 49 double car equipments, 25-hp steel motors.

Business Notices.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention, Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

WESTERN ELECTRIC COMPANY, of Chicago, is carrying a complete line of Perfection Dynamo Brushes, and can supply the western trade at short notice. This brush is made of woven wire mesh cut on the bias, and has no stitching or solder on the working end. It is flexible, and made of copper of the highest conductivity. The above sale was made through the Chicago office of Chas. E. Chapin, by Ernest Wm. Cooke, manager, 1649 Monadnock Building.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 26, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

RE-ISSUE 11,481. CLOSED CONDUIT ELECTRIC RAILWAY; W. Lawrence, New York, N. Y. App. filed March 13, 1894. The combination of an insulated conductor main, branch conductors leading therefrom, contacts connected therewith, vertically movable rods, independently movable contact points to co-operate with the ones first mentioned, the said rods united at their upper ends with the service conductors, and at their lower portion with levers connected with one set of said contacts, one rod being located near each end of each section, casings enclosing said contacts and located exterior to the conductor main and communicating therewith only by the branch conductors, and means whereby the rods are elevated simultaneously with the movement of the said contact points.

536,184. METHOD OF APPLYING INSULATION; F. E. Case, Schenectady, N. Y. App. filed June 21, 1894. The method of applying insulation to metal parts, which consists in interposing between the parts a compressed material adapted to expand under heat and retain its expanded form when cold, and then heating the parts

536,210. ELECTRICAL SIGNALING APPARATUS; W. E. M. Jackson, San Francisco, Cal. App. filed June 8, 1893. The combination with an electrical signal sending device, of a main circuit connecting with a receiving device, said circuit when closed, being continuous through a local source of electrical energy; the coils of an electromagnet, the body of an armature, and a back contact, but normally broken between said armature and back contact.

536,221. ELECTRIC SWITCH; C. J. Miller, Philadephia, Pa. App. filed Jan. 19, 1895. The combination of the terminals, the pivoted knife having yielding side plates, a tapered spring adapted to pass between the side plate and to force them out against the contacts, and a pivoted handle acting to withdraw the spring from between the side plates of the knife, and place it under tension, whereby the movement of the knife is accelerated as it is withdrawn from the contacts.

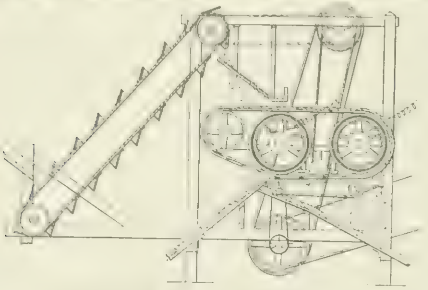
536,226. MAGNETIC SEPARATOR; J. D. McKinnon, Portland, Ore. App. filed Aug. 7, 1894. A magnetic separator comprising a suitable frame, two magnetic cylinders supported therein, an endless metallic belt connecting the cylinders, a pulley, a non-metallic belt passing over the metallic belt, and also over the pulley, an agitator arranged in the magnetic field, a suitable means of feeding the material to be separated, and two chutes disposed in opposite directions and meeting at a point where the belt becomes demagnetized so as to receive the separated material. (See illustration.)

536,233. TELEPHONE SYSTEM; J. I. Sabin and W. Hampton, San Francicso, Cal. App. filed Nov. 9, 1894. The combination with a telephone line extending to a board at the central station, and terminating in a switch thereon, of a local trunk line plug at said board, a switch at an auxiliary or assistant operator's board connected with said local trunk line plug, a telephone line extending to a board at a distant exchange, and a main trunk line extending between a plug at said auxiliary board and a switch at the head of the distant exchange

536,250. ADJUSTABLE SWITCH FOR TROLLEY SYSTEMS; M. M. Wood, Chicago, Ill. App. filed July 14, 1894. The combination in a switch for trolley systems of one or more tongues adjustably attached to a plate or body portion and a mechanical clamping device associated with each of said tongues and adapted to be manipulated so as to clamp or unclamp the trolley wire at will.

536,266. ELECTRIC SWITCH; C. C. Chesney, Pittsfield, Mass. App. filed Jan. 17, 1895. The combination of a jaw and a lever bar bearing a contact blade, both mounted upon an insulating base with a casing enclosing said jaw, and having a slide normally covering said jaw, said lever bar having a projection controlling the position of the slide when the bar is depressed.

536,271. ELECTRICAL SIGNAL AND SWITCH OPERATING APPARATUS; J. Dutrey, New Orleans, La. App. filed July 19, 1894. The combination with a locomotive or car, and contact devices comprising spring pressed plungers, arranged on the locomotive or car, a lever provided with a detent adapted to engage the notches of the rack, and cords or chains connecting the lever and the plungers of the contact devices.

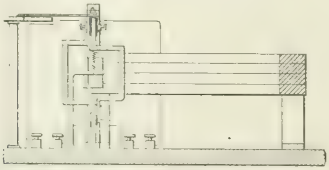

No. 536,226.—Magnetic Separator.

536,275. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS; C. E. Emery, Brooklyn, N. Y. App. filed March 15, 1894. The combination with railway tracks and with a car thereon carrying electric apparatus, of a non-insulated conduit, a series of live supports connected to an electric generator through a main electric conductor and a series of intermediate supports, both arranged within the conduit and adapted to support a flexible conductor, and a drag arm passing through a slot in such subway and carrying an electric conductor insulated from such slot and connected to electric apparatus on the car, and to a flexible conductor operating in connection with such supports.

536,311. FUSIBLE CUT-OUT; J. J. Wood, Fort Wayne, Ind. App. filed Dec. 27, 1894. A fuse box having circuit terminals, a lid therefor having overhanging ribs, and an insulating fuse block detachably held by said ribs, carrying the fuse and having fuse terminals adapted to connect with said circuit terminals when the lid is closed, whereby it is detachably connected to the lid so that it may be removed bodily carrying the fuse with it.

536,319. METHOD OF INSULATING HIGH TENSION COILS OF TRANSFORMERS; A. Schneller and W. J. Wisse, Haarlem, Holland. App. filed Dec. 27, 1894. A secondary coil for a transformer composed of wire covered with several layers of insulating material and the convolutions of which are embedded in wax or a waxy substance, and are separated from one another in a circular direction by strips or layers of insulating material, and are firmly secured together by binding cords passed several times transversely through the coil, which is finally provided with an outer protecting layer of material.

536,374. CONDUIT ELECTRIC RAILWAY; F. S. Davenport, Jerseyville, Ill. App. filed Jan. 28, 1895. The combination of an insulated feed wire, a casing secured to the wall of the conduit and adapted to enclose and support said feed wire openings in the insulated covering of the feed wire, and bands of insulating material adapted to hermetically close said openings, metallic contact studs passing through and made air-tight in said elastic covers, and rigidly secured in metallic spring arms insulated from the feed wire, a collecting contact bar supported by but insulated from arms depending from the car truck, said collecting bar adapted to come in contact with and depress the free ends of the spring arms so as to press the contact studs upon the feed wire as it travels over them, and an insulated wire for electrically connecting the collecting bar with the motor.


No. 536,478.—Combination Electrical Meter.

536,382. TELEPHONE EXCHANGE SYSTEM; S. W. Holman, Boston, Mass. App. filed March 24, 1894. The combination of a metallic thimble placed upon a finger of one hand whereby the operator at the telephone exchange may, by simultaneously touching one metallically tipped finger to the open terminal of a grounded generator and the other metallically tipped finger to the appropriate subscriber's terminal upon the switchboard, so send a calling signal to any desired subscriber.

536,417. FLEXIBLE TUBE; H. H. Brooks, Medford, Mass. App. filed Sept. 18, 1894. A flexible metallic tube having an internal spiral reinforce, composed of a strip of paper material, the inner tube serving to preven indentation.

536,420. TELEPHONY; P. B. Delany, South Orange, N. J. App. filed Nov. 19, 1894. An automatic transmitter comprising a tape having two lines of perforations therein, contact devices operating through each line of perforations, a split battery, a local circuit controlled thereby, a polarized relay in said local circuit whose armature is normally maintained in a neutral position, and is capable of movement therefrom in either direction, according to the polarity of the current in its coils, transmitting devices controlled by the armature of the polarized instrument in combination with a line circuit, and a battery from which successive currents of electricity are sent into the line, the polarity of such currents being determined by the direction of movement of the normally neutrally maintained armature lever.

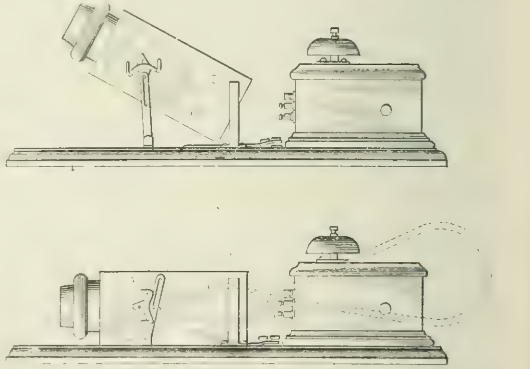
536,429. SIGNAL FOR RAILWAY CROSSINGS; E. A. Herman, St. Louis, Mo. App. filed Oct. 1, 1894. The combination with a trolley wire of a pivoted arm which supports the same, a contact point in the path of said arm, whereby upon the passage of a trolley wheel the arm is raised into electrical contact therewith, a wire which leads from said contact to lamps located in a signaling box, and a bell which is operated by a shunted circuit.

536,439. ARMATURE FOR ELECTRIC MACHINES; E. C. Morgan, Chicago, Ill. App. filed July 18, 1894. An armature for an electric machine having its coils connected by an independent conducting plate and an insulating wedge through which the plate passes and by which it is braced.

536,467. ELECTRIC SIGNAL SYSTEM; W. Gillette and A. S. Williams, New York, N. Y. App. filed Oct. 30, 1894. The combination with the telephone switch for controlling the line and local circuits, of a single plug having a single contact surface switch for throwing one pole of the connections of the battery and one pole of the secondary of the induction coil into electrical connection with the line.

536,478. COMBINATION ELECTRICAL METER; Herschel C. Parker, Brooklyn, N. Y. App. filed Jan. 9, 1895. An electrical meter, comprising a magnet, a pair of rotatable mounted coils arranged in inductive proximity to the magnet, and having their terminals adapted for connection independently of each other, said coils being of different resistances, and an index actuated by the movement of the coils. (See illustration.)

536,481. TELEPHONE; J. D. Price, Chicago, Ill. App. filed July 30, 1894. The combination with a telephone of a transmitter box hinged or pivoted to its support, having a hook or receptacle for the receiving instrument pivoted to the side, and mechanically connected with the back-board or supporter in such a manner that when the transmitter box is in one position the hook will support the receiver, and in another position the hook is inverted and will not support the receiver. (See illustration.)


No. 536,481.—Telephone.

536,530. ELECTRIC CURRENT REGULATOR; C. M. Jordan, Washington, D. C. App. filed Feb. 13, 1895. A current regulator for working circuits comprising a branch or shunt circuit deriving its current from the working circuit, and having a current of a pre-determined fixed strength of intensity, a motor within and driven by said branch or shunt circuit, a current regulator or controller with the working circuit, and a differential mechanism driven by and between the said motors and the current regulators.

536,535. ELECTRIC BRAKE; E. D. Lewis, Savona, N. Y. App. filed Nov. 12, 1894. In an electric brake, a fixed electromagnet, a movable electromagnet in the same circuit having a rod projecting, a hanger supporting the rod, and brackets, a pivot rod adjustably secured to the brackets, a brake lever mounted on the pivot rod and connected at one end to the rod, and a spring also connected to the brake lever.

536,547. SYSTEM OF ELECTRICAL SIGNALING FOR RAILWAYS; C. Selden, Baltimore, Md. App. filed Dec. 26, 1894. In a system of electrical signaling for railways an electromagnetic instrument consisting of a base containing a pair of magnets at one end, and with an electromagnet at the other end, the pair being arranged at right angles to each other, and adapted to unlock and lock the armatures and so control the signal circuit and the circuit of the electromagnet at the other end. An escapement device controls the back movement of the last magnet, and suitable track contacts properly spaced give a car or train sufficient time to clear the space between the two last track contacts.

536,559. RELAY; C. R. J. Willot, Paris, France. App. filed Nov. 24, 1893. A relay for electric telegraphs comprising two movable armatures fixed on the same axis, and an electromagnetic system in a magnetic circuit closed by means of two breech pieces and a combined magnetic field with two magnets acting simultaneously upon the mass of the soft iron of the electromagnet and upon said armatures.

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ELECTROLYSIS BY TROLLEY CURRENTS

In this issue we print the concluding section of Mr. W. Stuart-Smith's paper on the electrical condition of buried conductors due to leakage currents from street railways, which is probably the most important contribution yet made to the subject. The account of the distribution of current between the several systems of street railways is interesting, and shows that where there is more than one railway in the same territory any plan for the prevention of corrosion to piping cannot be confined to consideration of one road without reference to the other. The plan advocated by Mr. Smith to connect the rails to underground piping and employ the piping system as part of the underground circuit will not, we believe, meet with the approval of many, and we fear that the saving in copper entailed by such a method would have little weight in inducing gas and water companies to accord the necessary permission. An auxiliary system of conductors will, of course, be expensive, but its adoption is much more rational than the employment of underground piping, particularly as electrolysis at the joints of the piping would undoubtedly cause trouble eventually.

THE NEW TELEPHONE COMPANY.

The announcement last week of the plans of the Standard Telephone Company created an old-time sensation, which was accentuated through the public being entirely unprepared, owing to the secrecy with which the organization of the company had been carried on. It is true that rumors had been afloat for some time to the effect that a rival to the American Bell would soon be in the field, but so well had those interested kept their own counsel that no verification could be obtained. The fact is that the original intention of the organizers was to delay the announcement until June, by which time it was expected all plans would be completed for active work. This arrangement, however, was thwarted by the indiscretion of a Western member. The statements furnished by the officers of the new company bear out from their vagueness, the assertion in regard to the incompleteness of details at the present time, for beyond a list of those interested, the price at which telephone service is to be supplied, and the capitalization, but little definite information is given. Stress is laid upon the possession of valuable patents, but how much there will prove to be in these claims will remain for the future to determine. The statement in regard to patents on telephones, to the effect that there are now in existence only five commercially practicable instruments, of which the Bell Company controls the patents of two, and the Standard Company the remaining three, will come as a surprise to many, and more explicit details will be awaited with interest. As to the effect on the many smaller companies which have recently entered the telephone business, nothing can be predicted from the very indefinite outline of the policy thus far made public. Should this be based, as we hope it may be, on a "live and let live" policy, the effect will, we believe, be good, if for no other reason than that the telephone patent situation will be thoroughly cleared up. This is on the assumption that the Standard Company will bring to trial the monopoly claimed by the Bell Company of switchboard devices, in regard to which there is now so much uncertainty, and that would be likely to continue in the absence of a powerful interest to bear the great expense of the litigation necessary to establish the status of the many hundreds of patents now owned by the latter company. The public in any event will be benefited, provided that a combination is not made between the new company and the Bell Company, and a statement in a newspaper to the effect that such a combination was likely to occur was emphatically repudiated by the officials of the former when brought to their attention. The list, printed elsewhere in this issue, of those interested, containing as it does the names of well-known capitalists and public men from every part of the country, gives assurance, we believe, that the organization was effected in good faith for the purpose of bona fide work and not with an ulterior object in view. While such an imposing array of names and a capitalization of such startling proportions may have the desired effect on the general public for the present, the electrical public will, however, await further particulars bearing on the technical features of the system before a similar interest can be expected from that direction. As it is understood that the telephone patents of Perrin, Bonta and Cole will be used by the Standard Company, we give an account of these elsewhere. We may add that in the absence of any explicit statement that the claims of the company as to the value of its patents rest upon those we describe, these latter cannot, of course, be accepted as by any means a full or complete statement of this part of the company's resources.

MASSACHUSETTS CENTRAL STATIONS AND STREET RAILWAYS.

The recent annual reports of the two bodies of State Commissioners of Massaschuchetts having cognizance, respectively, of central stations and street railways show a state of affairs with respect to these two industries that cannot be considered especially satisfactory. From the resumés of the reports printed elsewhere in this issue, it will be seen that while the larger companies with few exceptions are paying satisfactory dividends, the smaller concerns still remain unprofitable. Of 59 electric stations, 35 paid no dividends, and only 19 paid 6 per cent. or over. We print elsewhere in tabulated form data of fifteen of the largest stations, part of which were taken directly from the returns and the remainder compiled from information there given. While the cost of the various parts of the plant are very suggestive, the other items have little professional value on account ot lack of information in regard to the total output, and from the aggregation of all expenditures under the head of "operating expenses," which even includes insurance and taxes, the items given in the table relating to the latter having been taken from another source than the station reports. It should here be stated that the maximum dynamo capacity given does not always accord with the boiler and engine capacity, the variations in some cases being very wide. But few of the companies appear to be making provision for the future by laying up a depreciation fund; some of the larger companies have such a fund, to which additions are made annually, but in other cases where there is a depreciation item it appears that it was expended during the year, and probably should have been charged off to current repairs instead of being placed under the head of depreciation. The general neglect of the importance of this factor does not augur well for the future, particularly in view of the probability that the next few years will require a radical change of the equipment of many of the stations to place them upon a modern basis. To engineers it is a matter of regret that the returns of the stations are not made in such a form as to give them a greater value. We undertand that the Electric Light Commissioners are now authorized to demand returns of the output, and if, in addition, the operating and other expenses were required to be reported and itemized under appropriate heads, a great service would be rendered to those connected with electrical engineering, While this might not be a sufficient argument to bring about such an improvement, a stronger one presents itself in the benefit that would be derived by the station managers themselves through the means thus offered for comparison. As electric light supply is not a competitive business, the usual argument against publicity giving rivals an advantage cannot be urged. We cannot see that any reasonable objection can be advanced against the publication of returns somewhat after the classification of the English Board of Trade, and we believe that it would result in great improvements in the operation of the stations. From the report on street railways we learn that there was an increase of 113 miles of electric railway during the year ending September 30, 1894, and that there were only 103 miles of horse railway remaining in operation at that date. While this showing is gratifying, there is another side presented not so pleasing, in the information that but 30 of the 68 railways paid dividends. As in the case of central stations, but few of the street railway companies make provision for a depreciation fund, though the necessity is greater in the latter case. The report also refers to the evils of over-capitalization, which is a further disadvantage with respect to central stations. In conclusion, it may be said that the unfavorable features of the reports to which we have referred are to be largely ascribed to installation of plants without sufficient regard to suitability of conditions and economy of working, united in the case of street railways, to financial irregularities wtih respect to over-capitalization. While the results where unsatisfactory may reflect unfavorably upon electric lighting and street railways, the advantages of these are only temporarily obscured, and by the eventual reorganization on a rational basis of the unsuccessful companies, will finally be demonstrated in even apparently hopeless cases.

SELF-INDUCTANCE.

While most of our readers doubtless find no difficulty in grasping the significance of self-inductance or the coefficient of self-induction as measured in henrys, yet from inquiries received we learn that among others a difficulty does exist, and what follows is intended more particularly for the latter. Starting with the conception of the generation of E. M. F. by lines of force cutting conductors, it follows that if the current maintaining lines of force in, for instance, a coil, ceases, these lines will pass out of the coil, and in doing so will, in effect, cut the coil, thus generating an E. M. F., proportionate to the rate at which they are decreasing. In starting a current, lines are being introduced into the coil, in effect cutting it, so that in this case also an E. M. F. will be generated, but opposite to the former one and opposing the impressed E. M. F. These are called inductive E. M. Fs. and as their value depends upon the number of lines cut, it therefore follows, leaving aside the rate of cutting, that they also depend in a given circuit upon the number of coils and upon the number of lines present with a given current, which latter may be calculated for that current, directly if no magnetic material is present, or indirectly otherwise. As different circuits may thus have different inductive E. M. Fs. with the same current though the rate of cutting is the same, it is useful to separate the factor which gives rise to this difference. This can be done, for example, by assuming that in a circuit in which this factor is unity, a current of one ampere in dying out in one second at a uniform rate generates an inductive E. M. F. of one volt. This assumption, in fact, corresponds to that adopted, the factor referred to being called self-inductance, and the name of henry given to its unit value. Suppose, now, we wish to know the self-inductance of a shunt dynamo field having 4,000 turns in its coils, through which three amperes flow, the voltage of the machine being 100 volts at a known load. Knowing the various constants of the armature, the revolutions and mean magnetic leakage, the total number of lines of force or webers passing through the coils can be approximately calculated. We will assume these to be 3,000,000, but as our unit current is one ampere, 1,000,000 lines or webers will correspond to this, which, multiplied by the turns in the coil, give the entire number of lines that would cut one coil when the current changes in value from one ampere to zero. If the change were uniformly made and in one second, $4,000 \times 1,000,000$ C. G. S. units of E. M. F. would be generated, but as our henry refers to volts, this quantity must be divided by 10^8, which finally gives us 40 volts, or we have 40 henrys as the self-inductance of the field. As the leakage usually considered in a dynamo includes all lines which do not pass through the armature, but which, nevertheless, with respect to self inductance, cut some of the coils, the usual leakage coefficient must be decreased in calculating the total number of lines or webers in this connection. The above calculation assumes that the permeability of the iron of the field is constant, which, of course, is not the case. Properly speaking, in a circuit with iron the self-inductance as above defined is not a constant, but varies with every change of permeability. Where the exciting current is alternating, as in the field of a polyphase motor, if the total flux or webers corresponds to the maximum value of the current, the self inductance calculated must be divided by $\sqrt{2}$ in order to reduce to henrys, but in this case also the result is not theoretically in accordance with the definition.

The Standard Telephone Company.

For a year or more it has been whispered that a rival to the American Bell Telephone Company was in process of formation, but those interested so carefully concealed their plans that no facts for publication could be ascertained. As an instance of the secrecy maintained, when a representative of the company was negotiating recently for quarters in the Postal Telegraph Building, no intimation of the business of the prospective tenant could be obtained by the agent of the building, and the lease was executed on the strength of personal assurances from the well-known gentlemen whose names were given as references. The indiscretion, however, of a sanguine Westerner interested in the new enterprise led to a premature announcement last week, it having been the intention to delay publicity until June, by which time it was expected all plans would be perfected.

The offices of the company, which have been in the Morris Building, 68 Broad street, are now being removed to the Postal Telegraph Building, 253 Broadway, where a suite of rooms will be occupied on the tenth floor. Whether this means that an alliance is expected with the Postal Telegraph Company is not known, but the president of the Standard Company has intimated that some arrangement is contemplated for long distance service with one of the present telegraph companies.

The officers and the directors of the company are as follows: Thurlow Weed Barnes, president; John A. Brill, president of the J. G. Brill Company, car builders, of Philadelphia; Carl F. Boker, of the hardware, steel and iron house of H. Boker & Co., of New York; John W. Candler, formerly representative, railway president and merchant, of Boston; George Crocker, of San Francisco; Henry Merz, president of the Heller Merz Company, manufacturers of colors, of New York; Allen T. Nye, general manager of the company; Manning C. Palmer, president of the Syracuse National Bank and Electric Light Company, of Syracuse; Felix Rakeman, of Bulch & Rakeman, of Boston; Charles T. Strauss, of Charles T. Strauss & Bros., importers of lace, of New York; Louis Windmuller, of Windmuller & Roelker, of New York, and Senator John P. Jones.

The State companies which have already been formed to operate as licensees of the parent company are the New York Standard Telephone Company, capital $10,000,000, to operate in the State of New York; Eastern Standard Telephone Company, Boston, capital $6,000,000, to operate throughout New England; New Jersey Standard Telephone Company, capital $3,000,000, Jersey City, to operate in New Jersey and Delaware; Pennsylvania Standard Telephone Company, Philadelphia, capital $5,000,000, to operate in Pennsylvania; Columbia Standard Telephone Company, Washington, D. C., Baltimore and Richmond, capital $4,000,000, to operate in Maryland, District of Columbia, Virginia and West Virginia; Ohio & Indiana Standard Telephone Company, Cleveland, Cincinnati and Indianapolis, to operate in Ohio and Indiana; Michigan Standard Telephone Company, Detroit, capital $4,000,000, to operate in Michigan; Northwestern Standard Telephone Company, Chicago, Davenport and Milwaukee, capital $6,000,000, to operate in Illinois, Iowa and Wisconsin; Northern Standard Telephone Company, St. Paul, Minneapolis and Pierre, capital $4,000,000, to operate in Minnesota, North and South Dakota. The Central Standard Company, St. Louis, Kansas City and Lincoln, capital $5,000,000, to operate in Missouri, Kansas, Nebraska and Arkansas, is in process of organization, the promoter being Griffith Coit, president of the Union Trust Company, of St. Louis. The organization of the Mountain Standard Telephone Company in Denver, Albuquerque and Salt Lake City, capital $4,000,000, to operate in Colorado, New Mexico, Utah and Arizona, is in the hands of George Q. Cannon, the head of the Mormon Church. There are other companies being organized west of the Mississippi.

The president of the company in New England is John W. Candler, of Boston. Col. A. K. Conger, president of the Glass Trust, of Akron, Ohio, is president of the Ohio-Indiana company; Ex-Gov. Fairbanks, of Vermont, and George W. Hunt, of Portland, Me., represent that portion of New England; Pabst, the brewer, of Milwaukee, represents Wisconsin. John de Laitre and C. A. Pillsbury, the flour man, are connected with the company in Minneapolis, and the board is also organized for St. Paul. George Q. Cannon, of the Mormon Church, leads the list of the directors for Utah. The head of the organization in St. Louis is George A. Madill, president of the Union Trust Company. The president of the local company in Philadelphia is Richard W. Clary, president of the Solicitors' Loan & Trust Company, and C. W. Bergner, the brewer, and H. A. Berwind, the large coal operator, are members of the Pennsylvania board. Gen. Felix Agnus, owner of the Baltimore *American*, is in the Maryland board. The president of the company in Washington is Lemon G. Hine, who made a large fortune through his connection with the Mergenthaler linotype machine. James S. Clarkson will manage Iowa and the Northwest. W. J. Campbell, of Illinois, is said to represent Standard Oil interests, and John S. Runnells is credited to Pullman interests.

New York will be managed by Charles T. Armstrong, sugar importer; Lowell M. Palmer, president of the Brooklyn Cooperage Company; William Dick, sugar importer, New York; John Dunn, Jr., president of the Syracuse National Bank; Alva W. Palmer, clothing, of Syracuse; Gustavus E. Strauss, lace importer, of New York; Anthony N. Brady, of Albany; Henry Siebert, Gustavus E. Jahn, sugar importer; Henry D. McCord, flour and grain, and George Hutchins, of New York.

It is the intention of the company to supply a telephone service at the rate of $24 a year for dwellings and $36 for business places.

No difficulty is expected by President Barnes in establishing an exchange in New York by reason of the connection of the Metropolitan Telephone Company with the subway company; he states that the subways are open to all upon payment of rental at the rate of $800 per mile for a cable of 700 wires.

Marcellus Bailey, who drew the specifications for the original Bell patent, is one of the company's legal advisers.

The statements made by the Standard company as to the patents under which it will operate are very vague and are to the effect that the instruments to be used are proof against the effects of induction, and are among the "only five known efficient telephones, two owned by the Bell company and the other three owned outright or controlled by the Standard." "All other 'phones are infringements on these patents" it is added. We have learned however, that the principal patents of the Standard Company are a number granted from 1885 to 1888 to G. W. Cole, of Detroit; J. W. Bonta, of Philadelphia, and T. J. Perrin, of Brooklyn, and of these we give an illustrated description elsewhere in this issue.

General Electric and Westinghouse.

As we go to press no official announcement has been made in regard to the terms of the General Electric and Westinghouse arrangement as to patents, but it is probable that a statement will soon be made public. One of the financial agencies ascribes the delay to the General Electric Company, the reason offered being the desire of some of those connected with that interest to take advantage of the situation with respect to the stock market. It is reported that the executive committees of the two companies have approved the plan of pooling the patents, which now awaits the signature of one member of the committee, T. Jefferson Coolidge, Jr., who has been detained in Boston on family business. By the terms of the plan it is said that each company will contribute an equal percentage to the pool to defend the patents of the two concerns against outside litigation and competition.

Street Railways in Massachusetts.

The annual report of the Massachusetts Railroad Commissioners gives the total mileage of street railways in that State on September 30, 1894, as 928, an increase of 54 miles over the preceding year. Of this total 824 miles were operated, in whole or in part, by electricity, and 103 miles wholly by horse power. This shows, as compared with the previous year, an increase of 113 miles equipped with electric power and a decrease of 59 miles equipped for horse power only. There were on the same date 59 miles of electric railway in course of construction. All of the lines use the overhead trolley except the Milford & Hopedale road, which used the storage battery when in operation. The largest roads are the West End, of Boston, and the Lynn & Boston, with 196 and 135 miles of track respectively.

The total income above operating expenses from all sources was $3,507,369—an increase of $114,510 over the previous year; the fixed and other charges on this income balance on account of interest, taxes and rentals amounted to $1,694,701—an increase of $295,241; leaving as the net income available for dividends the sum of $1,812,668—which was less by $180,731 than the corresponding sum for 1893.

The ratio of operating expenses to gross income was 69.51 per cent., the net earnings $3.65 per mile owned, and the expense of running and net earning 21.05 and 9.23 cents per car mile run.

The average cost of the street railways of the State per track mile (including the cost but not including the length of sidings), as it stood on the books of the companies September 30, 1894, was $26,748.31 for construction, $11,527.81 for equipment, and $15,356.08 for land, buildings and other permanent property—making a total average cost of $53,632.20 for each mile of main track, including second track.

These figures, says the report, are of value as showing how heavily the street railways as a whole are capitalized, or, in other words, the average amount per mile on which dividends and interest are to be earned. They furnish very little clue, however, to the cost per mile of any particular railway which, as returned by the several companies, ranges from $11,152 to $97,993 per mile.

The report states that the financial condition of the companies as a whole, though but little changed from the previous year, was changed for the better. The aggregate surplus, which had been reduced from 15 almost to 2 per cent. in the preceding seven years, was slightly increased the last year. This result was secured, however, by a reduction in the amount and rate of dividends declared. The amount of dividends declared was less by about $106,000 than in 1893. But 30 out of the 68 companies paid a dividend. The average rate on the capital of the paying companies was 7 per cent. as against 8.22 per cent. the previous year.

The floating debt was reduced about $2,750,000; but this was by the issue of stock and bonds, and not by payment from surplus earnings.

The ratio of operating expenses to gross earnings from operation, which had shown the remarkable decrease of nearly 12 per cent. since the introduction of electric power, the last year made a slight increase.

There have been the last year no visible instances of inflation or stock watering; and, so far as appears, no further absorption of the control of domestic companies by foreign corporations or syndicates.

During the two preceding years the average cost and capitalization per mile of railway, as returned by the companies, had increased at the rate of over $6,000 per mile a year. A considerable increase was in many cases entirely legitimate, as representing the higher cost of new electric railway, or the additional cost of equipping with electric power original horse lines. In other cases the increase was largely the result of stock watering, pure and simple. The last year, on the contrary, there was an actual reduction in the average cost and capitalization per mile of railway as it stood on the books of the companies; and, although the reduction was small (about $400 per mile), it indicates a radical change in the right direction.

The necessity to the financial success of the electric system of keeping the cost and capitalization per mile of railway within the lowest practicable limits was remarked in the last annual report, and a table is printed comparing the net earnings per mile of railway and the cost of railway per mile in 1893, with those of 1888—the last year in which the railways were operated wholly by horse power.

Notwithstanding the large gain in net earnings per single passenger and per car mile and round trip run, the net earnings per total mile of railway owned have increased only 50.87 per cent., while the cost of railway per mile has increased 59.17 per scent., and the capitalization per mile 63.95 per cent.

Annual Report of the Massachusetts Board of Gas and Electric Light Commissioners.

The annual report of the Massachusetts Board of Gas and Electric Light Commissioners shows that five companies supplying electricity have been incorporated during the last year, at Palmer, Reading, Lenox, Grafton and Attleborough, of which only the Central Massachusetts Electric Company at Palmer has commenced operations. The mortgage on the North Attleborough Steam & Electric Company's plant was foreclosed during the year and the property passed into the hands of the Attleborough Steam & Electric Company. The Woburn Electric Light Company has passed into the hands of a receiver and foreclosure proceedings have been commenced against the North Shore Electric Company. During the year the plant of the Nantucket Electric Light Company was taken possession of by the bondholders, in whose interest it is now being operated.

As to municipal ownership, the towns of Arlington and Hull are the only municipalities which have acted upon this matter for the first time during the year, and the latter town has acquired the plant of the private company within its territory. The following towns have plants now in operation: Braintree, Danvers, Hingham, Hull, Middleborough, Needham, North Attleborough, Peabody, Wakefield, and Wellesley. Of these, Middleborough and Wakefield have the only plants for supplying both gas and electric light. The others manufacture only electric light. The towns of Danvers, Needham and Wellesley do no commercial business, and the two last named purchase their electricity from a private company. The reports show that 40 towns have thus far taken official cognizance of the subject of municipal ownership, but in most cases no action resulted.

	Boston Electric Light Co.	Boston Edison Elec. Ill. Co.	Brockton Edison Elec. Ill. Co.	Cambridge.	Fall River Electric Light Co.	Fall River Edison Elec. Ill. Co.	Haverhill Electric Co.	Lowell Electric Light Corporation.	Malden Electric Co.	Pittsfield Electric Co.	Salem Electric Lighting Co.	Somerville Electric Light Co.	Boston Suburban L. & P. Co.	Springfield United Elec. Light Co.	Worcester Electric Light Co.
Assessed valuation	$710,900	$1,208,800	$91,250	$254,000	$120,000	$90,600	$87,950	$201,380	$140,000	$100 000	$195,000	$118,500	$88 600	$321,600	$253.300
Plant investment, total	$1,419,336	$2,949,571	$239 494	$441,124	$184.801	$130,520	$234,187	$485,733	$349,859	$178,685	$239 000	$316,544	$250.925	$557,880	$298.159
Real estate	$532,379	$717,198	$52,720	$74 056	$31.000	$30,000	$48,591	$27,239	$27,527	$40,964	$45,000	$22,739	$12,086	$104.453	$75,000
Steam plant	$436,594	$638,555	$36,806	$95 044	$41,538	$24,300	$50,965	$98,051	$45,430	$36,656	$85,000	$47,934	$238,835	$134,755	$54,730
Electric plant	$449,593	$240,000	$80,568	$152,052	$49,650	$17,250	$58,405	$119,640	$68,539	$52,429	$28 000	$64,597		$171,143	$79 000
Distribution	$951 770	$1,353,818	$69,400	†$119,972	$62,613	$58,970	$76,226	$240,803	$208,363	$48,636	$96,000	$181,274		$147,529	$89,429
Maximum dynamo capacity, total in kw.	3328	4608	578	622	339	475	367	796	526	369	524	550	493	814	882
Incandescent, kilowatts	1151	4608	475	312	39	475	240	316	444	312	344	368	345	519	399
Arc, kilowatts	2177		103	210	300	—	127	480	82	57	180	182	148	295	483
Income	$540,967	$587.514	$59,574	$103,471	$75,967	$51.114	$38,137	$118,574	$85,723	$49 320	$96,392	$71,686	$65,335	$171,346	$136.736
Operating expenses	$376,005	$317,470	$42,022	$64,761	$43,985	$30,147	$27,468	$73.080	$49,658	$35 602	$63,313	$53 558	$59.355	$95,592	$73.724
Percentage of income	69	54	70	62	58	59	72	62	58	71	66	74	90	44	54
Dividends for 1894, per cent	8	8½	6	6	6	8	3	7	8	5	6	6	—	6	8
Depreciation	$300	$17,747	$3,036	*$10,000	$13,500	$10,112	--	$3,823	$20,000	$5,000	$30,639	—	—	$37,658	$41.200
Taxes	$21,036	$26,854	$1,920	$4 191	$1,992	$1,613	$2,035	$4,491	$2,202	$1,640	$3,496	$2.532	$762	$5,155	$3,925
Steam plant, investment per kw	$131	138	63	153	123	51	139	123	86	99	162	87	484	165	62
Electric " " "	$135	52	139	244	147	36	160	150	130	142	53	117		210	89
Distribution, " "	$283	293	120	192	183	124	208	302	396	132	183	329		180	101

*Reserve fund. †Construction account $13,195 additional.

There were 81 companies in active operation on June 30, 1894, supplying electricity, of which 59 had only electric plants. Of the electric companies, 35 paid no dividends, two paid 2½ and 3 per cent., respectively; three paid 5 per cent., eleven paid 6 per cent., two paid 7 per cent., four paid 8 per cent. and two paid 8½ per cent. The larger companies in general paid dividends.

Above we show in tabulated form some of the data relating to the largest companies. In the report the maximum dynamo capacities are given in 16-cp, 1,200-cp and 2,000-cp lamps, and in the table are expressed in kilowatts on the assumption of 60 watts, 333 watts and 500 watts of supply, respectively, for the lamps named. The percentage of income and the investment per kilowatt in the steam and electric plants and distributing system, respectively, have been calculated from the appropriate data. It should be noted that in but few cases is there any provision for a depreciation fund, properly speaking, the amounts charged off for depreciation frequently being expended during the year and rarely carried in a fund for future expenditures for renewals.

A Modern Electric Light Station.

THERE is perhaps nowhere to be found a better example of modern central station design and construction than is afforded by the First District Station of the Edison Electric Illuminating Company, of Brooklyn, located in Pearl street, near Willoughby, which, though not yet quite through the process of changing over to latest methods, nevertheless serves to forcibly illustrate the strides made in the design of electric light and power machinery within a comparatively short period.

Within a floor space of 1,800 square feet are engines and generators capable of supplying 48,000 incandescent lamps, together with two sets of "boosters." There are two vertical engines, each direct connected to two 200 kw multipolar generators, as shown in Fig. 4, and two vertical engines each direct connected to two 400-kw multipolar generators, a partial view of one of which is given in Fig. 6. The smaller engines are 750 hp, three cylinder, compounds, made by the Lake Erie Engineering Works, and the larger ones are Williams 1,500-hp compounds, made by William Todd & Company. The generators are direct current, twelve pole machines, of the familiar General Electric type.

Near the engines and generators are two sets of Barstow boosters, each consisting of two small continuous current dynamos direct driven by a motor. Each dynamo has a current capacity equal to the load carried by the feeder on which it is to work, but the E. M. F. generated is comparatively low. Fig. 7 shows one set of "boosters." The operation is as follows: Supposing the E. M. F. at the end of one of the feeders supplied by a given generator to be considerably lower, from any cause, than that of the other feeders supplied from the same source, it is manifestly impracticable to make the voltages equal by any regulation of the generator. The "booster" set is put in operation, the motor, of course, being driven from the regular mains, and the *armature* of the "booster" dynamo is thrown in series with the feeder whose voltage is to be raised, while the field winding is connected across the station mains in series with a rheostat. The E. M. F. furnished by the "booster" dynamo is thus added to that of the regular generator so that the voltage at the end of the low feeder is brought up to and maintained at the proper point, without affecting the voltage of the other

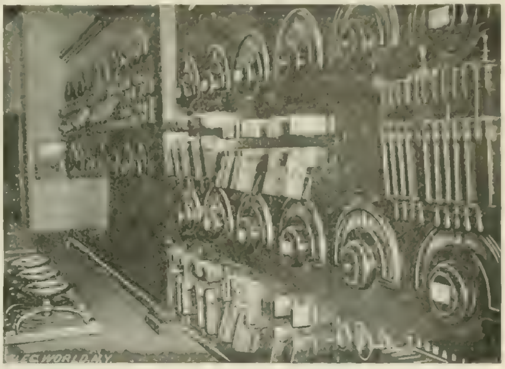
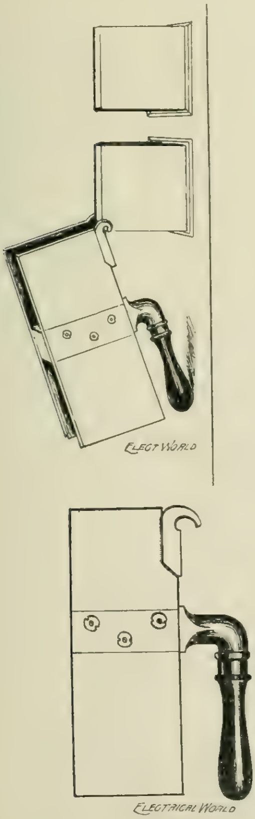


FIG. 3 —PARTIAL VIEW OF SWITCHBOARD.



FIGS. 1 AND 2.—SWITCH DETAILS.

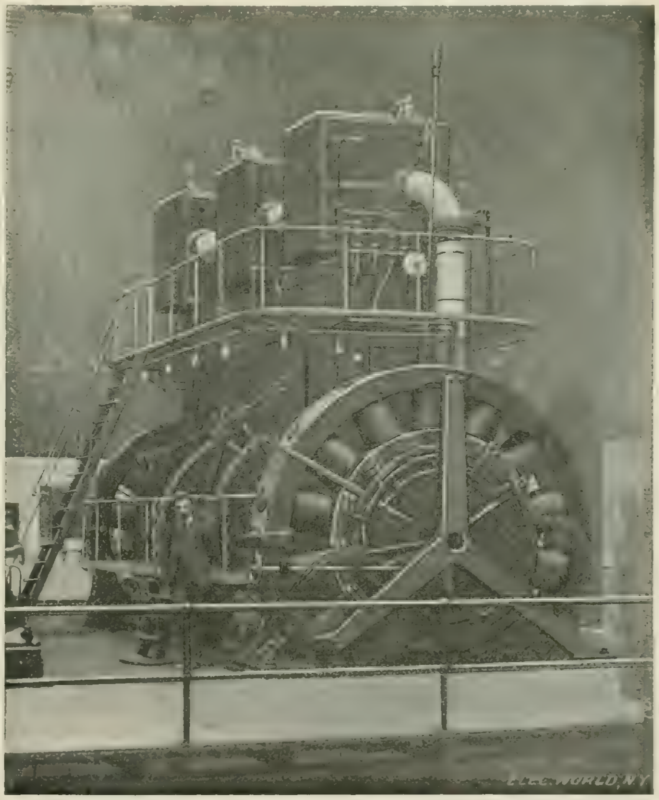


FIG. 4.—750-HP AND 200-KW GENERATORS.

feeders. The system is also used to cut down the voltage of a feeder in the event that the E. M. F. at its far end exceeds that of the other feeders supplied from the same bus bar. In such a case the armature of the auxiliary dynamo is, of course, so connected in with the "high" feeder as to *oppose* the E. M. F. furnished by the main generator, thus acting as a "choker" instead of a "booster."

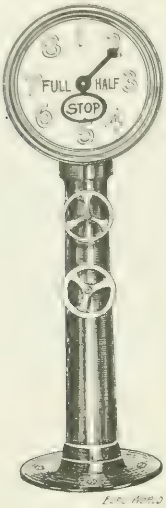


Fig. 5.—Signaling Apparatus.

In the Barstow "booster" system here referred to there are two auxiliary dynamos because the three-wire system of wiring is used throughout the plant. The space occupied by the dynamos and engines is free from pillars, braces, etc., and a 15-ton traveling crane is provided overhead which travels over the entire dynamo room. This crane is electrically operated, of course.

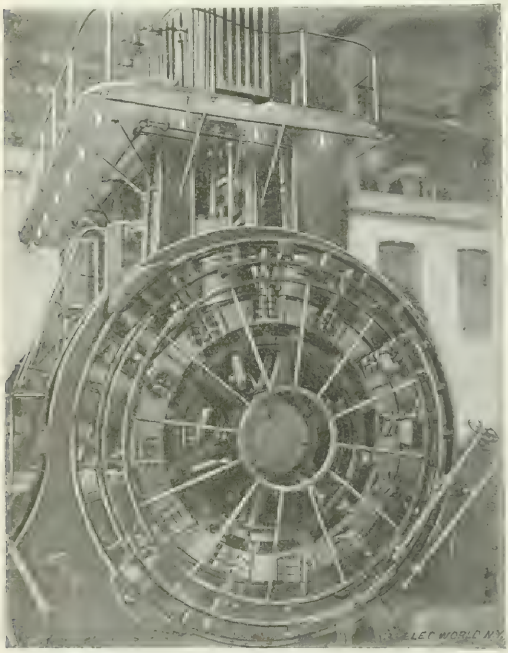


Fig. 6.—400-kw Direct Connected Generator.

The dynamo room will eventually contain two 750-hp engines with two 200-kw generators each and four 1,500-hp engines, with two 400-kw generators each, in addition to the present equipment.

At one side of the dynamo room and elevated above the engines is the switchboard gallery, containing all the electrical regulating apparatus. The central section of the board is devoted to volt meters, dynamo ammeters and connections, while the feeder ammeters and connections are put on flank sections on each side of the dynamo section. Fig. 3 gives a view of the central section and one of the end sections of the board. Figs. 1 and 2 show details of the switches used on the feeder sections of the board, the novel feature of which is the detachable switch-blade.

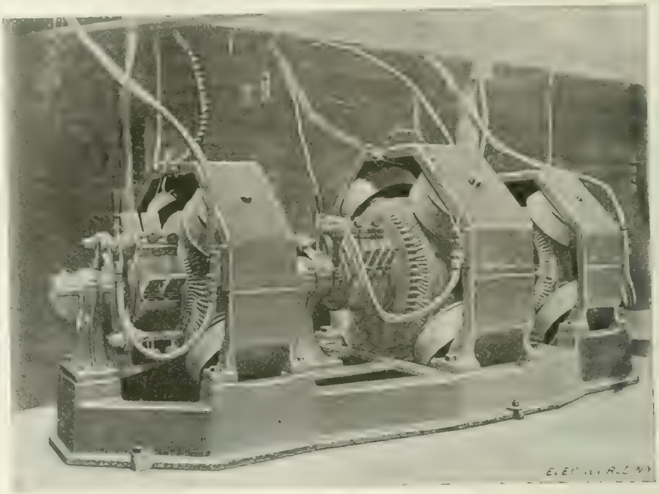


Fig. 7.—Booster Dynamos and Motor.

From the switchboard heavy cables are led down to a large vault beneath the sidewalk where connections are effected with the system of underground feeders.

A very convenient device, shown by Fig. 5, is used for signaling between the switchboard gallery and the floor of the engine room. On the face of the apparatus are painted figures to designate the different engines, and the words "Stop," "Half" and "Full," referring to the operation of the engine designated. A pointer indicates the number of the engine and a ring carried on a short arm encloses the desired signal word. The upper hand-wheel below the face operates the pointer and the lower wheel the ring-arm. There are two of these mechanisms exactly alike, one on the gallery and the other below on the engine room floor, the two being mechanically connected. A bell is provided to call the attention of the engineer to the signal dial.

The boiler plant consists of eight 240-hp Babcock & Wilcox and one 600-hp Morrin Climax boiler, the latter having been recently added. Three Davidson boiler feed pumps are used.

In addition to the station described the company operates two others, known as Second and Third District Stations. There is telegraphic communication between all the stations, an instrument being located at the switchboard of each so that when it becomes desirable to shut down one of the stations the other can be instantly notified to take the load, proper connections being provided for that purpose. The log of all three stations is kept by the switchboard attendant at the First District station, the readings and other information being telegraphed in at the proper intervals by the switchboard men at the other stations. It is stated that the service thus obtained is more satisfactory than the best telephonic service.

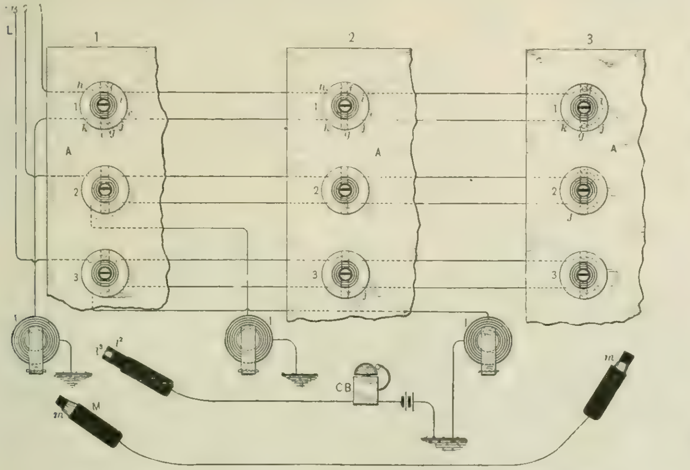
The First District station is at present supplying over 3,000 constant potential arc lamps and 2,000 hp in stationary motors, in addition to the regular incandescent service.

We are indebted to W. S. Barstow, general superintendent, for his courtesy in furnishing information, and to Mr. William Yaeger, superintendent of the generating department, for much kind assistance in procuring photographs of the building and apparatus.

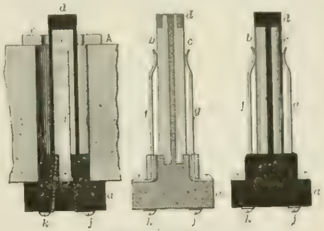
The Perrin, Bonta and Cole Telephone Patents.

The Perrin switchboard patents (Nos. 348,578 and 348,579) were granted Sept. 7, 1886, on applications filed Dec. 19, 1885. The Perrin switchboard is described at length in The Electrical World of Sept 4, 1886, from which we reproduce the accompanying illustrations. Three sections of the board are shown in Fig. 1, and Figs. 2 to 10 illustrate details. Each section as shown is provided with 100 annunciator drops and the usual number of "clearing out" annunciators, which are situated at the top of the board. The line terminal device is shown in Figs. 4, 5 and 6, and consist of a plug of insulating material *a*, carrying two metallic spindle sections *b*, *c* insulated from each other, and against which bear two contact springs *f*, *g*, projecting forward through the aperture in the board. Each spring and each spindle section are independently connected with a binding screw on the rear face of the plug, as shown in Fig. 7, Fig. 3 showing a plan view of the plug. Each opening of the board is, in addition, faced with a metallic ring, *e*, Fig. 4, shown in detail in Fig. 8. All of the main lines (Fig. 2) are brought in at section 1 of the board, and after running to their terminals of like number on the several sections, pass to their annunciators *I*, *I*, at their particular boards, and thence to earth.

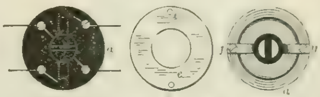
Following out the course of line 1, section 1, it runs to the binding screw *h* at the bottom of the plug described above, which screw is connected with the upper spring finger *f*. The latter in turn bears against the spindle section *b*, which is connected with the binding screw *i*. Thence the line continues to section 2, following out the same course, and then to section 3, the last section.



FIGS. 2 AND 3—LINE TERMINAL CONNECTIONS AND SWITCH PLUGS.



Figs. 4, 5 and 6.



Figs. 7, 8 and 9.

DETAILS OF LINE TERMINALS.

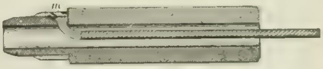


FIG. 10.—SWITCH PLUG.

On the last board of the line, after passing as usual to the screw *i*, it is connected around the plug to the screw *j*. This screw is connected to the lower spring finger *g*, which bears against the lower spindle section *c*, and is, in turn, connected to the binding screw *k*. The line then passes back again to the corresponding plug of each section, passing through the lower spring fingers and spindle sections, being finally connected to its proper annunciator and then grounded.

A test plug, shown in the lower portion of Fig. 2, is used to ascertain, before making a connection, if the line is free, the metal sleeve being connected through a call bell and battery to earth, as shown. Owing to the peculiar construction of this plug, if inserted in a terminal the operator's bell will ring if the line is not in use, and the subscriber will be rung at the same time. For instance, assuming that the test plug has been inserted in the terminal of line No. 1 in section No. 2, the circuit of the main line No. 1 will run through the upper connection *h*, *f*, *i* of its terminal on section No. 1 as usual, and thence to its terminal on section No. 2. With the test plug inserted here, however, the circuit runs from the lower spring finger *g* through the metallic sleeve of the plug to the call bell *C*, *B* and battery to earth. This gives a ground at the subscriber's and at the central office, and rings the bell at both places. There will be no circuit to the annunciator of the line, because the insulating material on the interior of the sleeve breaks connection with the lower spring finger *g* and the lower spindle section *e*.

Having ascertained that the subscriber's line is not in use, the operator proceeds to make the desired connection with each of the connected plugs *M*, Fig. 3. These plugs, one of which is shown in section in Fig. 10, are provided with annular conducting rings *m* surrounding a tube of insulating material which passes over the spindle sections. The end of the tube of insulating material separates the fingers *f* and *g* from the upper and lower spindle sections, respectively, while the conducting ring makes contact with the face or terminal ring *e*. When these plugs are inserted the main line circuit of each subscriber will be completed through the upper spring finger *f*, ring *e*, conducting sleeve *m* on the plug, and thence to the subscriber's line. The circuit will now be open by the separation of the spring fingers from the spindle sections, so that the earth and annunciator of each subscriber will be disconnected. If, therefore, the line is in use, an operator at any of the boards upon testing that line will get no signal on his call bell. For instance, suppose line No. 1 is in use and has been connected on its particular section No. 1, and that the operator in No. 3 inserts the test plug at the terminal of that line on section No. 3, the test circuit would then be from the earth to battery and call bell to the conducting sleeve of the plug, spring finger *g*, and screw *j*, through the upper terminal on sections Nos. 2 and 3 to the screw *i* and upper spindle section at the terminal of section No. 1. But here, as has been seen, the circuit is open, because the connecting plug *m* has been thrust between the spindle section and spring finger *f*. There would, therefore, be no circuit for the operator's call bell. As shown before, also, there would be no circuit from the lower spindle section of terminal No. 1 on section No. 3, where the test plug had been inserted, because the insulation would break the circuit from the spring *g* to the lower spindle section, and there would, therefore, be no ground through the annunciator on line No. 1 at section No. 1.

In the article from which the above is abstracted it is claimed that the operation of the board is very simple, and that it can be cheaply constructed. The patents include devices for the operation of the same board on metallic circuits.

In The Electrical World of Sept. 19 is described a telephone transmitter and relay patented by the same inventor on Aug. 18, 1885 (Nos. 324,726-7). Two other patents of the same date (Nos. 324,728-9) are for a telephone transmitting device and a telephone transmitter, respectively. As shown in Fig. 11, the transmitter and relay consists of a ring magnet *dD*, a diaphragm *C*, preferably of a non-magnetic metal, with an electrode *g*, carried by the diaphragm, and a pair of swinging arms, of magnetic material, *G*, carrying the other electrode; these arms rest on adjustable projections *K*, which are soft iron pole extensions from the ends of the ring magnet where it is split. Each of the electrodes *g* are included in a separate primary circuit of an induction coil (patented Aug. 19, 1884, No. 303,948, and Nov. 4, 1884, No. 307,728). These primaries are wound alternately with alternate layers of the same continuous secondary, so that variations of resistance occurring between the two pairs of contacts g, g' will both act upon a continuous secondary line for telephonic transmission. The attraction of the pole pieces K upon the ends of the arm G maintains the electrodes g, g' in contact under magnetic tension, so that they will not separate when a loud sound is made. In a groove d of the magnet is wound a coil of the secondary, which intensifies the attraction of the pole pieces, and adapts the instrument for use as a telephonic relay or repeater. Currents sent over the main line from a distant station will thus traverse the secondary wire, causing variations in the attraction of he levers, and thereby variations of contact of the electrodes. Another patent is a modification of the above. The final patent is for a method of providing a connection between the loose electrode of a gravity transmitter contact and the conductor of the primary circuit in which it is placed, which will permit the free jostling or rotation of the electrode around its support without in any way impairing its connection with the circuit. The device consists of a carbon ring resting on a carbon disc secured to a pin from the centre of a horizontal telephone diaphragm. Secured to the annular carbon is an arm projecting radially on opposite sides, and with its outer ends turned down and dipping in a circular metallic trough. The telephonic current passes from the diaphragm to the lower carbon and from its upper face to the lower face of the carbon rin thence through the arms to the mercury and line.

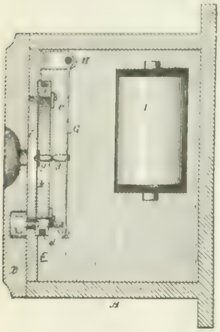


Fig. 11.—Perrin Telephone Transmitter and Relay.

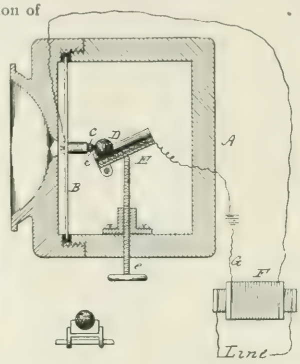


Fig. 12.—Bonta—No. 333,816.

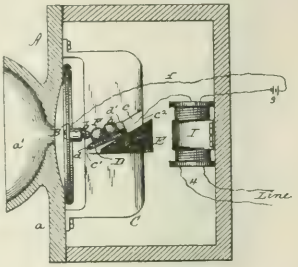


Fig. 13.—Bonta—No. 364,475.

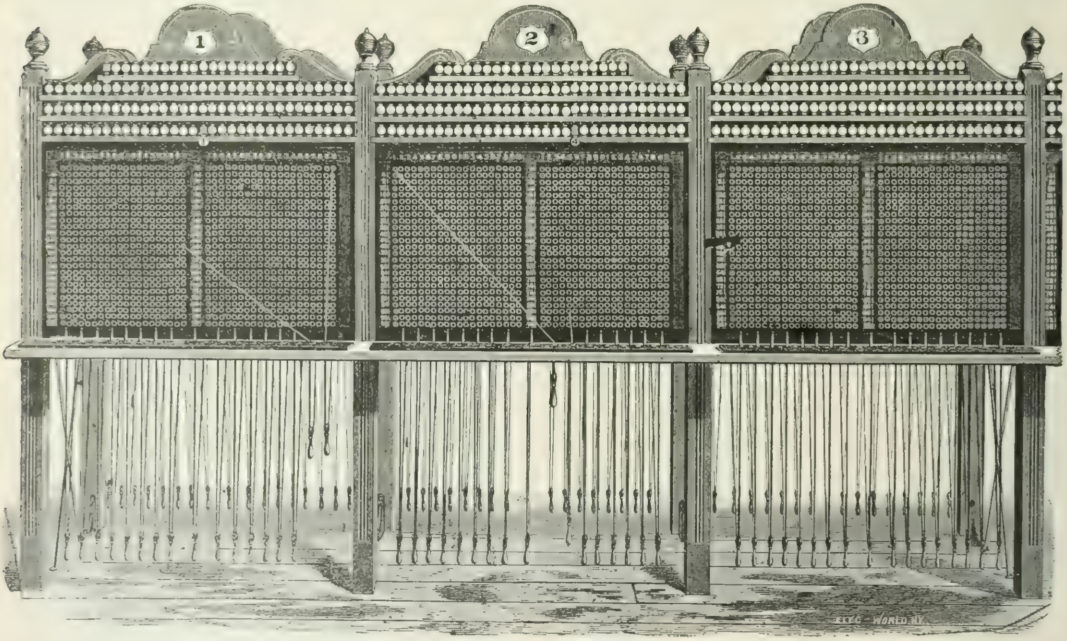


FIG. 1.—THE PERRIN MULTIPLE SWITCHBOARD FOR ONE THOUSAND SUBSCRIBERS.

There are 12 patents granted to J. W. Bonta, of Philadelphia, between the dates of Jan. 5, 1886, and Nov. 26, 1889. Fig. 12 illustrates a telephone on which a patent (No 333,816) was granted Jan. 5, 1886, the object of which was apparently to avoid the Bell principle, as the specification states that by means of it speech can be transmitted "in a commercially practical manner over a line which is alternately broken and closed by the transmitter, as in the Reis system." The cut clearly illustrates the principle of the invention. The single claim is for the art or method of transmitting articulate speech or other sounds telephonically by induced currents over a secondary circuit, which consists in causing the speech or sounds to vary the resistance as well as to open and close the primary circuit associated with such secondary circuit. Patents Nos. 322,176-9 (issued Nov. 9, 1886) are on various modifications of the inclined platform or plate supporting the ball. Fig. 13 shows another modification, patented June 7, 1887 (No. 364,475), in which adjustment is secured by means of the sliding wedge E.

In a patent issued April 12, 1887 (No. 361,124), Bonta states that he has discovered that vocal and other sounds can be transmitted without the necessity of vibrating or moving a body capable of inductive action in the neighborhood of a "conductivity" wire, or vibrating the conductivity wire itself in the neighborhood of a body capable of inductive action, or varying the resistance of the circuit, or varying the power of, or affecting, the battery in any way. Referring to Fig. 14, the patentee represents the phases of a pendulum by Fig. 1, a being the starting point a', a' the vertical, and a^2 the final point; a diaphragm should have the same effect, but owing to it being held by its edges, Fig. 2 would similarly represent its action, and Fig. 3 the case where a spring or weight is used to offer resistance to the diaphragm.

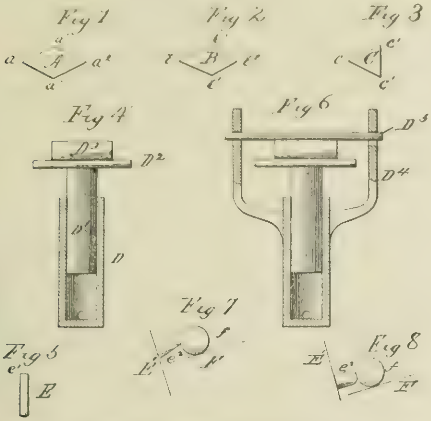


FIG. 14.—BONTA—No. 361,124.

Fig. 8 is to show that the pressure of D^3 on the platform of a hydraulic ram is not affected by the motion of the ram, which fact the inventor says is diagrammatically represented by Fig. 5. Fig. 6 is the hydraulic ram with a spring D^5 above the weight, which case he says is represented by Fig. 3. After a lengthy discussion the patentee considers that Figs. 7 and 8 represent, telephonically, the conditions of Figs. 4 and 5, and that the rolling body and movable body (diaphragm) "move as one, no matter how the impelling force or power may be varied, and the contact pressure between the bodies, therefore, remains constant." The patentee claims that "if this law be utilized in the construction of telephones and the instrument transmitting vocal or other sounds, a method of transmitting vocal or other sounds other than by electrical undulations similar in form to the vibrations of the air accompanying said vocal or other sounds would be produced."

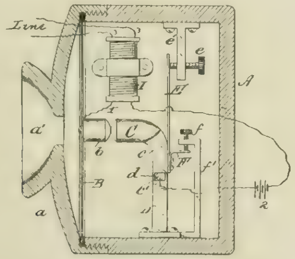


FIG. 14½.—BONTA—No. 365,778.

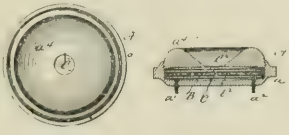


FIG. 15.—BONTA—No. 415,700.

The claims for this patent are for "the art or method of transmitting vocal or other sounds telephonically by causing intermittent or pulsatory currents of a uniform volume or intensity, and of durations corresponding to the phases of the oscillations of the diaphragm;" or "causing electrical impulses of constant volume and of durations corresponding to the elements of the sound force or ways;" or "causing electrical impulses which differ in duration with the overtones and fundamentals of the vocal or other sounds." The instrument illustrated which applies the discovery claimed in this patent is that of Fig. 12.

Another form of transmitter was patented by the same inventor on July 5, 1887 (No. 365,778), which, as shown in Fig. 14½, consists of an electrode C, attached to a right angled bar c pivoted below the electrode, and acted upon by the vertical spring E and the horizontal spring F, both springs having a common point of attachment to the arm C and adjustable tension devices. The diaphragm is either fixed or hinged, being of carbon in the latter case. The object of this invention is stated to be for maintaining efficient initial contact for the electrodes, and for varying their contact pressure.

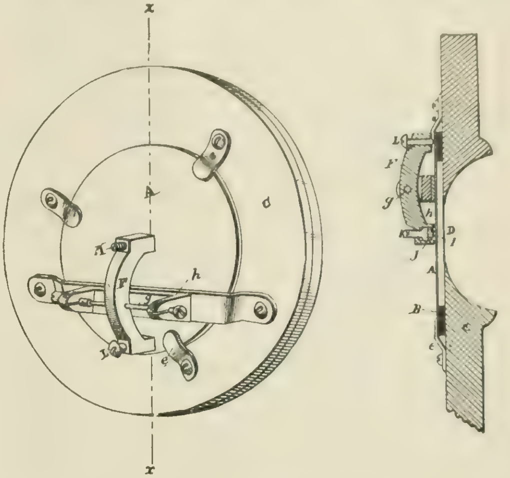


FIG. 16.—COLE—No. 351,250.

On Sept. 26, 1889, a patent (No. 415,700) was issued to Bonta for a telephone receiver having "a magnet which admits of the use of a diaphragm which does not vibrate in front of the magnet in the sense that the diaphragm of the Bell type of receivers vibrates, and yet produces articulated sounds clearly, distinctly and loudly." The magnet is in the form of a circular disc having a coil wound on its periphery. The disc is slotted radially both from the periphery and from the centre, but the slots extending inward and outward, respectively, less than half a radius, the central solid portion of disc remaining being recessed. The diaphragm rests upon the central and peripheral solid portions, being thus supported both at the centre and periphery.

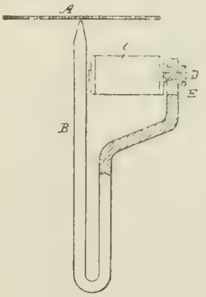


FIG. 17.—COLE—No. 352,735.

W. R. Cole is well known in telephone circles as an inventor, and the Western Electric Company has purchased a number of patents taken out by him in conjunction with W. A. Jackson. Fig. 16 shows a form of transmitter patented by him Oct. 19, 1886 (No. 351,250), the object of which is stated to give a strong undulatory current without any break in the connection, and thus obviate disagreeable sounds. The diaphragm rests upon a rubber ring *B*; a bridging piece *h* supports a polarized magnet *F* on trunnions; a carbon button *J* is pressed by the screw *K* against a platinum point *I*, secured to the diaphragm, the pressure being adjusted by the screw *L*. The claims are for a combination of the above details.

Another patent (No. 352,735) issued Nov. 16, 1886, is for a telephone shown in Fig. 17, the claim being for a receiving telephone having a permanent magnet with one of its poles free and arranged at right angles to the diaphragm (*A*) and the other pole attached to one of the poles of an electromagnet, arranged with its axis parallel to the diaphragm. The inventor believes that by this means a more sensitive telephone is secured.

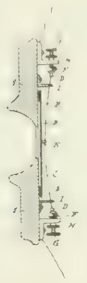


Fig. 18.—Cole—No. 352,806.

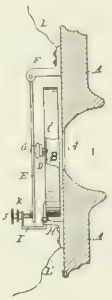


Fig. 19.—Cole—No. 386,965.

In a patent issued Nov. 16, 1886 (No. 352,806), for a microphone transmitter, shown in Fig. 18, the claim is made for an instrument very sensitive but which will not be materially affected by outside influences, jars, etc. The claim is on the curved spring bar shown, having a metallic contact point in the middle which rests on the diaphragm. Another patent (No. 386,965, dated July, 31, 1888), to attain the same object, substitutes a hinged bar, as shown in Fig. 19.

The Crocker-Wheeler Factory Destroyed by Fire.

The factory of the Crocker-Wheeler Electric Company at Ampere, N. J., was almost entirely destroyed by fire on Sunday afternoon, April 7. The fire broke out in some unexplained manner in the shipping building, near the centre of the plant. It being Sunday the works were shut down, and no one was in them but the watchman, who saw the flames and attempted to fight them with a patent fire extinguisher. He was overcome by the smoke and nearly lost his life, being rescued in an unconscious condition by the firemen. By this means valuable time was lost.

An alarm was given by a passerby on the track of the Delaware, Lackawanna & Western Railway, who ran nearly a quarter of a mile to the nearest alarm box. When the East Orange department arrived the buildings were wrapped in flames, and it was evident that nothing could save them. A second alarm was at once sent out, bringing out the entire force of the department.

The buildings were substantially built of brick and filled with costly machinery. The main machine shop was 400 feet long, and at right angles to this ran the electrical building, 250 feet long. Adjoining the machine shop was the power house, with a big Buckeye engine and Crocker-Wheeler multipolar dynamos.

More than 500 hands are thrown out of employment by the fire. Many of these lived in the little cluster of cottages and homes at Ampere Station.

The winding room and main machine shop buildings are practically destroyed, as well as the shipping department. The office building and pattern shop are uninjured. It is thought that the heavy machinery escaped with very little damage, for the reason that the building was but one story high, and the falling in of the glass roof would not materially injure the contents.

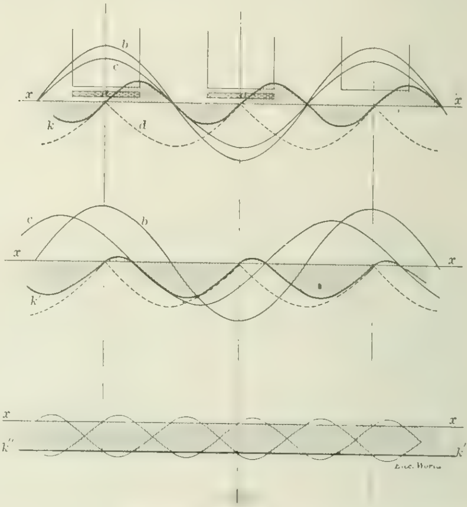
The total damage is unknown at present writing, but is fully covered by insurance. Temporary quarters will be secured at once to continue work on the many orders now on hand, and the reconstruction of the old building will be vigorously pushed.

Armature Reactions in a Simple Alternator Compared with That in a Multiphase Generator.

BY OSSIAN CHRYTRÆUS.

I am not aware that the armature reactions of simple and multiphase alternators have ever been represented comparatively, and as such a representation may be of interest, I will try to show graphically these actions on the fields of different machines.

It is apparent that the reaction from the armature on the field in an alternating current machine is not only dependent upon the current flowing, but also upon the position of the coils in regard to the poles. The most active position is when the conductors are between the poles, and its zero action when the conductors are under the poles. To get a graphical representation of this, let us assume that a direct current is flowing in the coil in Fig. 1, of a simple alternator, and through a curve represent its effect upon the field for different positions. This curve will then enable us to get the percentage of the ampere turns in the armature that are reacting upon the field. Let the ordinates to the curve *d* represent this. We will assume the curve to be a sine curve; it is not exactly so, but it is near enough. In the diagram, the sine curve *b* represents the impressed E. M. F. The curve *c* represents the current flowing and in phase with the E. M. F. We can now determine the reactive effect of the current, as the ordinates of the curve *c* represent the strength of the current, and the corresponding ordinates of *d* the percentage that is active. We thus get the curve *k*, which in the diagram is reversed every time the conductors pass over the centre lines of the pole, because the same current acts in opposition to the field on either side. The reaction upon the field is then represented by the curve *k*; in other words, it represents the current that would have to flow through an extra coil on the field in order to produce the same effect upon the lines of force.



Figs. 1, 2 and 3.—Armature Reaction in a Simple Alternator Compared with That in a Multiphase Generator.

If the current in the armature is lagging behind the E. M. F., the current that would have to flow in the extra coil is represented by the curve *k'* in Fig. 2, derived from the current curve *c'* in a similar way as above.

Such a fluctuation of the lines of force as the armature reaction will naturally effect in the simple alternator must cause a loss due to eddy currents. Further, a machine that under no load would give a perfect sine curve, would give when loaded a distorted curve of impressed E. M. F.

The reaction in the two-phase generator is represented by combining the actions from the coils in both phases. These coils are 90 degrees apart, and the reactive action for each coil separately must be that of the simple alternator under the same current lag. Now let us assume, first, that there is no lag of the current in either phase behind its E. M. F. Then we have the same conditions as in Fig. 1, but we must combine the action from the two similar curves k 90 degrees apart, and, as is easily seen, they must neutralize each other entirely.

If the current is lagging behind the E. M. F. equally in both phases, we have the conditions for each phase, as in Fig. 2. The resultant of these two combined is shown by k'' in Fig. 3.

The effect of the armature reaction in a two-phase generator is, then, to produce a steady demagnetization on the field, which only varies with the angle of lag. If, instead of a two-phase, we were finding the reaction in a three-phase or any multiphase generator, it is apparent that we would get a similar result.

The Niagara Plant.

One of the 5,000-hp double inverted turbine wheels and the 5,000-hp electrical generator, at Niagara, were tested on April 6 in the presence of officers and stockholders of the Cataract Construction Company, the Canadian Niagara Power Company, the Niagara Falls Power Company, and the Erie Railway Company and others. The No. 1 turbine wheel was used. No current was generated, the fields not being excited.

The machine was started at 17 revolutions per minute and increased gradually to 32 revolutions. To generate the 5,000-hp 250 revolutions must be reached. The mass of steel and iron comprising the wheel, shafts and dynamo, estimated at 75 tons, was held poised on the bearings by the weight of water which strikes the turbines from below. Mr. Rankine, the secretary and treasurer of the power company, states that the results were wholly satisfactory.

Heat from Various Sources of Artificial Light.

The following comparison, compiled from data in Palaz's "Industrial Photometry" will be useful to electric light managers in presenting the advantages of the incandescent light, particularly for summer use. All of the numbers refer to sixteen candle power of light, and represent the number of pounds of water that will be raised 10 degrees F. in temperature by the heat given off in one hour's lighting:

Arc light, - - -	4	Gas, Argand burner,	380
Incandescent light, -	14	Candle, - - -	473
Kerosene, Argand burner,	331	Gas, butterfly burner,	511

No air, of course, is vitiated by the incandescent lamp, and a negligible quantity by the arc light. The other sources in producing sixteen candle power of light vitiate as much air as would four to seven men.

The Care of Storage Batteries.

BY R. MACRAE.

In the report of a discussion on storage batteries at the meeting of the Electric Light Association at Cleveland, contained in The Electrical World of March 2, Prof. Stine, after referring to the prejudice against storage batteries in this country, says:

"There also occurs during every charge and discharge a certain amount of chemical action which cannot be reversed, resulting in the eventual consumption of the plates, whose material, accumulated at the bottom of the cell, tends to produce short circuits.

"The separate plates of the elements should be so attached to the connecting bars that they may be readily removed for inspection or repairs. Good sulphuric acid should be used, free from metallic impurities, such as iron or arsenic, and particularly lead sulphate. If commercial acid is used, it should be purified by sulphuretted hydrogen or other means."

Prof. Elihu Thomson, in The Electrical World of March 3, 1894, says:

"The greatest disadvantage in the use of storage batteries is the fact that the cells require watching or constant attention to detect any incipient weakness.

"It is well to have the connections of a series of cells made so that any faulty cell can easily be disconnected, and if need be, removed from the set."

If so much depends on having the material used in the construction of a lead battery chemically pure, and such constant inspection is necessary as might be inferred from the above, it is not difficult to account for the prejudice against storage batteries referred to by Prof. Stine. A central station manager is not likely to invest in anything that requires such constant doctoring as indicated by Profs. Thomson and Stine. As a matter of fact, a lead battery, properly constructed and adapted to the work that it is to perform, does not require constant or any attention, other than to charge it after it is discharged. It is of course necessary that the charging and discharging be done in a proper manner. It is not desirable to have the plates and cells joined up in such a way that they can be readily removed for inspection and repairs; nor is it necessary to use chemically pure material in the construction of a lead battery in order to obtain good results. It is not easy to see what objection there is to sulphate of lead in a lead battery or what the result would be if sulphate of lead was not formed and reduced during the action of the cell. Any one having practical experience with renting storage batteries knows that when a new customer finds his battery exhausted, that the first thing he generally does is to fill it up with such chemicals as he may have at hand in order to avoid the expense of recharging, the favorite substances being nitric acid, chloride of ammonium and bichromate of potash. In such cases the degree of chemical purity necessary to put the battery in good working order is attained by immersing the elements for a short time in cold water, and filling up with fresh solution.

A storage battery of 480 cells that has been in constant operation in one of the telegraph offices here for the last two years was not connected up in such a way that the individual cells could be readily removed and repaired, but was joined together by fusing with a blowpipe. The material used in the construction of the battery contained the usual impurities found in commercial lead, lead oxide and sulphuric acid, but up to this time not one cell out of 480 has been removed on account of any defect whatever.

When a battery of storage cells shows incipient weakness, instead of looking up short circuits in individual cells all the positive elements in the battery ought to be renewed. If one plate or cell shows defects when the others are in good condition, the battery should be condemned and a type of battery installed that will not require patching up until it is time to put in a complete set of positive plates. The life of the positive plates in a properly constructed battery depends entirely on the rate of charge and discharge, and not at all on the amount of inspection that they receive and the readiness with which short circuits are detected.

With the early types of storage battery it was, of course, necessary that each plate could be readily removed for repairs. The method of making repairs was simple and effective. The plate causing the trouble was laid on the floor with a board placed on top of it. The electrician then jumped on the board, after which the plate was put back in the cell. Experience has shown, however, that it is better to give more attention to the original construction than to rely upon this method of keeping a battery in working order.

The criticisms of Profs. Thomson and Stine could be justly applied to the types of accumulators that were in use several years ago. During the past two years, however, a form of secondary cell has been put on the market from which the weaknesses referred to have been entirely eliminated.

Strassenbahnwagenuntergestelle.

If any of our readers, in looking over articles on electric railways in the German language, should come across the word *Strassenbahnwagenuntergestelle* they need not be alarmed or discouraged nor be afraid to use it in good society. Instead of getting at the subject directly, as is done in English, this single word relates quite a little story—a sort of riddle of which you are expected to guess the answer. The story is, briefly, as follows: In about the middle of the word we find that the object referred to has some connection with a car, and returning to the beginning it appears that this car is intended to run on rails (as cars usually do, by the way), that these rails are in the streets of a city, and that the car is supported on some structure; near the end it is explained that this supporting structure is below and not above the car, and finally it is added that it refers to the apparatus in general and not to any one form in particular. With the aid of this description it will not be difficult to guess correctly that the German writer would have said *trucks* instead, had he been privileged to use the English language.

A Priori Advantages.

Prof. Crookes, says Sir David Salomans, once made a significant remark to him, to the effect that had the electric light been universal at the present day, the candle, if suddenly introduced, would be thought a wonderful invention. The arguments advanced would be that it enables any person readily to obtain light in its simplest and most portable form, and without the use of cumbrous machinery, or the necessity of attaching the lamp to any fixed point by means of wires before it could be lighted. Recent claims for the new acetylene gas illustrate the point of above remark.

Electrical Power Transmission.—XX.

BY LOUIS BELL, PH.D.

In practical alternating circuits the curren wave is never truly sinusoidal, but consists of a main or fundamental wave with the odd (*i. e.*, 3d, 5th, 7th, etc.) harmonics of various amplitudes superimposed upon it. In nearly every case the third harmonic is the most prominent and is quite capable of causing resonance even to a dangerous degree if it happens to fall in with the frequency of the system. The extent of the rise in voltage, however, is very much less than that produced by resonance with the fundamental frequency. The point at which resonance occurs and its magnitude are found for the harmonics by the formulæ already given.

To facilitate computation the following table is given showing the inductance and capacity of ordinary overhead lines per mile in millihenrys and microfarads respectively. The wires are supposed to be of copper and to be suspended as a parallel pair at a distance of 18 inches, as in the case of the table of impedance factors. Within the range of ordinary practice varying the height above the ground makes no sensible difference in inductance or capacity.

Size. No.	Inductance.	Capacity.
0000	1.48	.0102
000	1.52	.0099
00	1.56	.0097
0	1.59	.0095
1	1.63	.0093
2	1.67	.0090
3	1.71	.0088
4	1.74	.0086
5	1 78	.9084
6	1.82	.0083

So far as the line is concerned the facts regarding resonance can be easily computed with tolerable accuracy. From the table it is evident enough that the line capacities are generally so small as to make the oscillation period so short as not to correspond with the frequencies in ordinary use except in the upper harmonics, which are generally of small moment although one case of severe resonance from a higher harmonic (probably the 7th) has come to the author's notice.

It must be remembered that not only the line capacity but the capacity of the receiving apparatus must be considered. The former is but small except in the case of underground or submarine cables, for which the capacities are likely to be from ¼ to ⅓ microfarad per mile, as ordinarily manufactured. High voltage translating devices like synchronous motors and transformers often may have static capacities of several tenths of a microfarad.

As a matter of fact, experience seems to show that one is not likely to stumble upon very serious resonance in overhead lines, although in cables it is easily possible. On the other hand, it is more than likely that resonance of a minor kind, mostly from harmonics, is far commoner than is generally supposed. High pressure alternating currents often show a tendency to jump across air spaces and insulation that is hard to account for otherwise. This tendency must not be confused with the occasional displays of atmospheric electricity on overhead lines. It is not uncommon to get somewhat severe shocks from an aerial line entirely disconnected from any machinery.

The most obvious way of avoiding trouble from resonance when it exists or is threatened is to vary the frequency, inductance or capacity so as to throw the oscillation period of the system and the frequency of the current far apart. The frequency is usually fixed by other considerations, but inductance and capacity are varied with the utmost ease. In fact, they are never constant in practice.

The readiest way of getting a clear idea of the inductance of a system is from its power factor, *i. e.*, the ratio between the apparent energy as found from voltmeter and ammeter readings and the real energy as given by a wattmeter. This not only gives the current which must be carried for a given amount of energy but measures the angle of lag between current and E. M. F. In fact,

$$\frac{\text{Energy}}{\text{Volt amperes.}} = \cos\theta,$$

which gives the angle of lag at once. But in general

$$\text{Tan } \theta = \frac{2 \pi n L}{R}.$$

So that knowing the ohmic resistance of a circuit and its "power factor" we can get a tolerable approximation to its coefficient of self-induction, R being reckoned in ohms and L in henrys. As, however, the lag is determined by both inductance and capacity, the formula is principally of use in connection with individual pieces of apparatus.

From a practical standpoint it is quite out of the question to compute the total inductance of a proposed system on which any resonance effects depend, with anything like accuracy, since the character and amount of the apparatus is indeterminate. One can, however, gain from experience a tolerable idea of the probable lag in a mixed system, which will at least tell whether there is imminent danger of resonance. There is really little danger at ordinary frequencies unless the static capacity involved is large—several microfarads at least.

One other phenomenon in connection with alternating current work deserves notice here. Several years ago Sir William Thomson pointed out that the ohmic resistance of a copper wire was greater for alternating than for direct currents. This is for the reason that the current density through the cross section of the conductor is not uniform when the current is an alternating one. The propagation of any current is mainly along the surface of the conductor, and only after a measurable, though short, time is the condition of steady flow reached.

When the current rapidly alternates in direction the interior of the conductor is thus comparatively unutilized, for before the flow has settled into uniformity its direction is changed, and the original surface flow is resumed. The larger the wire and the greater the frequency the more marked this effect. Fortunately with the common sizes of wire and the frequencies ordinarily employed for power transmission work, it is quite negligible. At 60 periods the increase of resistance due to this cause in a conductor, even half an inch in diameter, is less than one-half of one per cent. Any line wire that is allowable on the score of its impedance factor will be unobjectionable on this account as well. Only occasionally, as in bus bars for low voltage switchboards, is it worth considering, and in such case the use of flat bars, half an inch or less thick, will obviate the difficulty.

We have now investigated all the important factors that enter into the design of a transmission line, whether for direct or alternating currents. Let us review them with the idea of seeing how they enter into practical cases. First comes the all important question of initial voltage, involving the choice between the direct generation of the working pressure or its derivation from transformers if alternating currents are used. We have already seen the practical limitation of voltage for direct currents. With alternators the commutator troubles are absent, and the limitations are those imposed by generator design. The higher the voltage of a dynamo the more space on the armature must be allowed for insulation, thereby cutting down the output of the machine. Hence the practicable voltage depends on the size of the generator.

In a general discussion it is difficult to make exact statements as to what can or cannot be done, but experience seems to show at present that 3,000 to 5,000 volts is the greatest pressure that can economically be derived from the generator, the latter only in very large units. Higher voltage than this has been attempted, but there is good reason to believe that the reduced output and increased cost of construction lead to a higher cost per kw output than if low voltage generators with transformers were employed.

For present purposes, then, we may assume that in a large proportion of cases the voltage of the generator cannot well be above 3,000-3,500 volts. With raising transformers 5,000 to 10,000 volts is known to be a practicable pressure. At some particular distance, then, in each case, the annual interest and depreciation charge against, say a 3,000-volt line, will equal the interest and depreciation charge against, say a 10,000-volt line, and its raising and reducing transformers. For a fair comparison two things must be noted—first that 3,000 volts is an available pressure on a working circuit, so that it has the advantage over 10,000 volts, of both sets of transformers—second, that the systems must be of the same efficiency, *i. e.*, the line loss in the first case should be equal to the losses in both line and transformers in the second case.

The exact distance at which the costs by the two methods become equal must be computed from the data above outlined in each individual case on account of the variations introduced by size of units, cost of copper and transformers, delivered, differing conditions of depreciation, and so on. The distance, however is generally longer than would be at first sight supposed. Assuming an equal rate of interest and depreciation in each case, a few hundred horse-power as the amount transmitted and current prices of copper and larger transformers, we arrive at the following approximate result: At about

7 miles 3,000 volts from the generator and 10,000 volts with raising and reducing transformers become equal in cost. This distance becomes between 11 and 12 miles if 5,000 volts only are derived from the transformers. Generators wound for 4,000 or 5,000 volts generally will require reducing transformers for the working circuit, so that they have the advantage of the raising and reducing system by only one set of transformers.

In most cases it is desirable either to generate a voltage which can be used on the working circuit or to use from 5,000 to 10,000 volts derived from transformers. So much for the selection of a proper line voltage.

As to loss in the line much has been said already, and the best advice that can be given is to make a few trial computations along the general lines indicated. Almost every case will require special treatment in certain particulars, depending on the conditions of service. For example, a common complication is the supply of power or light or both at a point perhaps halfway along the line. Then, according to the amount and kind of service it may be desirable simply to tap the line, to tap the line for power and use a motor generator for lights, to establish a sub-station with regulating apparatus, to compound the generator for the point in question and use either of the above methods at the end of the line, to instal rotary transformers or to run a separate line with regulators at the generating station.

The line structure should preferably be of bare copper wire carried on wooden poles. Do not go underground unless you have to do so. It may be necessary to insulate portions of the wire, but it is best not to put much faith in an insulating covering. Instead, it is desirable to make a very thorough job of insulation at the supports, and provide for the easy inspection of the line.

In using alternating currents inductance in the line must always be considered. Practically it means raising the voltage of the generator or raising transformers by a few per cent., unless a considerable part of the load is in synchronous motors which can be employed to counteract the inductive drop. In nearly every case its real importance is small in spite of its scaring the uninitiated now and then.

So, too, with inductive load. Its real effect is merely to increase the current in the line by a small amount, usually less than 10 per cent., and to demand increase of excitation at the dynamo. If this is so designed as to regulate badly, an inductive load will render it difficult to keep a uniform voltage. On the other hand, a generator capable of holding its voltage from no load to full and inductive load with an increase of only 20 or 25 per cent. in the exciting current will give no trouble whatever. The total net result of inductance in line and load is to call for a well-designed generator with good regulation and a reasonable margin of capacity. One who knowingly installs anything else deserves all the troubles that inductance can produce.

Rise in voltage on throwing off the load or through distortion of the current wave by an inductive load can be reduced to insignificance by employing a proper generator as above noted. Aside from this, a mixed load particularly if consisting in part of synchronous motors, seldom has a bad power factor or great and sudden changes in amount.

As regards static disturbances, few overhead systems have capacity enough to give cause for alarm. Difficulties are to be looked for chiefly on very long lines, longer than any now in use, and those composed in part of underground or submarine cables. In these cases one can sometimes know the conditions well enough to calculate the actual result in rise of voltage. More often, the data are incomplete, and the simplest way out of the difficulty is to try the effect of varying the capacity of the system before it goes into regular operation. If the addition of a condenser, say of ⅓ microfarad, makes a sharp variation in the voltage, look out for resonance and investigate the capacity of the system step by step. A change of capacity or inductance can be made sufficient to avert any serious danger of resonance.

We may now pass to the practical calculation of a line. Case I.—The simplest possible case is the transmission of direct current over a short distance. Let it be required to deliver 200 hp to a machine shop for operating machinery and a small tramway over a distance of one and a half miles, power to be about equally divided between small motors and tramway. Source of power—water power—owned outright by the company, and ample in amount. Load on small motors steady, on tramway very variable. In a case of this kind the use of direct current is advantageous, since with plenty of power considerable drop can be permitted and the use of any alternating system would involve changing to direct current for the tramway. For use in a machine shop the speed of the motors need not be very uniform, so that there will be no especial difficulties of regulation. On account of size of motors 500 to 600 volts will be the highest permissible voltage.

There are several courses open in determining the drop. The easiest is to assume for the final voltage such a value as will give the greatest drop compatible with convenient regulation, and the voltage delivered by a standard railway generator. A special generator is objectionable on account of both first cost and difficulty of repairs. The generator can be counted on for 600 volts maximum. If, therefore, we run it at a normal no-load voltage of 550, and over compound about 10 per cent., we shall get no more than about 550 volts at the motors. During the time that the tramway is working we can let the voltage fall to 500, for which the tramway motors give their normal output without interfering materially with the regulation of the other motors. We take the maximum drop then at 100 volts. The amount of power to be delivered at full load is 200 hp.

Taking the average commercial efficiency of the motors at 80 per cent., the electrical hp to be delivered is 250, which equals very nearly 187,500 watts at 500 volts. The current, therefore, is 375 amperes. To allow for sag, joints and waste, we should take the mile as about 5,400 ft. instead of 5,280. We are now ready to determine the cross section of the wire by the formula already given. We then have

$$\text{cm} = \frac{16,200 \times 11 \times 375}{100} = 668,250.$$

Looking now in our wire table, we find that the nearest convenient approach to this cross section is three No. 0000 wires, each of 211,600 cm. We might reinforce these by a No. 5 wire and get almost exactly the amount required, but the game is hardly worth the candle, since we are working for minimum first cost, and a very trifling increase of drop is not worth considering, particularly as the maximum load will be for only a few minutes at a time. A nominal 200-kw generator will serve our purpose if built as standard railway generators are, to stand small and temporary overloads at any time. The cost of the copper for such a circuit is considerable. 48,600 ft. of No 0000 will be required, weighing, when insulated, as it generally would be in running into a town, about 750 lbs. per 1,000 ft. The total weight would then be 36,450 lbs., costing, at 12½ cts. per lb., $4,556, nearly $23 per hp delivered.

Case II.—A cotton mill is operated by steam, coal costing about $5 per ton, the actual brake horse power required to drive the machinery being 650. Speed must be constant, load is very uniform, and any reduction of available horse power cuts down the output, all of which is badly needed to fill contracts. A cheap water power, distant 22,000 ft., is acquired by the mill owners. Sixteen thousand cubic ft. of water is available, and the greatest head that can be utilized is 30 ft. At the given price for coal electrical transmission will certainly pay. The full 660 hp must be delivered, or the power will have to be supplemented by steam, unless part of the looms are shut down.

The given amount of water will produce, when utilized in first-class turbines, almost exactly 800 mechanical hp. Two turbines are used for security against breakdown, and each runs 150 revolutions per minute. The commercial efficiency of the plant must then be at least $\frac{600}{800} = 82.5.$ per cent. Taking 300 kw units for generators and motors we can be sure of a commercial efficiency of .93 in each machine. This limits the efficiency of the line to not less than 95.4. It is evident at once that direct coupled generators must be used, since the 4 or 5 per cent. lost in belting would be quite inadmissable.

As to voltage, it is evident that the highest available in a 300-kw unit should be used. Without going into special windings, the maximum would be, say, 3,000 over compounded about 10 per cent., giving 3,300 at the brushes. At the assumed efficiency of motors there must be delivered to them 529 kw. At 4.6 per cent. drop in the line 168 amperes must be the current. All question of inductive drop may be neglected, since the motor field can be adjusted to compensate for it. Taking the actual length of circuit as 45,000 ft., and employing the formula as in Case I., the cross section of conductor comes out as 547,100 cm.

This is very nearly met by three No. 0000 B. W. G. wires. Wire drawn to this British wire gauge can be readily obtained without increased cost. The combined section of the three varies but a little over 1 per cent. from that required, hence will serve excellently. Supposing bare wire to be used, the weight of each conductor per thousand feet is 547 lbs. The total weight of copper is then 73,845 lbs., costing, at 12 cents per lb., $8,861. Any increase in the loss in the line will cause a failure to deliver the required power and necessitate the operation of a subsidiary steam plant, or the shutting down of nearly a score of looms for each per cent. decrease in efficiency. Doubling the line loss would save $4,430, but at the cost and trouble of a 40-hp steam plant, or the loss of the output of 75 or 80 looms. In a case of this kind the easiest way of reducing the cost of line would be to use the three-phase synchronous system, or the three-wire two-phase, either of which would save a quarter of the above copper at the same efficiency.

Case III.—It is desired to deliver for general service in a city 1,000 kw from an ample water power 20 miles distant. Power is to be used for arc and incandescent lighting, and a motor service of unknown amount, possibly as great as 500 hp; 3,000 to 4,000 hp can be obtained at the power station, and allowance must be made for extensions.

On account of reduced cost of line the three-phase system is desirable, using the distribution by secondary mains at about 220 volts between wires, using a balance wire for lamps. This requires a little less than 30 per cent. of the copper needed on the two-wire system with the same voltage at lamps. Evidently raising and reducing transformers should be used, and the climatic conditions are favorable enough to allow 10,000 volts on the line. We should first decide on the generators. Six hundred kw is a convenient size, two being used for the total plant. The voltage should be moderate, say, 500 volts. With this preliminary, let us figure the line. We can conveniently lose about 10 per cent. of the energy, say, 5 per cent. in the two banks of transformers and 5 per cent. loss in the line. The voltage at the receiving end will then be 9,500, with 10,000 at the raising primaries. As to regulation, the distributing system is worked from a sub-station where the regulating is done.

Since the copper required is ¾ of that needed for a two-wire system at the same voltage, each of the three wires will have one-half the cross section of either wire on the two-wire system. We may, therefore, use our previous formula if we take account of this factor ½. The simplest way of doing it is to take the single distance of transmission instead of the double distance. As to the current in the formula, it must be the equivalent single-phase current. If we write $\frac{W}{V}$ instead of C, we shall avoid all confusion on this score. Our formula then becomes

$$\text{cm} = \frac{D \times 11 \times \frac{W}{V}}{V_1}$$

wherein D is the distance of transmission, W the watts received, V the voltage of reception, and V_1 the volts lost in the line. In our case $D = 108,000$ (the mile being taken as 5,400 ft.) $V = 9,500$, $V_1 = 500$, $W = 1,000,000$. Then cm $= 250,000$ (nearly).

But we must remember that our load is a mixed one of lights, and probably both synchronous and induction motors. Hence it will have an inductance. Hence a current somewhat larger than that given by $\frac{W}{V}$ must be taken. With fairly good luck in our proportion of synchronous motors, 5 per cent. increase will be enough to allow. At worst it could hardly be greater than 10 per cent., which would mean a very small increase in ohmic drop. Taking it at 5 per cent., we add that amount to our cross section and obtain 262,500 cm. The nearest approach to this with standard wires is two No. 00 = 266,000 cm. This is ample.

Now as to inductive drop. At worst the impedance factor of the line will not be greater than 1.79, with 60 periods and wires strung 18″ apart. Therefore, a rise of less than 4 per cent. in our generator voltage will take care of the inductance in the line. As to capacity, each pair of wires will have a capacity of less than $\frac{1}{100}$ microfarad per mile, so that we need not borrow trouble on the score of resonance. The effect of total inductance on the generator is small, since the power factor of the system is likely to be as great as .95, and if the generator is even tolerably well designed, a few per cent. increase in excitation will compensate for this. Now computing the total amount of copper we find it to be 261,144 lbs., costing, at 12 cents per lb. for bare wire, $31,337.

We now have a working line laid out, and feel sure that no contingencies we are likely to meet will cause the drop to vary much from 5 per cent., since within the plausible range of power factor that can be found in a mixed plant both line and generators are well able to take care of the variations. The net result of inductance has been to increase our allowance of copper by 5 per cent., and to require 10 or 12 per cent. margin of excitation and current capacity in our generator.

This may seem a rough and ready process for figuring a transmission line, but it gives a safe and conservative result, as nearly exact as the data generally available for a new plant permit. If the capacities and inductances of the future system could be pre-determined, we could take their vector sum and compute a small correction to our factor of safety in the generator. If the future load were exactly known we might wish to change the drop slightly. No exact data are available under ordinary circumstances, hence we must rely on our judgment in selecting the drop, and factor of safety in the generator, which, unless it be downright bad in design, will have margin enough to meet any reasonable requirements.

It Depends on Oneself.

The *Engineering Magazine* editorially makes the following statement: "We do not expect to live to see cars running at 120 miles per hour by any now known mode of propulsion." We do not know how old that writer is at the present time, nor the state of his health, and, therefore, we cannot say whether we agree with him or not; as steam locomotives, we believe, have been known to have attained a speed of 114 miles an hour, those of us who are not as old as that writer, or, perhaps, in better health, may hope to live to ride at that rate in cars driven by electric power.

Electrodynamic Machinery—XXXI.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

161. Besides the eddy currents set up in the armature and in the conducting masses of the metal on the armature, they also occur in the edges of the pole pieces of the field magnets, both in the case of dynamos and motors. The strength of these eddy currents is greater in the pole which is approached by a generator armature, and in that which is receded from by a motor armature, as is evidenced by the fact often observed, that, although both polar edges become warm during the action of the machine, one edge becomes warmer than the other. The reason for this difference will be considered later.

162. The tendency to the development of eddy currents in pole pieces is increased when the armature is changed from a smooth core to one of the toothed-core type. The reasons for this are two-fold; in the first place, in the toothed-core armature the core is brought nearer to the pole face, so that all magnetic disturbances in the core are more likely to set up corresponding disturbances in the poles; in the second place, because the revolving teeth set up waves of magnetization in the polar surfaces, thus giving rise to the development of eddy currents. Consequently, the change from a smooth-cored to a toothed-cored armature suppresses the eddy currents in the wire on the armature, but creates, or tends to create, eddy currents in the pole pieces.

163. In some types of machines the pole pieces are grooved or slotted, so as to check the development of eddy currents, just as the armature is in effect grooved or slotted by the use of laminated cores. In fact, some field magnets are constructed of an iron frame with receptacles within which are placed the pole pieces formed of a number of iron plates bolted together, the laminations extending in the same direction as those in the armature beneath.

It will be evident that there can be no tendency to set up eddy currents in the solid cores of the field magnets excited by steady, continuous currents. Consequently, no advantage is derived from a lamination of field magnet cores at distances beyond the influence of magnetic changes produced by the teeth or conductors on the revolving armature.

164. Besides the losses in the iron masses of a dynamo due to eddy currents there are others in the same masses due to magnetic friction or *hysteresis*. This latter loss, like the others, is dissipated as heat.

The losses due to hysteresis occur in nearly all forms of dynamo-electric machinery. In continuous current generators they are practically limited to the armature; in some forms of alternating current machines they exist both in the armature and field, and are especially present in alternating current transformers. It becomes, therefore, a matter of no little importance to thoroughly understand the nature of this source of loss.

165. A certain amount of energy has to be expended in order to magnetize a bar of iron. This energy resides in the magnetic flux passing through the magnetic circuit of the bar. The energy is transferred from the magnetizing circuit by the production of a counter E. M. F. in the magnetizing coil, and this counter E. M. F. *e* (usually very small), multiplied by the magnetizing current strength *I* at that moment, gives as the product *e I*, the activity expended in producing the magnetic field. As soon as the full magnetic flux is established, the counter E. M. F. ceases, being dependent upon the rate of change of flux enclosed, so that no more energy is expended in the iron, and the current only expends energy as $i^2 r$ in heating the magnetizing coil. When the magnetizing current is interrupted, say by short circuiting the source of E. M. F. in the circuit, the magnetism in the bar tends to disappear, and as the magnetic flux diminishes an E. M. F. is set up in the coil tending to prolong the action of the waning magnetizing current. In other words, the E. M. F. set up in a circuit by the waning magnetic flux is such as will tend to do work on the current, with an activity of the type *e i* watts, and in this manner restore to the circuit the energy expended in the magnetization. Were all the energy in this case returned to the circuit, there would be no loss by hysteresis. As a matter of fact, however, while practically all such energy would be returned to the circuit if the coil magnetized air, wood, glass, etc., yet, when the coil magnetizes iron, although a greater magnetic flux is obtained, yet some of the energy is not restored, but is expended in the iron as heat.

166. It is now generally believed that each of the molecules in a mass of iron is naturally and permanently magnetized, so that each molecule may, therefore, be regarded as a molecular compass needle. In the ordinary unmagnetized or neutral condition of iron, these separate molecular magnets possess no definite alignment, and, consequently, neutralize one another's influence by forming closed loops or chains. When the iron becomes magnetized by subjection to a magnetizing force, these loops break up and become polarized or aligned, all pouring their magnetic flux in the same direction, *i. e.*, parallel to the magnetic axis. When the magnetizing force is removed the molecular magnets tend to resume their old positions; and if they did resume exactly their old positions, the magnetism in the iron would entirely disappear on the removal of the magnetizing force, and all the magnetic energy would be restored to the circuit. In point of fact, however, they do not exactly resume old positions, but take new intermediate positions, in virtue of which a certain amount of *residual magnetism* is left in the bar.

167. When now the magnetizing force is reversed by reversing the current through the magnetizing coil, the molecules are forced around, and breaking suddenly from their positions, fall into new positions either with oscillations or with a frictional resistance to the motion that dissipates energy as heat. The energy thus lost by molecular vibration or molecular friction cannot be returned to the circuit. Consequently, a loss of energy occurs in the circuit supplying the reversing magnetizing force, at each reversal of magnetism in the magnetized iron, since the opposing counter E. M. Fs. developed in the coil during magnetization and demagnetization are not equal, and the energy so lost results in an increase in temperature of the iron. By *hysteresis* is meant that property of iron or other magnetic metal whereby it tends to resist changes in its magnetization when subjected to changes in magnetizing force. That is to say, when a mass of iron is successively magnetized and demagnetized, or passes through cycles of magnetization, the magnetic intensity in the mass *lags behind* the impressed magnetizing force. The word hysteresis takes its origin from this fact, since it is derived from a Greek word meaning to lag behind. This phenomenon is called hysteresis, and the loss of energy due to this cause is called hysteretic loss, or loss of energy by hysteresis.

168. When iron undergoes successive magnetic reversals the amount of hysteretic loss is found to depend upon the maximum magnetic intensity in the iron at each cycle, that is to say, upon the maximum value of $\mathcal{B}$. As $\mathcal{B}$ increases, the amount of work that has to be expended in reversing the magnetization increases, and if we double the value of $\mathcal{B}$, we practically treble the amount of work that has to be expended. It was first pointed out by Steinmetz as a consequence of this relation, that the hysteretic loss varied as the 1.6th power of $\mathcal{B}$, or as $\mathcal{B}^{1.6}$, the formula for the amount of activity expended in one cubic centimetre of magnetic metal being $P = n\,\eta\,\mathcal{B}^{1.6}$ watts. Since the same loss of energy occurs in a cubic centimetre during each cycle, the more rapidly the cycles recur, the greater will be the wasteful activity, and n in the above formula expresses the number of complete cycles through which the iron is carried per second. The co-efficient η is the *hysteresis co-efficient* for the metal considered, and has to be determined experimentally. It may be regarded as the activity in watts which would be expended in one cc of the metal when magnetized and demagnetized to a flux density of one gauss at one complete cycle or double reversal per second. The following table gives the values of this co-efficient and also the amount of hysteretic loss produced in a cubic centimetre and in a pound of ordinary good commercial sheet iron at various frequencies and intensities.

TABLE SHOWING THE HYSTERETIC ACTIVITY IN GOOD, SOFT SHEET IRON OR STEEL UNDERGOING ONE COMPLETE MAGNETIC CYCLE PER SECOND, IN WATTS PER CUBIC CENTIMETRE, WATTS PER CUBIC INCH AND WATTS PER POUND, FOR VARIOUS MAGNETIC INTENSITIES IN GAUSSES AND IN WEBERS PER SQUARE INCH.

Webers, per sq. in..	6,452	12,900	19,360	25,810	32,260	38,710	45,160	51,620	58,060	64,520	70,960	77,420	83,860	90,320	96,770	103,200	109,700	116,100
Gausses [$\mathcal{B}$]	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000	11,000	12,000	13,000	14,000	15,000	16,000	17,000	18,000
Watts, per cc.	1.58×10^{-5}	4.78×10^{-5}	9.15×10^{-5}	1.45×10^{-4}	2.07×10^{-4}	2.78×10^{-4}	3.55×10^{-4}	4.40×10^{-4}	5.31×10^{-4}	6.28×10^{-4}	7.31×10^{-4}	8.40×10^{-4}	9.55×10^{-4}	1.08×10^{-3}	1.20×10^{-3}	1.33×10^{-3}	1.47×10^{-3}	1.61×10^{-3}
Watts, per cubic in.	2.59×10^{-4}	7.84×10^{-4}	1.50×10^{-3}	2.38×10^{-3}	3.40×10^{-3}	4.55×10^{-3}	5.82×10^{-3}	7.20×10^{-3}	8.69×10^{-3}	1.03×10^{-2}	1.20×10^{-2}	1.38×10^{-2}	1.57×10^{-2}	1.76×10^{-2}	1.97×10^{-2}	2.18×10^{-2}	2.41×10^{-2}	2.64×10^{-2}
Watts, per lb.......	9.17×10^{-4}	2.78×10^{-3}	5.32×10^{-3}	8.43×10^{-3}	1.21×10^{-2}	1.62×10^{-2}	2.06×10^{-2}	2.56×10^{-2}	3.09×10^{-2}	3.65×10^{-2}	4.25×10^{-2}	4.89×10^{-2}	5.56×10^{-2}	6.26×10^{-2}	6.99×10^{-2}	7.75×10^{-2}	8.53×10^{-2}	9.35×10^{-2}

It is to be observed that the table represents average samples of good commercial iron, and by no means the best quality of iron obtainable.

169. As an example of the application of this table, suppose that it is required to estimate the power expended in hysteresis during the rotation of the armature of the octopolar generator represented in Fig. 125, the weight of iron in the armature being 2,700 lbs.

At the maximum intensity of 9,500 gausses, or 61,290 webers per sq. in., the table shows that the hysteretic activity per pound at one cycle per second is about 3.4×10^{-2} watts. In each revolution of the armature there would be eight reversals, or four complete cycles, and at 2.867 revolutions per second, the frequency of reversal would be 11.468 cycles per second. The total hysteretic activity is, therefore,

$$P = 2,700 \times 3.4 \times 10^{-2} \times 11.468 = 1,053 \text{ watts.}$$

This would be the hysteretic activity in the armature when generating 155.7 volts. When generating a lower E.M.F., the flux intensity in the armature would be reduced, as well as the hysteretic activity.

170. Hysteresis, therefore, occurs when a mass of iron undergoes successive magnetizations and demagnetizations, and this is true whether such are caused by the reversal of the magnetizing current, with the mass at rest, or by the reversal of the direction of the mass in a constant magnetic field. Consequently the revolutions of the armature of a dynamo or motor, the successive magnetizations and demagnetizations of its core, are accompanied by a hysteretic loss of energy.

The amount of this hysteretic loss increases directly with the volume v of iron in the armature in c. c., the number n of revolutions of the armature per second, the hysteretic coefficient η of the iron employed, and the 1.6th power of the maximum magnetic intensity in the iron; for it is evident that in one complete revolution of the armature its direction of magnetization will have undergone two reversals, provided that the field is bipolar. In a multipolar field the number of reversals increases with the number of poles p, and the hysteretic activity becomes $p = \frac{v\ \eta\ n\ p\ \mathcal{B}^{1.6}}{2}$ watts. In the case of a generator, this activity must be supplied by the driving power, and in the case of a motor by the driving current.

171. When a generator armature is at rest in an unmagnetized field, the *torque*, *i. e.*, the twisting moment of the force which must

be applied to the armature in order to rotate it, is such as will overcome the friction of the journals and brushes. When, however, the field is excited so that the armature becomes magnetized, the torque which is necessary to rotate the armature is increased even when the armature is symmetrically placed in regard to the poles. This extra torque is due to hysteresis, and is equal to

$$q = \frac{2 \eta p \mathfrak{B}^{1.6}}{4 \pi} \text{ joules.}$$

172. The total expenditure, therefore, of power in an armature core is the sum of the hysteretic and eddy current loss. The former increases as the speed of revolution directly, but the latter, as already pointed out, increases as the square of the speed. Consequently, if we have an unwound armature core and rotate it on its shaft through a field which is at first unexcited, we expend an activity which might be measured, and which would be entirely frictional loss. When the field is excited we expend activity against friction, hysteresis and eddy currents combined. By varying the speed of rotation, and observing the rate at which the activity given to the rotating armature increases, it is possible to separate the three descriptions of losses from each other.

173. Although, as we have seen, the hysteretic loss increases with the 1.6th power of the intensity of flux, yet it is stated to have been found experimentally that when a mass of iron, such as an armature, is rotated in a sufficiently powerful magnetic field, the hysteretic loss entirely disappears, owing to the supposed rotation of all the elementary molecular magnets about their axis during the rotation of the armature without their losing parallelism, and consequently without any molecular oscillation and expenditure of magnetic energy as heat. So far as experiments have yet shown, this critical intensity in the iron is above that which ordinary dynamo or motor armatures attain, so that under practical conditions the 1.6th power of the maximum intensity determines the hysteretic loss.

174. From an examination of the formula expressing the hysteretic activity in the armature, it is evident that the activity might be decreased by a decrease either in the number of poles, the speed of revolution, the flux density, or the hysteretic coefficient. Since, however, in any machine the first three factors are practically fixed, it is important that the remaining factor, or hysteretic coefficient, should be kept as low as is commercially possible. For this reason, whenever the hysteretic loss is a considerable item in the total losses of the generator, care is taken to select the softest iron commercially available, in which the hysteretic coefficient is a minimum.

175. We have already referred to the increase in temperature of the edges of the field magnet poles during the operation of a dynamo armature, and have ascribed the cause of such heating to the development of eddy currents locally produced there. It is to be remarked, however, that some of the heat in such cases may be ascribed to true hysteretic changes in magnetization.

(To be continued.)

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Electrical Condition of Buried Conductors Due to Leakage Currents from Electric Railways.—IV.

BY W. STUART-SMITH.

These tests along the S. M. road were made with a double scale Weston voltmeter reading to five volts on one scale and 150 volts on the other. It was arranged in a box with a two-point switch and small reversing switch. There were two outside contacts to which permanent connection could be made at each testing point, and generally the five-volt scale was used, and small differences could be easily manifested. In case the readings approached the upper end of the scale a movement of the two-point switch transferred the reading to the larger scale. When beginning the tests along the Metropolitan road an instrument having a scale of 75 volts only was used, and the tests along this road were finished with an instrument having a 30-volt scale. These less sensitive instruments may account for the fact that generally along the Metropolitan road the pipes were found neutral until the gas terminals were being approached.

Along this road no ground readings were generally obtained until Van Ness avenue was reached, where the pipes were a half volt + to the ground and neutral to each other. This ground reading diminished slowly but was still appreciable at Market street, twelve blocks from the electric road. A few blocks further west a similar condition was found. It was also peculiar that on Ellis street, from Larkin to Gough, the pipes were + to the Ellis street rail on the north side of the street and − to the rail on the south side. The cause of this was not understood, but later tests probably offered some explanation.

These tests were made under direction of the San Francisco Gas Company and only extended as far as the terminals of the gas pipes. It so happened that these limits were just at the points where the pipes began to be permanently + to the track, and the regions dangerous to pipes were not explored. Shortly after this series of tests was completed the Market Street Company's Mission & Third Street line was started and a new factor brought in. The location of this company's power house will be noted. A negative wire was led out from the power house and connected with the Brannan street track between Ninth and 10th streets. No cars were run on Brannan street, but it was bonded and acted as a return for the Third street branch. The potential of the Brannan street track was so far lowered that the pipes were + from the terminus near the power house to Fourth street. Four negative wires were led on poles to 16th and Mission streets and there connected to the track for a return for that portion of the road. In virtue of these wires the pipes were + to track from about 11th to 24th streets.

After the Market Street Company had started their system and the fall rains had come and the conductivity of the ground presumably increased the Spring Valley Water Company decided to have a series of tests carried out with a view to determining what changes had taken place since summer along those portions of the lines which had previously been tested, to determine the extent of the danger territory in the neighborhood and determine upon methods for obviating the danger that might exist.

The work was placed in the hands of the author with instructions not to assume that any conditions remained as they were during the previous tests, but that every fact should be determined anew, and the tests continued until all possible information was obtained.

During the previous tests the search for potential relations had been the main thing, the fact of universal drop of potential not having been discovered until near the close of the tests. In the second series the tests for drop of potential were given first place, the direction of current flow in the pipes being recorded at every street corner over wide areas. This was generally done, not simply in one direction, at a street crossing, but from every corner, so that at nearly every street crossing the current direction was known in all four directions.

In many places along the lines of the roads the same was done every 100′ from block to block. As will be seen, the time so employed was by no means wasted, but some valuable data were obtained.

Some of the results of this investigation may be passed over in a few words. As the tests along the lower part of the Metropolitan road did not show a potential relation to exist between the pipe systems while a potential difference everywhere existed along the line of the S. F. & S. M. road, it was assumed that the difference was due to the heavy current introduced into the pipes along the latter road by means of the wires between track and pipe, and it was thought that if these wires were cut off the potential relation would disappear, and it was considered doubtful whether any drop in pipes could be obtained (no tests for drop had originally been made along the Metropolitan road).

It was therefore determined to locate and cut off these wires, but in order that any changes found might be certainly laid to the door of the wires some preliminary tests were made both along the line of the Mission and S. M. roads. The wires were then cut off and tests begun under the impression that great changes would be found, but to the author's surprise there was no change whatever except in the immediate vicinity of what had previously been the wired points.

The potential difference between pipe systems was as great as it had previously been and the drop of potential remained practically unchanged. The pipes were + to ground as before, and at the terminals of the gas pipes the relations indicated that practically the same current was being passed to water pipes. It seemed certain that with the wires off the current in the pipes had not diminished. This was probably due to the fact that as the wires did not introduce current to greatly reduce the potential difference between track and pipes the leakage was greater. Facts later discovered showed that the presence or absence of an *occasional* wire where the track is + to the pipes is a matter of little consideration one way or the other. With closely wired points it is a different matter.

It will be needless to give much, if any, data regarding the drop of potential. Sufficient to say that there were few places within considerable distances where a very appreciable drop could not be obtained over 100′ of either gas or water pipe. The drop generally varied from about 1-60 volt to two volts, as much as 1½ volts being obtained over 24 feet. Generally it averaged about 1-10 to ½ volt, but was generally considerably more immediately after a hard rain than if it had not rained for some days, thus indicating increased leakage with very wet soil.

During the summer tests several wired points previously named were located along the lower San Mateo road, but in order to be certain that they were all out tests for drop of potential were begun at Stewart and Market streets and continued up Stewart under the impression that when a point was found where the current direction reversed, *i. e.*, from which the current flowed in both directions, a wire would be found connecting track and pipes. Such a point was soon located about 200′ south of Market and by careful testing over individual points of the water pipe a section was soon found that was + to sections on either side of it. This was confidently uncovered with a view to cutting off the wire, and there was some chagrin at discovering no wire. Something had evidently gone astray. A further examination showed a water service leading out of that section and passing under the tracks to a house on the opposite side of the street.

There was no wire, but, nevertheless, there was a point of intake of a considerable quantity of current, and it was evident that simple reversal of current direction was not enough to locate wires. Generally, however, at such points of intake by leakage the potential difference between pipe and track was much less reduced than when a wire was present, and by careful testing wires could be located.

It will be noted that the Mission street and S. M. roads cross at Stewart and Mission.

After crossing Mission street and testing further south on Stewart the readings began to be very erratic. Contacts would be made and the drop determined, and while the instrument was being watched to note any changes in value suddenly there would be a reversal denoting that the current direction had suddenly reversed. This was very puzzling at first, but the facts were noted, and continued tests on Stewart street demonstrated the fact that there were no wires there, but the points of intake of current were frequent.

After the tests on Stewart street were completed tests were made on Mission to determine if possible the cause of the reversals of current direction found on Stewart street and which could not be accounted for by any movement of cars on that street. It was found that leakage points were frequent along the Mission road, and that the current reversals were due, first, to a current in the pipes received from the S. M. road, then from the Mission road. This was rather unexpected because the construction of the Mission track is excellent. The rails are heavy and the joints all triple bonded.

Careful measurements were made all the way out Mission street and it was found that frequently at the street corners the current would flow away from the crossing in all four directions, then perhaps in the next block the current would flow toward the street crossings four ways from the middle of the block.

In some cases two points would be found in a block from each of which the current would flow toward the corners and also toward the middle of the block, producing currents apparently running against each other. In this case the currents toward the middle of the block probably passed to the gas mains.

It was demonstrated beyond question that while the general resistance between track and pipes may be high and the current leakage small yet there are frequent points where there are paths of low resistance through the soil where the flow of current is many times above the normal. It was a singular thing that such points seemed to be as frequent and the flow of current apparently as strong along the well-built and bonded Mission road as along the very poor S. F. & S. M. road.

Some points were found where the leakage was so great that by watching the drop of potential over 100′ of water pipe all the movements of the car controller could be noted when a car started near the leakage point.

In the regions where the pipe was + to the track many similar points were noted, but of course the readings were the reverse of those found where track was +. If there was a path of low resistance at a street crossing the current would flow toward that point from all directions, while such a point in the middle of a block would be denoted by current flowing toward the middle from both ends.

There is one more point of some importance to be noted which the author believes to be new, at least the fact has not been previously noted.

Along the 18th street line the water pipes stop a short distance above Castro. They do not cross the region marked Hill Park or unoccupied hills.

On Haight street just north of the Hill Park is a large main which connects with one on Castro street and the block below Castro. The largest, however, is on Castro.

Along the line of the Metropolitan road the pipes are + to track from the crossing of Baker and Oak all the way past the power house to the terminus of the road at Ninth avenue and H street. During the summer tests the Haight street cable track came neutral to the pipes at about Baker.

Far to the south it will be noted that the Mission street road and the S. F. & S. M. road come nearly together at Randall street. Along the line of the S. F. & S. M. road the ordinary cast iron service mains do not go beyond Randall toward the power house, and these pipes, as well as the gas pipes, come to dead ends at about the limits of 30th street down on the map. They run out Mission street a few blocks south of Randall, but do not cross over to the San Jose road.

On the San Jose road and passing the S. F. & S. M. power house is a 30″ wrought iron trunk main which follows the line of the electric road to Randall and Chennery streets.

There it leaves the line of the road and turns down Randall to Mission, then down Mission to Valencia, down Valencia to Market, beyond which it does not concern this pipe. On the San Jose road it is the only pipe, while on Mission or Valencia it has no connection with the ordinary cast iron pipes except as they come close together in the soil.

Now from the location of this pipe it is evident that whatever current follows the waste pipe to the S. M. power house must pass through the soil from the cast iron service mains to this pipe. It is evident that the greater transfer will take place toward the terminals of the cast iron pipe, and it may be expected that the current will concentrate in the cast iron pipes near Valencia. In fact it does so accumulate, and this accounts for the heavy current in the Mission street pipe, during the summer, in virtue of which these pipes were + to that track before the Mission road was put in operation. It also accounts for the + condition of the pipe relatively to the Valencia cable track for a street distance near 26th street. Probably at that point there is a low resistance path between the cast iron service mains and the wrought iron trunk main, with the result that there is a heavy concentration of current in the cast iron pipes at that point. This shows that a careful study of the pipe lines is sometimes necessary in order to understand some peculiarities that may be found.

All along Mission street from the water front to about Fourth street the current in the pipes was found to set toward Market street as might be expected. From about Fourth street out to about Ninth it was noted with surprise that there was a heavy set of current from Market toward Mission. It was supposed the current which had passed to Market street pipes lower down town was returning to the Mission pipes in order to reach the power house, but the puzzling fact was that the volume returning seemed to be very much greater than that which had gone to Market street.

From about Fourth to Seventh or Eighth the current continued across Mission street toward Howard, across Howard toward Fulsom and Harrison. Beyond Eighth it apparently followed partly out Mission and partly around to Howard.

It was not known at that time that the Brannan street track was bonded and connected to the dynamo and acted as a return, with the consequent formation of a region when the pipes were + to track, but when testing along Harrison and Bryant it was found that the current in the pipes was not following the line of the S. M. road, but was setting strongly to the south, and upon following up this current it was discovered that Brannan street was used as above for a return.

When testing on 14th street, between Mission and Guerrero, it was found there was a heavy set of current in the pipes down 14th street, and on Guerrero, from 14th to 24th, it was found that the current constantly set heavily toward Valencia street, and upon testing at Valencia it was found that this current was crossing and going to Mission street. On Mission street the general direction of current was toward 16th from both sides, as was natural, since that was the point where the return wires to the dynamos connected with the track. There was some variation of current direction, owing to natural paths of low resistance from pipes to track, but, in general, the current was toward 16th. As soon as the limit of + condition of pipes was reached at 24th street, however, the current in the Mission street pipes no longer set toward the Mission street power house, but passed up to Valencia, the current from Guerrero also coming to the same street. Up Mission, beyond the junction with Valencia, the current in the cast-iron pipes was up Mission toward Randall, and this current direction continued until Randall was reached. As soon, however, as Randall was passed the current in the Mission street pipes reversed towards Randall from the other direction. The reason is obvious, because the great trunk main passing the S. F. &. S. M. power house turns from Randall into Mission, and the current flowing from Mission toward Randall shows a transfer of current from the cast to the trunk pipe, but the current coming down to Randall from the south can only be leakage current from the Mission track, as there is no other road located where it would be possible for current to reach these pipes.

This current must be the leakage to pipes in about four blocks, as the pipes extend no further than that on Mission beyond Randall.

Up the 18th street line there is a heavy set of current in the Castro street pipes around the Hill Park to Haight street, and out Haight street toward the west. So much so that whereas in the Summer the pipes were + to Haight street track only as far as Baker, now they are + way down to Steiner.

When testing on the lower Metropolitan line a heavy set of current was found going down to Market and across Market, thus explaining the set of current previously found from Market toward Mission.

These various facts can now be connected together. The different power houses are so located with reference to each other that the lower Metropolitan line is nearer the Mission power house than it is to the Metropolitan, and the current which leaks to the pipes passes to the Market street company's power house. The same is true of a considerable portion of the current which leaks to the pipes from the S. F. &. S. M. tracks as far south as 24th street. On upper 18th street the current goes around the hill to Haight street and so to the Metropolitan power house in sufficient quantity to balance the current which went from the lower part of the Metropolitan road to the Market street company's power house. Finally, the current which goes from the S. F. & S. M. road to the Market street company's power house is balanced by current from the Mission road going up Randall in the big main and so to the S. M. power house.

In general it may be said that when several power houses are located in a city within the limits of a network of ground conductors which is everywhere practically continuous, the current which passes to the continuous conductor from the several roads will distribute itself between the different power houses in such a manner that the resultant return circuit for each road is the shortest possible without reference to the dynamos from which the current came. Of course, each station must take back as much current as it sends out.

This being true it would evidently be advantageous for different roads to wire their tracks together at properly determined points, as each could thus make a very considerable virtual reduction in the length of the ground circuit.

It would manifestly be to the advantage of all roads to wire the Metropolitan to the Mission where they come close together at Fifth street, to wire the Market street company's road and the S. M. road together where they cross at 14th and 29th streets, and carry a wire across connecting the tracks at Randall street. Finally, the S. M. road should be wired to the Metropolitan where they come close together beyond the Hill Park.

The Metropolitan road has come into the hands of the Market street company, and is to be remodeled, and the power house removed, so these conditions will be changed.

The conclusions to which these tests lead are that everywhere along the line of an electric road where the track is + to the pipes there is leakage to them. This is generally small in amount in most places, but the sum total of all the leakage currents along the line of a road of any considerable extent will be of very large amount, and there is no practical system of surface road construction adequate to prevent such leakage.

Although the leakage is generally small at most points, yet at frequent intervals there are paths of comparatively low resistance through the soil, and at such places the leakage is very much above the normal.

Where the wires from the negative of the dynamos are connected to the track the potential of the track is lowered, with the result that throughout a region of greater or less extent, depending upon the circumstances, the pipes will be + to the track. All the current which leaks to the pipes when the track is + must flow to these regions where the pipes are +, and as they are relatively of small extent the volume of current in the pipes may become very great.

This current must return to the dynamos, and to do so must pass through the ground to the track, and in so doing will produce corrosion of the pipes. This corrosion would be very slow and distributed in proportion to the potential difference between pipes and rail at various points if the resistance between pipes and track was everywhere the same; but, as above noted, the experiments demonstrate the frequent location of paths of resistance much below the normal, and at such places the flow of current, and consequent corrosion, will be much greater than the average. In fact, the existence of such places will protect the neighboring pipes by drawing away current that otherwise would pass everywhere.

Throughout the entire region where pipes are + such points will be found where corrosion is steadily going on, and while it might not be manifested by the giving way of the pipes within three or four or more years, yet when they did begin to give way they would be found to be so weakened in many places that the application of the pressure after one place was repaired would probably cause other places to give way.

Corrosion is much less than sensational newspaper articles would lead one to suppose, but it is steadily going on, and may be expected eventually to cause much trouble unless means are adopted to prevent it.

Probably it can never be entirely overcome, but it can be so far minimized as to be practically removed as a source of serious danger.

As a protection it was recommended that at frequent intervals (say at every street crossing) throughout the region where the pipes are + to track, the pipes and track be wired together by a No. 0 wire (or more than one if necessary), care being taken to make good and permanent metallic contact by the wire with both pipe and track. These wires will be metallic paths of such low resistance between the track and pipes that the current will return by them instead of through the soil, and hence corrosion be prevented. This is the simplest and cheapest remedy that can be adopted, and in the author's opinion is the only practical method of overcoming the danger with the present method of operating the cars. Any complicated and expensive special conductors running from the station into the danger region and there connecting with the pipes is entirely unnecessary. With pipes as ordinarily located with reference to a station, it is not considered advisable to wire very heavily at a point near the power house, as this would cause a final concentration of all the current in one pipe, and while the pipe might be protected as far as the track is concerned, bad corrosion might be expected at the joints. The method of distributed wiring is much to be preferred.

Wires should be put in until the pipes and track are neutralized throughout the region where the pipes tend to be + to track. By beginning the wiring near the centre of the region and wiring toward the ends it will be found that the region will undergo considerable contraction, thus diminishing the necessary number wired points.

Potential readings do not in themselves mean anything unless the resistance is known, but when the extreme sensitiveness of the pipe joints to current is taken into consideration it will be found that a Weston voltmeter is not only sufficient for the obtaining of data regarding potential relations, but by means of it points where there is any appreciable amount of leakage either to or from pipes can generally be closely located and even the condition of the track bonds be fairly well determined.

The San Francisco and San Mateo track was — to the 30″ trunk main from the junction of Randall and Chennery to far south of the power house. A spur from the power house joins the main road at Sunnyside avenue, as shown, and at that point the pipes averaged 6½ volts + to the track. This point was wired to track, and in the middle of the day the current passing over these wires was between 250 and 300 amperes. At that time the station output was but 400 amperes (average), thus showing that more than half the total output of the station was being returned through the pipes. Wires were put in at various points until the pipes and track were practically neutral, and all danger removed.

Putting in these wires not only removed the danger of corrosion of the pipes, but by returning current to the station through a very low resistance diminished by a very considerable amount the power required to drive the current out of the pipes, thus reducing the coal bill.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors, or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 927 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French, or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

Note.—Through the kindness of Mr. Katogi, the editor of the "Electrical Friend," the only electrical paper (monthly) published in Japan, the Digest will hereafter include data and other matter of interest to Americans which appears in that journal.

DYNAMOS, MOTORS AND TRANSFORMERS.

Compensating Coils for Armature Reaction.—Mr. Menges in the Lond. "Elec.," March 22, in referring to the recent paper of Mr. Sayers (see Digest, March 16, 23, 30), calls attention to the British patent of Edison, No. 5,127, 1883, which he says relates to substantially the same device as that of Mr. Sayers. He, Menges, subsequently invented another device for the same purpose, which was preferable, and which, in the discussion, was attributed to Mr. Swinburne; his patent has expired. Extracts of the Edison patent, with illustrations, are published in that journal.

Niagara Dynamos.—Prof. Forbes, in the Lond. "Elec. Rev.," March 22, in reply to Mr. Brown (see Digest last week) states that the alternator to which he referred has a stationary armature between two revolving fields which fails to secure the advantages he sought for; he claims that most of the points mentioned by Mr. Brown are not adopted in the Niagara dynamos.

Niagara Dynamos.—The recent communication of Mr. Brown, mentioned in the Digest last week, is reprinted in the "Elec. Eng.," April 3, together with illustrations of the Forbes design and that adopted.

Tesla's Oscillator.—See "Tesla's Inventions" under Electrophysics.

LIGHTS AND LIGHTING.

Electric Lamps in Coal Mines.—An experiment of Dr. Haldane is recorded in the Lond. "Elec.," March 22. He entered a mine containing large quantities of "black-damp" with an electric lamp, and proved that there is a wide margin between the point of extinction of a candle or lamp and the point of danger to life; a miner could with impunity penetrate atmospheres containing three times as much black-damp as would extinguish a lamp, and the difficulty of respiration would give ample warning if the electric lamp did not; electric lamps ought therefore to be very useful for inspectors.

Possible Rival of Electricity for Illumination.—The "West. El.," April 6, contains an article by Mr. Haskins on this subject, in which he gives the properties of calcic carbide and acetylene (all of which have been fully reported in these columns); regarding the possible competition with the electric light he merely states in closing "whether acetylene will some time rival electricity as an illuminant is yet to be seen."

Tesla's Lighting Effects.—See "Tesla's Inventions" under Electrophysics.

Decorative Lighting.—Some decorative electroliers are reproduced from "Ornamental Iron," in "El'ty," April 3.

POWER AND HEAT.

Annealing Wires.—The Dresler process is described and illustrated in the "Elek. Echo," March 9 and 16; it is for use chiefly in connection with wire drawing in order to soften the wire without the production of the scale produced by the usual method, which involves also a subsequent pickling and cleaning. The Legrange & Hoho process (which has been fully described in these columns, and is known in this country as the Water Pail Forge process) is made use of. The wire passes continuously over rollers through a suitable liquid such as a salt solution, and thence up through oil or some similar liquid for cooling it; a current is passed through the wire into the electrolyte and thence to a suitable electrode the action of which is to heat the wire in contact with the liquid; passing it through the oil subsequently cools it sufficiently so as to prevent scaling, the wire therefore remains perfectly bright; the extent of the annealing is regulated by the speed with which the wire is drawn through the solution; it is claimed to be a perfectly practical method and is thought to be economical also.

Electric Riveting Machine.—An electric riveting machine and its application in the construction of bridges is described and illustrated in "L'Industrie," Feb. 3; an electric motor is used to drive a pump for operating the hydraulic riveting machine, the whole apparatus being quite portable.

Mining Machinery.—In a description of a plant in a mine at Prague, in the "Zeit. f. Elect. u. Electrochem.," March 15, several illustrations are given, one of a movable pump and another of a windlass.

Electricity in Agriculture.—A recent paper by Mr. Brutschke is abstracted in the "Zeit. fuer Elek.," March 15.

Transmission Plant.—An installation for about 53 kw is described and illustrated in "L'Elec.," March 23; the plant runs several saws, a pump and a large ventilator; a table of data is given of the power required by each of the machines.

Installation at a Copper Mine.—According to a description of the Ashio mine plant in the "Elec. Friend" (Japan) for February, 1,419 hp are used in 14 generators, nearly all of which are driven by water power; the energy is used for driving 17 motors, 1,600 incandescent lamps and 40 arc lamps.

Electric Motor in a Boiler Shop.—A brief illustrated description of a motor installation in a boiler shop is given in the "Am. Eng." for April in which also the recent letter of Mr. Melotte (see Digest, March 16) is published in full.

TRACTION.

The Use of One or More Motors on Cars and Locomotives.—In an article by Mr. Hoho published in "L'Eclairage Elec.," March 2, he discusses in detail the action of two motors on the same car, connected in series, in parallel and excited in various ways; he discusses it with reference to the traction resistance and the resistance against slipping, and concludes that the use of two or more electric motors on the same car or train involves serious objections from the point of view of slipping or skidding; there are cases, however, where the conditions, such as the dimensions of the motors and other considerations, make it necessary to sub-divide the motor, and in that case there is no doubt that coupling them in parallel is better than in series; it is necessary to take all possible precautions in dividing the load on the axles to avoid partial slipping.

Relative Costs of Operating Motor Cars and Trailers.—In a discussion of the subject in the "Zeit. f. Elect. u. Electrochem.," March 15, the costs of running the cars are divided into several different classes, and the relative costs for motor cars and trailers are then readily determined under each of the headings.

Mechanical Power on Tramways.—In a brief article by Mr. Dawson in the Lond. "Elec. Rev.," March 22, he gives some figures regarding the cost of cable and electric traction, etc., based on various American roads.

Determining the Traction Effort of Locomotives.—A new method is described by Mr. Ferron in "Cosmos," Feb. 9.

Statistics.—The statistics regarding electric railways in Europe, given in abstract in the Digest last week, are given somewhat more fully in the Lond. "Elec. Eng.," March 22.

Kioto Railway.—According to the "Elec. Friend" (Japan) for February the first commercial electric railway in Japan was temporarily opened on Feb. 1 with four motor cars upon four miles of road; the road will soon be seven miles long, extending from Kioto to Fuskimi; the power is obtained from waterfalls and the apparatus is all of American manufacture.

Surface Contact Road.—An illustrated description of the road in Lyons in which a surface contact system is used (see Digest, Oct. 13 and 20), is published in "La Nature," March 2.

Electric Carriage.—The Pouchain carriage is fully illustrated with details, and described in "Cosmos," Feb. 16; the results obtained are claimed to be remarkable; the following data are given: there are four boxes of 13 accumulators each; they are contained in a box of aluminium lined with celluloid; the solution is made of three volumes of sulphuric acid at 30 degrees and one volume of silicate of soda at 18 degrees, making a gelatinous substance; the capacity is 70 ampere hours; by coupling these four sets in different ways three different speeds are contained, the fastest being 9.6 miles per hour; one charge will run 30 miles at least, depending on the road; the motor is a series wound machine of about 3.5 kw, but can be forced to 6 or 7 hp. Provision is made in the carriage for a light petroleum motor which may be used to charge the accumulators during a trip, by which means the distance may be doubled; the carriage weighs about 2,800 pounds, made up as follows:

accumulators 1,100, dynamo 242, accessories 66, body of the carriage 1,390.

Boat Traction.—The French journal the "Rev. Industrielle," March 9, contains a long description of the de Bovet system, which is in use in France, and in which the boats are drawn by means of an anchored chain, the friction of which against the drum being produced by a magnet; the article contains a large double page plate of drawings of the details. The system has been described in these columns.

Compressed Air Traction.—An article by Mr. Saintive giving a description, including data, of the systems used in Paris, is contained in "Cosmos," Feb. 23.

[illegible]—"Cassier's Mag." for April contains an article by Mr. Townsend. He considers it a well settled fact that serious damage is being done to gas and water pipes and believes that the success of the remedies proposed is somwehat doubtful as long as the rails employed form part of the circuit. He discusses the question as to the responsibility of the injuries and compares it with a similar question which arose a few years ago in the controversy between the telephone and the electric railway companies the majority of which decided in favor of the latter; the value of these precedents, however, is open to grave doubt; he points out the differences and cites other cases of a more similar nature. The damage by electrolysis cannot be said to be unavoidable because there is a plain remedy in the use of the double trolley, the use of which is not inconsistent with the full enjoyment of all the advantages to the public from electric transportation; although the courts may dismiss the claim of the telephone company for damages arising from joint occupancy of the streets because the injury in that case is the result of an attempt to use that which each has a right to, no such disposition would answer fully any claim which the owner of an abutting lot might make for damage to his easement in the street for the purpose of water and gas pipe connection because, on principle, that use stands practically upon the same footing as his right to secure light and air from the street. A remedy exists in the form of a double trolley and there is sufficiently reasonable expectation of relief from the expedients which are now being proposed to free the railway companies from the charge of negligence; these remedies will probably so diminish the evil that it will become difficult to place the liability or to say with certainty what the corrosion hereafter observed is attributable to, that is whether to the trolley current or to the direct corroding influence of the earth and its constituents.

Corrosion of Underground Pipes in Brooklyn.—The "Elec. Age," March 30, reproduces some of the illustrations from the report of the Board of Commissioners of Electrical Subways in Brooklyn.

Three-wire System.—In the Knight system briefly described and illustrated in the "Elec. Eng.," April 3, the objections to the difficulty in balancing are intended to be overcome by crossing over the trolley wires of the different tracks at specially located points so that cars on the same track will take currents from different sides of the neutral wire.

Conduit Railway in New York.—According to the "St. Ry. Jour." for April a section of about a mile and a half of Love conduit will shortly be laid in New York City.

Rapid Transit in Large Cities.—Part of a recent discussion at a meeting of the New York Mechanical Engineers is reprinted in the "Am. Eng." for April; most of it refers to steam roads. Mr. Parsons expressed the belief that the day had already come when electricity as a motive power is more economical than steam; he gives the following figures representing the coal consumed in pounds per ton per mile on the different elevated roads as obtained from the officers of those roads: Liverpool .416, Intramural .495, City & South London .604, Ninth Avenue Manhattan Road, short trains .609, Brooklyn elevated, short trains .661, Manhattan, large trains .928, Brooklyn, large trains .526; he claims that it is unfair to take into account the Manhattan figures. For the electric roads the consumption of coal in pounds per ton per mile is about two-thirds that for steam roads; on the Liverpool line a cheap grade slack is used while on the Brooklyn road they burn a high priced anthracite; if therefore the comparison is made in dollars the difference would be far greater than when expressed in pounds.

Economical Equipment of Power Stations.—In an article by Prof. Carpenter in "Cassier's Mag." for April, he discusses that portion of the equipment of power stations for electric railways which belongs particularly to the province of a mechanical engineer; a number of illustrations of the Ithaca plant are given, also a table of the probable water consumption per indicated and per delivered horse power per hour for various classes of engines with different loads; another table gives the cost per horse power for a plant of 500 hp with different kinds of engines; another, the yearly cost per 100-hp including fixed charges and fuel for various classes of engines.

The Successor of the Railway.—An article with this title by Mr. Morgan is published in the "Pop. Sc. Mo." He discusses the trolley system with special reference to its effects on steam roads; also such questions as that of eminent domain, cheapness, etc. This newcomer "seems equipped with every opportunity that the railways have been coveting for 50 years and to be getting for the asking everything for which the railways have to pay the heaviest;" it "is actually and practically solving those social and agrarian problems which within a few years had threatened serious upheaval of the body politic;" "who shall guess whether the 20th century trolley company will not be as remorseless a tyrant as the poor superseded railway company was alleged to have been in its days of dominant usefulness and prosperity?"

Rights of Suburban Electric Railways.—The important decision of the Supreme Court of Pennsylvania against electric railways, regarding the right of eminent domain, is reprinted in the "St. Ry. Gaz.," March 30.

Connecticut Electric Railways.—An address by Judge Gager on behalf of the electric railways of the State, forming a reply to a recent address of Mr. Hall, is reprinted in the "St. Ry. Gaz.," March 30.

Street Railway System of Boston.—A long and complete article, illustrated with about 50 cuts, is published in the "St. Ry. Jour." for April, describing the construction and operation.

Lynn & Boston Line.—An illustrated description is published in the "St. Ry. Jour." for April.

Minneapolis-St. Paul.—The annual report is abstracted in the "St. Ry. Jour." for April.

Repair Shops.—The "St. Ry. Jour." for April contains an article by Mr. Merriam describing the design and equipment of a railway repair shop, including illustrations of the building and the tools.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electric Lighting Companies in Japan.—According to the "Elec. Friend" (Japan) for January, the dividends for the last six months of the preceding year declared by the companies are as follows: Tokio (steam) 7.5 per cent., Kioto (water-power) 15 per cent., Osaka (steam) 12 per cent.

Train Lighting.—Some details of the systems used in Denmark are illustrated and described by Mr. Bruun in the Elek. Zeit.," March 14.

Amortization.—The discussion of the subject is continued in the "Elek. Zeit.," March 14, by a communication from Mr. Pruecker.

Storage Battery Plant.—A private residence plant of a capacity of about 300 lamps and a few motors, the current being supplied from a distant station, is described and illustrated in the"West. El.," April 6.

Electric Lightship at Sandy Hook.—A brief illustrated description is published in the "Elec. Age," March 30.

WIRES, WIRING AND CONDUITS.

Sodium in Conduits.—Mr. Wright in the Lond. "Elec.," March 22, calls attention to a compound which he found on underground wires and which, several days after its removal, gave brilliant but minute flashes of light by drawing the finger over it; he suggests that it might have been sodium or potassium.

Mr. Voysey in the Lond. "Elec. Rev.," March 22, in reply to a recent editorial in that journal states that the energy with which sodium decomposes water produces sufficient heat to ignite the escaping hydrogen if the sodium is prevented from darting about on the surface of a sufficient quantity of water to cool it; metallic sodium as found in conduits could therefore produce ignition.

Grounded Neutral Wire.—To decide whether permission should be given in a certain city to grounding the neutral wire of a three-wire system, the question was submitted to the leading electrical society of Germany, whose report was favorable; the whole report signed by Messrs. Kapp and Slaby is published in the "Elek. Zeit.," March 14.

ELECTRO-PHYSICS AND MAGNETISM.

Duration of Lightning Flashes.—"La Nature," March 2, contains a short article by Mr. Guillaume in which he discusses the duration of an electric discharge. A spark produced suddenly is brilliant during a very short interval but fades away gradually, its total duration is very variable, depending upon circumstances under which it is produced; ordinarily the very luminous period extends over several hundred thousandths of a second, but Hertz has shown that the duration of the phenomena is so short that one has not been able to determine it; it is, however, much less than a hundred millionth of a second; a lightning discharge often seems longer but it is easy to be deceived in this. Photography as ordinarily applied does not prove anything regarding the succession of sparks from the same causes which it is reasonable to believe exist, as the air heated by the first discharge becomes a good conductor and offers a good path for a second spark; an impression of a light of short duration has been shown to be followed by a sensation of darkness, then by one of light and again by one of darkness, but a simple observation is not sufficient to prove the succession of discharges. Several photographs of lighting discharges are reproduced, one by Weber in which the camera was simply rotated by hand so as to describe the surface of a cone; it shows two parallel jagged lines connected by striations, some of which form complete eclipses between the two lines; another photograph shows a multiple discharge; in another by Mr. Trouvelot the camera was given a jerking motion in a horizontal plane, the image therefore showed numerous parallel jagged lines of different widths and shows either that the duration of the discharge was sufficiently long or that it was composed of numerous discharges in exactly the same path.

Electric Currents of High Pressure and Periodicity.—A paper by Mr. Swinton is reprinted with some of the illustrations of the apparatus in the Lond. "Elec. Eng.," March 22. He discusses the action of such currents and shows a number of well-known experiments, the currents used being those from the disruptive discharges of Leyden jars. He estimates that the duration of the discharge of the jars which he used was about one 50 thousandths of a second and the rate of oscillation about 200,000 complete periods per second, making about four complete oscillations for each discharge; the jars were charged with an alternating current; he calls attention to the relatively long period of rest between the discharges and criticises the term "high frequence" as applied to such currents because, although the periodicity is decidedly high during each discharge, the time of discharge is so short that the comparatively long intervals make the average frequence really not high at all; he furthermore believes that high frequence is not at all necessary to explain the effects produced (which effects are mainly those shown by Tesla), all that is necessary being impulses of exceedingly short duration. He describes a number of well-known experiments and discusses at some length the heating of an incandescent lamp filament by exceedingly small currents of this kind.

Transmission of Electricity through a Gas Surrounding a Conductor.—The paper of Messrs. Vicentini and Cinelli, abstracted, in the Digest March 2, is abstracted at some length in "L'Eclairage Elec.," March 2.

Resistance and the Discharge in a Mixture of Nitrogen and Hydrogen.—An abstract of the paper of Miss Fawcett from the "Proc. Roy. Soc.," vol. 56., p. 263, is published in "L'Eclairage Elec.," March 2.

Waves and Vibrations.—An abstract of the second lecture of Lord Rayleigh is given in the Lond. "Elec.," March 22.

Magnetic Rotary Dispersion.—A recent paper by Mr. Siertsema is abstracted briefly in the "Rev. Gen. Des. Sciences," Feb. 28; some curves and formulas are given showing the relation between the length of the wave and the rotation, for nitrogen, oxygen and air.

Electric Origin of Earthquakes.—The question whether earthquakes are due to violent electric currents between the earth's crust and the atmosphere is discussed in "L'Elec.," March 23; the theory was offered by Mr. Offern and was favored by Plante; it is believed that earthquakes are merely superficial.

Tesla's Inventions.—The "Century Mag." for April contains a long well illustrated article on "Tesla's Oscillator and Other Inventions" by Mr. Martin; it is written in a popular style describing the oscillator and a number of light effects, which latter are well illustrated, some of them by means of photographs made by their own light; among the light effects are those of the incandescence of a solid, phosphorescence, incandescence or phosphorescence of a rarefied gas and luminosity produced in a gas at ordinary pressure. He describes also effects with widely separated resonating circuits in one of which it is claimed that at least one-tenth of a horse power was transmitted across a space of some 20 feet into the bulb of a lamp without using any wires at all; other experiments show how lamps were lighted by currents passed through the human body; an experiment is described showing the disturbance of the earth's electrical charge.

Some other illustrations of the oscillators are reproduced with a brief description in the "Elec. Eng." and "Elec. Rev.," April 3, and one of them in "El'ty," April 3. In the former it is stated that the principle involved in the oscillator is that of "oscillating a coil or magnet with great economy of energy in an intense field and thus generating current on terms of very high efficiency and regularity as well as with marked diminution in size and weight of apparatus. The engine resolves itself down to a chest or cylinder for the working fluid and the piston for carrying the armature." There is a strong air spring in the top of the apparatus and the construction is such "that the engine is always in exact synchronism with the vibrations of this spring;" the engine varies the amplitude of the vibration but the period remains always the same; "the recoil of the spring is of course incomparably greater than the impulse received by it from the engine." Several distinct types are shown and briefly described, that of the more advanced form being as follows: "this minute machine had a capacity of 12 lights. It consisted of a small oscillator and a dynamo, the latter comprising a field magnet with its exciting coils and an armature merely of iron. The magnet had on its inside a number of pole projections upon which the induced coils were wound. The armature had projections of lesser number than those of the field. In this way the output of the dynamo was increased, by the number of teeth." It is stated that there is a preponderance of one impulse over the other creating virtually the effect of a direct or continuous current, but this is not described. With the latest form of oscillator which is illustrated, the frequency is 80 to 100 and the steam pressure 350 pounds, the steam admission being controlled by a small independent oscillator. In conclusion it is stated that "there can be no doubt that in this appliance we have a mechanism for the simultaneous utilization of steam and generation of current under conditions that must effect large economies in every direction; while it should also prove a powerful instrument for exhaustive research."

Velocity of Electric Waves.—A paper by Prof. Trowbridge and Mr. Duane is published in the "Am. Jour. of Sc." for April. Some time ago they suggested the following method of measurement: the size of a Hertz vibrator is increased and if necessary the shape changed until the period of oscillation is sufficiently long to be determined by photographing the spark; the length of the induced waves in a secondary circuit tuned to resonance with the vibrator is then measured and the quotient of the wave length by the time of a complete oscillation will be the required velocity. They arranged the apparatus so that the reaction should be wholly electrostatic; the method, which is described in detail, proved to be very successful; the average result is 2.816 multiplied by 10 to the tenth power; in the generally accepted value for the velocity of light, the constant is 2.998; they do not think it likely that the error in their determination is as great as the difference between the two values; their experiments are to be carried out more carefully.

Double Refraction of Electric Waves.—A paper by Mr. Mack from the "Ann. d. Physik. u. Chemie.," No. 2, p. 342, is abstracted briefly in the "Am. Jour. of Sc." for April. He found that by interposing pieces of wood between Hertz's well-known parabolic reflectors, the axes being inclined to each other, the electric waves can be doubly refracted; wood has a different structure along the direction of the fibres from that perpendicular to this direction, it is thus analogous to doubly refracting crystals. The same paper is abstracted briefly in the "Elec. Eng.," April 3.

Production of Kathode Rays.—A translation of the abstract of Mr. de Kowalski's paper (see Digest, March 23) is given in "Elec. Eng.," April 3.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolysis of Gold.—Mr. Keith's paper (abstracted in the Digest last week) is published in full with the illustration in the Lond. "Elec.," March 22. In the discussion which followed Mr. Vautin stated that Dr. Gore in the "Philosophical Transactions" in 1860 proved that mercury is electronegative to gold in a solution of cyanide of potassium and that Mr. Skene some time ago pointed out that gold was so electro-positive to mercury that it was dangerous to allow them to come in contact, as the gold was dissolved and the mercury was not; the same process had been used in a mine in Hungary for two years; experiments were carried out there with and without the mercuric cyanide and the results were in favor of mercury cyanide alone; of all the methods suggested he thought none were better than the practice of simply using zinc; if there is any free alkali present there is a great risk of forming alkaline sulphides. Mr. Swinburn favored going back to the simple process of using zinc shavings without all the complications of the electric process and he does not think that electrolysis is going to do much good in the recovery of gold. Mr. Crompton asked whether there was not considerable difficulty in keeping the porous pots in order, as such pots had given considerable trouble in an important copper process; he suggested that the results of a more quantitied character would not have been acceptable. Mr. Keith stated that he had never passed as much as 100 tons through the process, but he had used it to a sufficient extent to satisfy himself that the process was practicable; in the zinc process he believed that about 50 times as much zinc was used as was necessary; there was no difficulty in the use of porous pots. The subject is also discussed in the leading editorial in that journal, which however contains nothing new.

Mr. Andreoli in the Lond. "Elec. Rev.," March 22, remarked that Faraday would have been horrified if he had heard this paper read; he believes that there are some people who are ready to upset the elaborate equations and theories regarding the statement that the presence of oxygen is necessary for dissolving the gold; he believes that there is nothing particularly original in this mode of electro-deposition, and although its merits and advantages are exaggerated, it is no doubt far superior to and cheaper than the Siemens process, which is neither very good nor new; he suggests that there is nothing about the electrolysis of gold solutions in the paper. Mr. Fitzgerald in an article in the same journal also discusses the subject. He considers the paper open to objections and discussion; he discusses the question why such a poor solvent as cyanide of potassium is ever used when so powerful a solvent as chlorine is so readily available, the explanation of which is that gold in chloride solutions is electro-negative to almost every other metal; he also discusses the question whether potassium cyanate and not potassium cyanide is the real solvent of gold and doubts whether it is necessary to convert any cyanide into cyanate in order to promote the solvent action; other analogous questions are discussed.

Diaphragm of Soap.—According to "Cosmos," March 9, Mr. Kellner of Austria has patented the use of a diaphragm of soap for use in electrolysis. In separating substances by a diaphragm those which have an affinity for the material of the diaphragm traverse it more rapidly; in electrolyzing a solution of salt if the salt is placed in the anode portion and is forced to diffuse through the diaphragm the return diffusion of the caustic soda from the cathode portion is prevented almost completely; the phenomena can be explained by a sort of chemical repulsion between the soap and the salt solution or by a special affinity of the soap and the alkaline caustic; it is best to make the soap of the same alkali as that contained in the salt.

Electrolysis of Fused Salt.—The article of Mr. Andreoli is continued in "L'Elec.," March 23; the historical summary is continued; a table is reprinted from a paper by Mr. Braun giving the conductivity and other data of a number of fused salts, as also the fusing temperatures of the metals.

Cells with Fused Electrolytes.—An abstract of Mr. Swan's paper from the "Proc. Roy. Soc.," vol. 56, p. 56, is published with illustrations in "L'Eclairage Elec.," March 2.

Resistance of Electrolytes.—The "Lond. Elec. Rev.," March 22, calls attention to an article by Prof. Kohlrausch in the "Zeit. Phys. Chem.," 15, p.126, in which he justifies the use of his well-known method of determining the resistance of electrolytes; he believes that the telephone method with alternating currents can be used for much higher resistances than those examined by Mr. Wildermann and is more convenient.

Electrochemical Analysis.—The Lond. "Elec. Rev.," March 22, recommends a paper by Mr. Bottmann in the "Monatshefte fuer Chemie," 15, p. 280, in which he describes the method of estimating the halogens electrolytically. Also a paper by Mr. Oettel in the "Zeit. f. Elec. u. Elektrochem.," 6, p. 192, in which he describes the electrolytic determination of nickel and cobalt.

Plating with Cadmium-Silver Alloy.—The Cowper-Coles process is described briefly in "La Nature," March 2; the bath is made of a solution of the double cyanide of cadmium and potassium and the anode of the alloy of cadmium and silver, containing say 7.5 per cent. of cadmium; the cadmium hardens the silver.

Electric Tanning.—The Lond. "Elec. Rev.," March 22, recommends very highly (but does not abstract) a paper by Mr. Groth in the "Scottish Leather Trader" (no date given); the paper was read quite recently and shows the superiority of the Groth system. (According to a recent statement in a German journal the use of this system in a large installation in Switzerland was abandoned as it was too expensive.)

UNITS, MEASUREMENTS AND INSTRUMENTS.

Mean Spherical Intensity of Sources of Light.—An article of some length by Mr. Blondel is begun in "L'Eclairage Elec.," March 2. He defines luminous flux and discusses the formula for it; he describes an apparatus for measuring the intensity of a light in different directions in a vertical plane; all those in which mirrors are used at different inclinations combined with the displacement of the source of light are open to criticism; in the method which he describes, first suggested by von Hefner Alteneck, these objections are overcome; an illustration is given, the light itself remains fixed and its direct rays are intercepted by an opaque screen between it and the photometer; an inclined mirror is arranged so as to make a fixed angle with an axis drawn from the light to the photometer, this mirror being then revolved around this axis, thus reflecting the light emitted in various angles in a vertical plane into the photometer, the inclination of the mirror with respect to the beams of light, and the distance from the light to the photometer being thereby always maintained constant; this latter distance should be comparatively great, the loss in the mirror can be measured by replacing the lamp with a standard candle. This method has given very good results in practice and is the one at present used at the Central Laboratory in Paris. He discusses the objections to this method, one of which is the large number of measurements which must be taken and it is not sufficiently accurate, the errors being about 20 per cent.; he promises a description of another method which is more accurate.

Measuring the Figures of Merit of Telephone Annunciators.—An article by Dr. Tobler in the "Jour. Teleg.," Feb. 25, describes a simple method for comparing annunciators, and contains the results of some comparative tests. The figure of merit is usually given for continuous currents but he believes it should also be obtained for alternating currents; the difficulty in the way of such measurements is that an alternating current ampere meter for such small currents is a very expensive instrument; he therefore used a Froment motor driven by four Leclanché cells giving 3.6 volts and 0.6 amperes, which was made to operate an interrupter connecting the testing circuit alternately with the two ends of a series of cells, the middle point of which was connected to the other end of the circuit, thus generating an alternating current from a battery; a continuous current milliampere meter is inserted in one branch of the battery circuit and an equivalent resistance in the other, the amperemeter therefore measures one half of the current. The results seem to show the superiority of the annunciator made by the Western Electric Manufacturing Company.

Induction in Cables.—A paper by Dr. Breisig is begun in the "Elek Zeit.," March 14; in the present portion he describes measurements which were made with coils of double wires.

Heating of Wires.—A paper by Dr. Muellendorf on safety fuses is reprinted in the "Zeit. fuer Elek.," March 1 and 15; it appears to deal almost entirely with the heating of wires and contains a number of simple formulas.

Galvanometer.—The Sullivan universal galvanometer of the D'Arsonval type is described and illustrated in the Lond. "Elec. Rev.," March 22; it is claimed to be the only form of moving coil galvanometer which can be used at sea.

Harmonic Analyzer.—A Physical Society paper by Mr. Yule is abstracted briefly with an illustration and the theory, in the Lond. "Elec.," March 22; the instrument is practically the inverse of the one invented by Prof. Henrici.

Instrument for Measuring Difference in Phase.—Major Cardew's paper of the "Proc. Roy. Soc.," vol. 56, p. 250, is abstracted in "L'Eclairage Elec.," March 2.

Electrical Standards.—The specifications for the practical application of the definitions of the electrical units referred to in the Act of Congress of July 12, 1894, and which were adopted by the National Academy of Sciences Feb. 9, are published in full in the "Am. Jour. of Sc." for April, including an illustration of the standard cell.

Tests of the Guelcher Thermoelectric Battery.—A translation of the article with illustrations, abstracted in Digest, Dec. 22, is published in "Elec. Rev.,' April 3.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telegraphic Newspaper Printing.—The "Zeit. fuer Elek.," March 15, describes the system of Messrs. Meray-Horvath and Roza, with which experiments are being made in the city of Gráz, Austria. The system is briefly as follows: the news is received at a central station, and is transcribed by an instrument like a typewriter which prints one copy in typewritten characters and another copy in corresponding dots and dashes on the strip of silvered paper; the speed of this machine is said to be ten times as great as that of a compositor setting type by hand, and is estimated to be 200 to 300 lines per hour (presumably referring to a newspaper column); this copy is then corrected and the same corrections made on the paper band; by means of the latter it is then transmitted telegraphically by an automatic apparatus to as many receiving stations as desired, at which stations the matter is received in the same form on a band of paper; the speed of this apparatus is said to be about 500 lines per hour; these bands as received pass through another machine which automatically presses a type, corresponding to the letter of the Morse signal, into a plastic mass, into which stereotype metal is then poured forming the plates from which the paper is reprinted. It is claimed that the saving in the latter machine is 86 per cent. as compared with hand setting; the price of the latter machine is said to be about $17,500 to $25,000 while that of machines for sending the messages telegraphically is only about $850; a machine can deliver 120 lines per hour.

Automatic Telegraph Transmitter.—The Schklar system is described and illustrated in the "Zeit. fuer Elek," March 15; the transmitter has a keyboard like a typewriter, the lever for each key having make-and-break contacts corresponding to the particular letter, according to the Morse alphabet; on depressing a key the corresponding signals are sent to line automatically; the apparatus is said to be simple and practicable and insures greater accuracy in transmitting.

Telegraph Poles in Japan.—According to an article in the "Elec. Friend" (Japan) for January the number of poles belonging to the government is 272,058 for telegraph wires, and 12,633 for telephone wires; almost half of these are "bouchalized" (treated with copper solution), the average life of which in that country is about 15 years, while that of the poles not treated is 7.52 years; the poles are of cedar, which is very plentiful there.

Telegraph Instruments in Japan.—According to "Elec. Friend" (Japan) for January the number of instruments in Japan at the end of 1894 was as follows: Morse inkwriter 1,143, quadruplex 6, duplex 22, Wheatstone automatic 8, telephones 33.

Government Telephone Lines in Austria.—The complete list of the lines and number of subscribers is published in the "Elek. Zeit.," March 14.

Telephone Reminiscences.—An interesting and historical retrospect taken from a recent subject by Prof. Hughes is published in the Lond. "Elec." and "Elec. Eng.," March 22.

Telephone Rates for New York City.—The "Elec. Eng." and "Elec. Rev.," April 3, publish a table of the new rates based on the number of messages.

New York State Telephone Bill.—Some criticisms of Mr. Sterne's pamphlet are given in the "Elec. Rev.," April 3.

Automatic Block System.—The Hall system used between Philadelphia and Jenkintown is described and illustrated in "Eng. News.," April 4.

MISCELLANEOUS.

Developing Muscles by Electricity.—"Cosmos," Jan. 19, contains an article by Mr. Gil reprinted in full in the "Rev. Int. d'Electrotherapie" for January in reply to a short article which was reprinted in numerous American papers (copied we believe from the Digest, Aug. 4, and THE ELECTRICAL WORLD, Aug. 11, p. 122); he describes the original experiments more fully (see also THE ELECTRICAL WORLD, Nov. 24, p. 544); they were made by Dr. Debedat in Bordeaux to determine the question whether the number of muscular fibres was increased or whether the special properties of the muscular tissue were developed. Experiments were made on the left thigh muscles of six similar rabbits during their growing period; they were submitted to the action of electric currents during 20 consecutive days the treatment lasting four minutes, during which the applications were made regularly at the rate of 30 per minute; the muscles on only one side of the animal were treated, those on the other side being left normal for comparison; during the whole time the animals were confined so that they could not move. The conclusions were as follows: the action of electricity on muscular nutrition is complex; in the form of continuous currents it acts differently than to excite contraction; so far as it excites contraction its action is comparable to that of ordinary exercise, over which it has important advantages from a therapeutic standpoint; moderate muscular exercise caused by rhythmic faradic currents, representing natural exercise, produced very marked effects; excitation by rhythmic galvanic currents in the form of shocks produced a favorable action, but the action is less than that produced by faradic currents; prolonged tetanization by faradic currents produced an overworking of the muscle followed by a wasting away of the tissue; a static spark produced no permanent modification. In conclusion he states that contrary to the opinion of certain authors, these experiments show that the action of electricity is a real one; they also show what mode of electrification is best to produce muscular contraction; the results are of great importance. An extract from the paper is also published in "L'Elec.," March 2.

Calcium Carbide and Acetylene.—A recent lecture by Dr. Frank on the production of acetylene and its application in the manufacture of illuminating gas, alcohol, etc., is reprinted in the "Elek. Zeit.," March 7. In an editorial in the same issue it is claimed that the fear that this gas will become a powerful competitor of the electric light is groundless as is shown by the stock quotations of the electrical companies, when this invention was made public; it considers that stock quotations may be relied upon as a means of prophesying; electrical companies need therefore have no fears; the use of pure acetylene for illuminating purposes meets with very important objections of which two are mentioned, it cannot be used in the same burners and the present gas works represent so much capital that they would not be rebuilt immediately for the manufacture of acetylene. In order to compete with the Welsbach company, acetylene, for the same illumination, would have to be sold for about half the price of ordinary illuminating gas, and it is hardly likely that it can be made at that price; if therefore the Welsbach light has not been able to injure the electric light, acetylene will be even less capable of doing so. It is claimed that one of the chief values of the carbide lies in the fact that it may be used as a carrier of energy.

Disintegration of Organic Tissue by High Tension Currents.--A recent paper by Dr. Parsons is abstracted briefly in the Lond. "Elec. Rev.," March 22. He describes investigations undertaken to ascertain the capabilities of electricity as a destructive agent in the treatment of malignant diseases; his experiments were conducted with high tension currents which reduced the heating and caustic action and increased the destructive action enormously; with freshly killed beef the structure was completely destroyed; with a lower pressure, muscular fibres were broken up and the destruction extended through the whole path of the current. Dr. Jones, who made similar experiments, claims that the destruction is due simply to the heat, as there is no other possible way in which the energy could expend itself on such a conductor. Dr. Horrocks believes that if it can be shown that living cells are broken up by an electric current it is conceivable that this method has a future before it; if the tissue of a tumor for instance could be broken up by electric currents one might succeed in setting up changes which would result in the absorption of the tumor or the exudation.

Electric Currents in the Living Body.—Mr. Hattatt in a communication to the Lond. "Elec. Rev.," March 22, considers that the recent lecture of Prof. Horsley (see Digest, March 23, 30), is hardly up to date. He quotes at some length from a paper by Drs. Bleyer and Weill read before the American Electrotherapeutic Association in September, 1893, which he claims should be read by all interested.

Death by Electricity.—According to the "Rev. Int. Electrotherapie" for December Dr. D'Arsonval stated that it is generally believed that alternating currents are more dangerous than continuous; it is quite the contrary, however; accidents with continuous currents are almost always fatal because of death being due to electrolytic phenomena, as the body is not a homogeneous conductor and polarizing actions are produced not only at the points of application but also at every surface separating two different tissues traversed by the current. Mr. Chaubeau in reference to resuscitation stated that there was a great difference whether the subjects were in a state of syncope or whether they were asphyxiated, in the former case resuscitation may take several hours while those in the second "at the end of a relatively very short time, which does not exceed more than several minutes, resist all efforts at resuscitation."

Electrotherapeutics.—A translation of the paper of Mr. Meylan on "Utilizing Electric Lighting Circuits in Electrotherapeutics," which was abstracted in the Digest, Dec. 1, is published in the Lond. "Elec. Rev.," March 22, with the illustrations.

Electrotherapeutics.—The French monthly "Revue Internationale d'Electrotherapie" contains numerous interesting articles on this subject which, as they pertain more directly to medical science, will not be referred to in these columns unless they are thought to be of general interest.

Extracting Metallic Particles from the Eye.—In a note in the "Rev. Int. Electrotherapie" for January Mr. Sulzer states that an electromagnet can be applied in two ways for extracting particles of iron from the eye, either by placing a strong magnet in front of the eye or if this does not suffice then by means of a pointed magnet introduced into it; with the magnets formerly used in the second method, one pole was used, directly, the other pole being held by the operator, but the attractive force is then very feeble; a much greater force may be obtained by making the magnet in the form of a horseshoe the two pointed poles coming very close together and separated by a non-magnetic metal.

Electro-Culture.—"Cosmos," March 23, abstracts briefly from "Genie Civil" the results of some experiments of Mr. Luehnenschloss with the apparatus called geomagnetifere (not described); in a potato field those plants which were treated weighed 11¼ per cent. more and the richness in starch was 23.7 to 20 7 greater; during another year the treated plants yielded 10 per cent. more potatoes in quantity and of a superior quality.

Electrical Industries.—According to Mr. Shoolbred the amount of capital engaged in this industry, not including telegraphy, is as follows: England $100,000,000, France $150,000,000, Germany $200,000,000, Austria, Italy, Spain and Switzerland $180,000,000; Russia, Sweden, Norway and Denmark $50,000,000; United States $450,000,000, Canada and other American countries $50,000,000, making a total of about $680,000,000 in Europe and $500,000,000 in America.

Educational.—The article by Mr. Wilke mentioned in the Digest last week is concluded in the "Zeit. f. Elect. u. Electrochem.," March 15.

Maxim.—"Cassier's Mag." for April contains a long, well illustrated article by Mr. Smith on "Some Features of the Inventive Career of Hiram S. Maxim;" although dealing mainly with his other inventions some reference to those in the electrical field is given.

Scientific Foundations of Electrical Engineering.—A paper by Mr Bailey read before the Northern Soc. of Elec. Eng. is reprinted in full in "El'ty," April 3.

Manual Training.—A second article by Dr. Henderson on manual training is published in the "Pop. Sc. Mo." for April.

Note.—The number of journals which were examined and abstracted for this department during the first three months of the present year is as follows: foreign 262, American 188, total 450, or nearly 35 journals per issue.

New Books.

THE TELEPHONE HAND-BOOK. By Herbert Laws Webb. Chicago: Electrician Publishing Company. 146 pages, 128 illustrations. Price, $1.

In the preface to this useful little book the author states that its object is to meet a demand for a practical book on telephone working and management, and that with the exception of a few descriptions the matter is based entirely on American practice.

The first several chapters give in simple language the theory of the telephonic transmission of speech and of the telephone microphone and accessories, following which are a dozen or more chapters descriptive of numerous forms of telephone receivers and transmitters. A number of chapters come next relating to batteries and their management, magneto bells, switches, line construction, circuits, installations, inspection and maintenance, etc. Other topics treated are the condenser in telephony, electromagnetic retardation, long distance and duplex telephony, simultaneous telegraphy and telephony, exchange working, party lines, the bridging bell, etc.

We have no hesitancy in saying that the work is by far the best practical treatise on the modern practice of telephony yet written, and we can recommend it with confidence to those engaged in practical telephone work, as well as to students and others desiring to obtain an intelligent knowledge of the subject. We regret to add that the mechanical execution of the book is far from being in keeping with the value of its contents.

The National Electric Light Association has published in book form the proceedings of the Washington Convention, held in February, 1894. The binding and typographical work are of the very acceptable style which characterized the previous volumes of proceedings, and the book is given, by Mr. C. F. Scott's paper on the transmission of power by polpyhase currents, a permanent value which the average convention record could not be expected to attain. The illustrated lecture of Messrs. Martin and Stieringer also gives special interest to this volume of proceedings.

Public Reception of the Edison Electric Illuminating Company of Brooklyn.

On April 3 the officers and directors of the Edison Electric Illuminating Company of Brooklyn gave their annual reception, which was rendered of more than usual interest by the opportunity given to inspect the new machinery in its First District station in Pearl street.

In order to add to the interest of the occasion a large number of very interesting exhibits illustrating the progress of electrical science were shown. The guests upon entering the building were ushered into the new Otis electric elevator, which carried them to the third floor, where they entered a large tiled main hall in which was located an exhibition platform. Here were seen in operation electric motors, incandescent lamps of different candle power in various colors, and every kind of electric cooking utensil. One of the exhibits here which attracted particular attention was the Quimby hydraulic elevator pump by means of which it is possible to operate the present hydraulic apparatus by electricity far more economically than by steam pumps, and it is therefore fast finding favor among users of elevators.

The lecture room was given over to a large number of novel exhibits, including a new direct-connected elevator outfit, built by the A. B. See Manufacturing Company, in full operation. With this elevator system energy is only consumed when it is in actual operation. There are already some hundred of these elevators in use in the city of Brooklyn.

Dr. Hutchinson, of the Long Island College Hospital, kindly furnished his services for the evening to illustrate the use of medical apparatus. Among the apparatus shown were a private collection of Dr. Hutchinson and devices by the Monarch company, Messrs. J. C. Vetter & Co., and the Meyrowitz Company. Mrs. Lempke, the well-known lecturer, illustrated the use of different electric cooking utensils, of which a very large number were on exhibition. This excited great interest among the lady visitors, who saw meat roasted and cakes baked within a few feet without the usual accompaniment of distressing heat.

Among the exhibits which appealed strongly to the ladies was that of a piano operated by an electric attachment made by the Automaton Piano Company. This attachment can be fitted to any ordinary piano and renders it possible to produce the most difficult music without human aid.

In the meter room the Edison electrolytic meter was explained to the visitors.

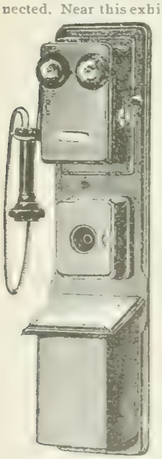
The guests were taken along the gallery in front of the large distributing switchboard, and the various meters and switches for controlling the underground circuits and regulating the E. M. F. were explained. Much interest was manifested in the new plant, which is described in another column, particular curiosity being manifested as to the "boosters."

The space in the engine department left for future machinery was occupied by a number of exhibits, including one by the De La Vergne Refrigerating Company. With the process of this company employing electric motors it is possible to furnish cooling power and ice at much less cost than by the older methods. On the same floor was an exhibit of the Edison street arc light system, which has recently been put in such extensive use in the streets of Brooklyn. The exhibit included the automatic clock switch used for turning on and off the lights, as well as a model of the underground system of service mains to which the pole was connected. Near this exhibit was one of the water pail forges, which excited much surprise among the visitors, who saw the smith heating his iron by simply dipping it in water.

Another exhibit of interest to the ladies was a sewing machine run by an electric motor and operated by Mr. Ellis who did a large amount of fancy embroidery upon thin material. The General Incandescent Arc Light Company of New York had an exhibit of low tension arc lamps, including a variety of ornamental designs for inside lighting.

The officers of the Illuminating Company are Mr. Ethan Allen Doty, president; Mr. Royal C. Peabody, secretary and treasurer, and Mr. W. S. Barstow, general superintendent.

Aluminum Diaphragm Telephone.


New Telephone.

The new telephone herewith illustrated is being introduced by the Pittsburgh (Pa.) Telephone Company. The feature of the instrument is the compound aluminum diaphragm, which is claimed to give the most perfect results so far obtained. With this diaphragm it is said to be possible to carry on conversation eight to ten feet away from the transmitter and at four to six inches it is said to be equal to the best long distance transmitters. A new non-infringing receiver hook is another feature of the instrument. The outfit is made in the most familiar form in order not to confuse any one using it for the first time. The aluminum diaphragm is very resilient and will respond to vibrations as low as 16,000 and as high as 24,000 per second. It withstands oxidation and exposure to weather and is highly polished and tempered.

These telephones are not an experiment, but are now in use on grounded circuits from 58 to 130 miles in length. In one instance 13 instruments have been operated in series on grounded circuit 116 miles long, and successful results are claimed to have been obtained on a metallic circuit 300 miles long.

Some Improved Electric Search Lights.

Although electric search lights have long been included by the navy in the category of indispensable equipment, their use in commercial marine service has been restricted by reason of the great cost and the necessity of skilled attendance. These objections are said to be entirely removed in the Rushmore and the Huntington search lights, manufactured by the Rushmore Dynamo Works, Jersey City, which are now extensively used in all classes of land and marine service. A few of the most recent types of the Rushmore lights are shown in the accompanying illustrations.

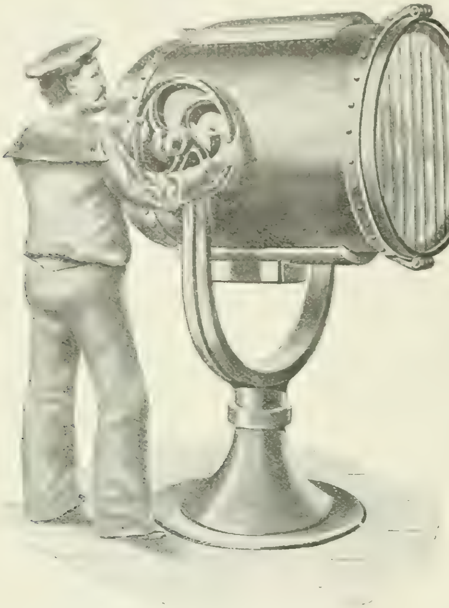


Fig. 1.—Improved Search Light, 40,000 Candle Power.

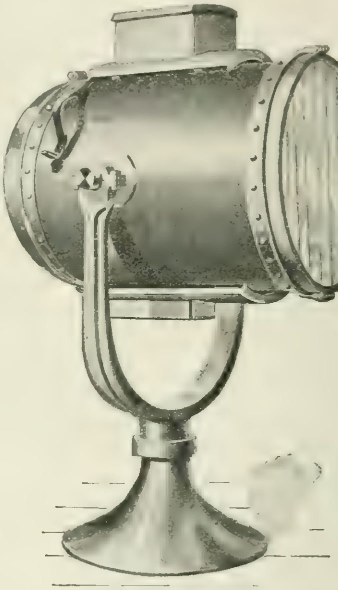


Fig. 2.—Improved Search Light, 12,000 Candle Power.

Fig. 1 shows the lens mirror projector designed for large steamships and places where a very powerful light is required; this type is built in sizes from 15,000 to 40,000 cp. Fig. 2 shows the standard plain light for smaller vessels, where a cheaper and less powerful light is required, and Fig. 3 is the standard pilot-house light, specially designed to be placed on top of the pilot-house, where it can be operated by the man at the wheel.

The Rushmore works also makes the well-known Huntington lights, which are built to operate on any direct-current circuit—constant current or constant potential. The feeding mechanism is of liberal proportions, and the feed is not affected by the position of the light when used for flashing signals on the sky at night. The construction is such that an ordinary mechanic can make repairs when required.

These lamps are now extensively used in conducting engineering work at night, and a large number have recently been sold to electric railways for use in attracting crowds to places of amusement along their lines.

Telephone Troubles.

The question of the alleged disturbance of the telephone service, says the London *Electrician*, has been discussed with the representatives of the National Telephone Company, and as a result, the following report has been submitted by Mr. Dane Sinclair, its engineer: "With reference to the disturbance on our wires, caused by the circuits of the arc lighting at Portsmouth, I have now the result of the test made on Saturday, and it proves conclusively that, if the corporation so arrange their circuits as to balance the amount of work done by each conductor, the trouble caused to our subscribers will disappear; and as this means that it would only be necessary to put an equal number of lamps, arranged alternately, on each of the two conductors forming the cable, the work, in my opinion, ought to be done at comparatively little cost."

A Compact Air or Gas Compressor.

We illustrate below an air or gas compressor built by the Philadelphia Engineering Works, Ltd., Mifflin street, Philadelphia, which is particularly compact and simple in design. It will be noticed that the air pump is set tandem with a Corliss engine, giving the combination the appearance of an ordinary tandem compound engine. There is a specially heavy box frame under both cylinders, giving continuous contact with the foundation with a view to obviating all vibration.

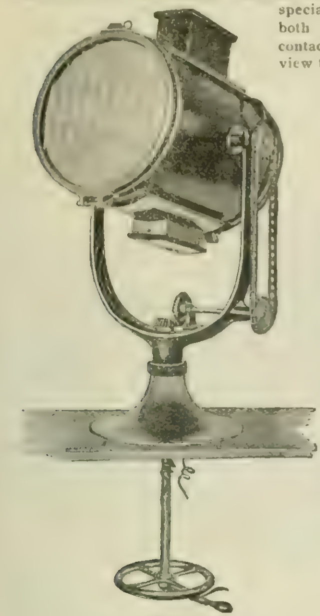
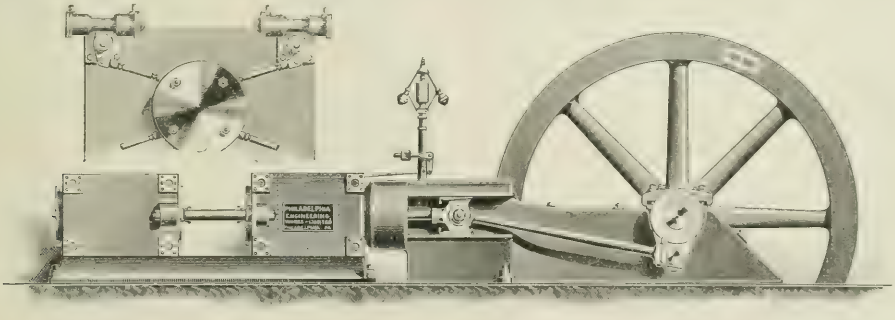


Fig. 3.—Pilot House Search Light.

The valves are all operated by one eccentric, a connecting rod being used to transmit the motion of steam chest wrist-plate to the wrist-plate controlling the pump valves. The inlet valves of the pump are operated coincidently with the exhaust valves of the steam cylinders. The outlet valves are closed positively by the valve gear at the moment the pump piston reaches the end of its stroke, but the gear has no control over the opening of these valves, and they remain closed until the pressure within the pump attains a value equal to that of the pressure in the mains. This is accomplished by giving the small cylinders on the pump valve bonnet a greater diameter at one end than at the other and connecting the smaller end with the discharge main, and the larger end with the pump cylinder. When the pressure in the pump reaches that in the main the preponderance of force on the pump side of the valve, due to the difference in area between the two ends of the small valve cylinders, causes the valve to instantly open wide. There are no catches, hooks or springs; the valve is left closed by the valve gear, and reopened by the pressure within the pump cylinder.



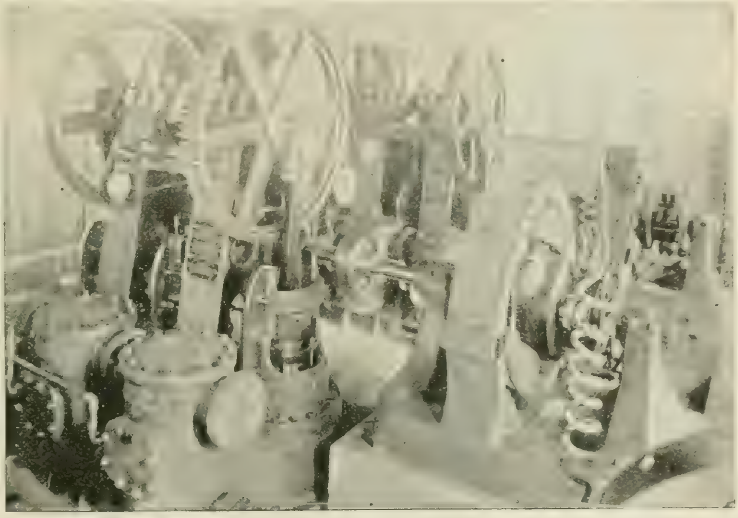
Philadelphia Air or Gas Compressor.

The smaller sizes of these pumps are guaranteed to work well up to 100 revolutions per minute.

For excessively high pressures the pumps are compounded, one pump receiving the fluid and compressing it into a cooling receiver from which a smaller pump takes it and brings it up to the ultimate pressure.

Electric Pumping Station.

The accompanying engraving illustrates a complete electrical pumping plant for domestic and fire service, which has been installed at De Kalb, Ill., by The Gould Company, of Chicago. The installation consists of a 10-inch drilled well from which water is drawn by a deep well pump driven by a 30-hp electric motor. The water from this pump is discharged into a reservoir near the pumping station, from which it is pumped into the mains by two 10″ x 12″ Goulds pumps, also operated by electric motors. The mains are so arranged that all water not consumed during the time of pumping is carried to a standpipe from which it goes to the mains when the pumps are idle, giving a constant flow. The pumps are of the triplex pattern, having three pistons 10 inches in diameter with 12-inch stroke, and are directly connected to a 70-hp multipolar slow-speed motor by means of rawhide pinions. At 43 strokes per minute the capacity of each pump is 500 gallons. For domestic service the pumps work against a pressure of 60 pounds, but are capable of working against a pressure of 125 pounds for fire service. An automatic device is used for closing the standpipe connections from the mains in case of fire. As the capacity of these pumps is far in excess of the needs of domestic duty, they are used on alternate days so that both pumps may easily be kept in good working condition. In case of fire both pumps may be employed, giving a combined capacity of 1,000 gallons working against a pressure of 125 pounds.



An Electric Pumping Plant.

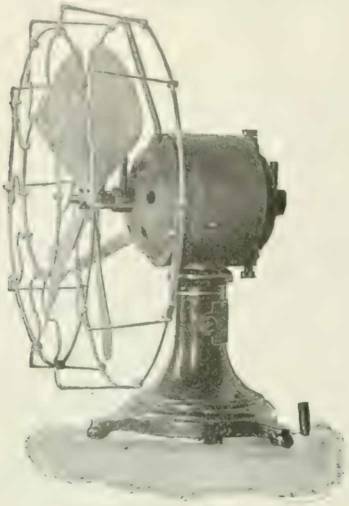
The current to operate the motors is furnished by the De Kalb Electric Company, being transmitted from the power station to the pumping station, a distance of 3,000 feet. Five feeders are used, and three feed wires, non-interference being insured by the use of duplicate pole lines. This arrangement of wiring gives complete control of the motors, thus rendering it possible to start or stop them at a moment's notice.

In the contract between the city of De Kalb and the De Kalb Electric Company the latter assumes all care and attention of the machinery in consideration of a price of four cents per 1,000 gallons of water pumped.

This contract is advantageous to the city in many ways, but especially in that the city has to assume no responsibility of the expense or maintenance of the plant.

New Riker Motors.

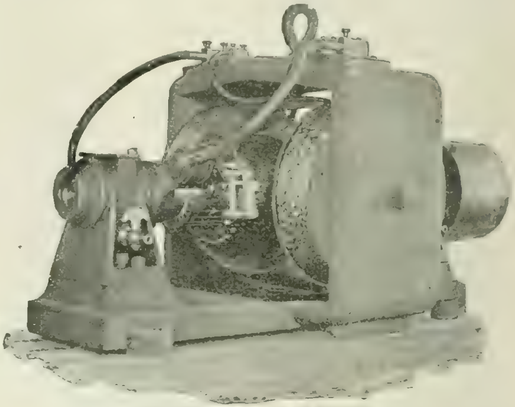
The fan motor which we illustrate below has been brought out this season by the Riker Electric Motor Company, of 45 York street, Brooklyn, and possesses several improvements over last year's type. The parts of the machine, which are interchangeable, are thoroughly protected from dust, though easily accessible. The body of the motor is made of cast steel and the base and bearings of cast iron. A variable resistance, enclosed in the base, enables one to run the fan at different speeds, ranging from 900 to 1,800 revolutions per minute. The fan is 12 inches in diameter and 1,800 revolutions the motor is said to require ¼ ampere at 120 volts.



1895 Riker Fan Motor.

A new type of bi-polar machines made by the same company is also illustrated herewith. This form is used for machines of from ¼ to 7½ kilowatts capacity. The outer magnet frame and base are cast in a single piece of steel; the magnet cores are cylindrical within the coils, but provided with pole shoes, and are bolted to the frame.

The armature is of the toothed drum type, and all details are thoroughly worked out. The best material and workmanship are embodied throughout in the construction of the machines.

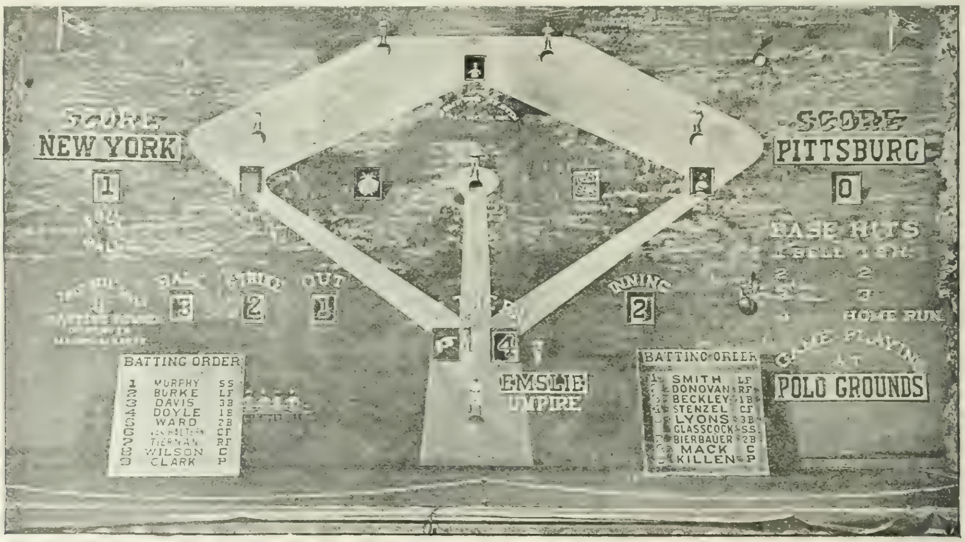


New Bipolar Riker Motor.

Baseball Electrically Reproduced.

The accompanying illustration gives an excellent idea of the Compton Electric Baseball Reporter, invented by Melville D. Compton, Postal Building, New York. As the cut shows, a baseball field is painted on a curtain, and apertures are left in the curtain at each playing position and under the words "Score," "Ball," "Strike," Out," and "Innings." The two teams are distinguished by colors; thus if New York is white and Pittsburgh brown, when New York is at the bat the round apertures under the fielders will be filled by a brown disc, and the other apertures are backed with white. The illustration shows New York in the field and Pittsburgh at the bat. The number at the right of the home plate indicates that player No. 4 is batting, while the numbers at the other apertures outside the diamond show that the inning is the second, the man at bat has had three balls and two strikes and one man is out. The square apertures near the bases indicate a man each on first and second. Should the batter knock a foul a buzzer on the left indicates the fact; if a base hit is struck the bell on the right makes it known, and the batter is represented by a figure in the square hole near the base when he reaches it. When a fly is struck a large "blue-bottle" appears at the opening between the pitcher and third base.

The contrivance is manipulated by an operator who is in communication with the grounds and receives by telegraph the necessary information throughout the progress of the game. It was shown in actual practice at the Standard Theatre last summer, where the series of games played on the Polo Grounds by the New Yorks was followed by an enthusiastic and appreciative audience.



Electric Baseball Bulletin.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, April 6, 1895.

THE RECENT FLURRY in electrical stocks has spent itself, and the principal stocks have continued to steadily recede from the exalted points attained week before last. General Electric has fallen off 2¼, Westinghouse 1½, Electric Storage 1, and American Bell 10, from last Saturday's closing prices.

METROPOLITAN TRACTION continues to afford some little excitement, and to draw forth numerous hypotheses as to the why and wherefore of its behavior. The stock broke to 83½ at the first of the week, and then rallied to 88¼. There has been considerable pressure brought to bear upon the management with a view to having a detailed statement of the company's affairs made public, but without avail. President Widener and Secretary Warren maintain that the company has earned every dividend that has been paid, and that its affairs were never in better shape than now. It is said that the antagonism proceeds chiefly from the firm of Chas. D. Barney & Co.

THE STANDARD TELEPHONE COMPANY, capital stock $160,000,000, the existence of which has just leaked out, claims to be in position to give American Bell serious competition. Thurlow Weed Barnes is president of the new concern, and the directory is a very strong one. Detailed information is given in other pages of this issue.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	97¼	98½
" " " Brooklyn	100	..	108
" " " Boston	100	..	..
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	29½	..
General Electric	100	33¼	33⅜
General Electric, pref	100	63	66
Westinghouse Consolidated, com	50	34	34¼
" " pref	50	51	52
BONDS.			
Edison Electric Ill., New York	100	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co. deb. 5s	100	..	90¼
TELEGRAPH AND TELEPHONE.			
†American Bell Telephone	100	182	..
American District Telegraph	100	30	40
American Telegraph & Cable	100	89	91
Central & South American Telegraph	100	117	120
Commercial Cables	100	137	..
Erie Telephone	100	51	51½
Gold & Stock Telegraph	100	105	
New England Telephone	100	71	72
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63½	
Western Union Telegraph	100	86⅝	86⅞
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	15	15¼
Binghamton RR. com	100	100	..
Brooklyn Traction	100	9	11
" " pref	100	..	53
Buffalo St. Ry	100	66½	69
Cleveland City Ry	100	68	70
Cleveland Electric Ry	100	59	60
Chicago City Ry	100	305	315
Columbus St. Ry	100	46	49
Consolidated Traction of N. J	..	30	33
Electric Traction, Philadelphia	50	78½	79
Long Island Traction	100	7½	8¼
Louisville St. Ry. com	100	37	39
" " " pref	100	87	88
†Metropolitan Traction, Philadelphia	100	87½	87¾
New Orleans Traction	100	15	18
" " pref	100	56	60
North Shore Traction	100	..	..
" " pref	100	74	83
People's Traction $30 pd	25	55¼	55½
‡Philadelphia Traction	50	79¼	80
Rochester St. Ry	..	38	..
Union Ry. (Huckleberry)	100	112	115
West End, Boston	100	63	63½
" " pref	100	87½	..
Worcester Traction	100	..	13
" " pref	100	77	80
BONDS.			
Buffalo St. Ry. 1st con. 5s	100	101	..
*Binghamton Railroad Co. 5s	100	99	100
*Columbus St. Ry. 1st 5s	100	9	..
Rochester St. Ry. 1st. 5s	100	95	97
*Union Ry. 1st. mtge 6s	100	105	108
*Westchester Electric 1st. mtge. 5s	100	98	101

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* With accrued interest.

† Ex-div.

‡ Ex-rights.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 BROADWAY, NEW YORK, April 8, 1895.

MRS. SCHUYLER S. WHEELER, wife of Dr. Wheeler of the Crocker-Wheeler Electric Company, died on Monday of this week after an illness of several months. Dr. Wheeler will have the sincere sympathy of the entire electrical fraternity in his grievous affliction.

MUNICIPAL OWNERSHIP.—The New York State Assembly has passed a bill requiring the submission of the question of municipal street railway ownership to ballot by the people. At the same session a resolution was passed ordering a sweeping legislative investigation of the condition and management of street railways, surface and elevated, now operated within municipalities.

ELECTRICITY AND THE NEW YORK CENTRAL RAILWAY.—President Depew proposes to forestall the Ely electric railway between Buffalo and Niagara by the adoption of electricity for motive power on the lines of his company between these places. It is proposed to run the trolley cars between the schedules of steam trains. There is also said to be a big scheme on foot among the New York Central capitalists to purchase all the water powers on the Black River between Carthage and Dexter, including those in Watertown, for the purpose of utilizing them in the generation of electricity. The electricity is to be used as a motive power on the Vanderbilt railroads in Northern New York.

THE BROOKLYN CITY AUTHORITIES have forwarded to Albany a bill requiring the immediate equipping of electric cars with fenders. It provides that "the Mayor, the Commissioners of Police and Excise, and the Commissioner of City Works shall proceed to investigate in such manner as they deem best as to the style or plan and material of safety fenders, to be used upon the cars of the surface street railway companies operating cars by electricity in the city of Brooklyn. Such style or plan or material shall be such as, in the judgment of the officers will afford the best protection against injury from the operation of such cars, and shall include both front and wheel guards." After a selection of a fender has been made, the companies are to be informed, and within three months every road in the city must equip its cars, front and rear. Any company failing in this will be liable to a penalty of $100 for each and every car not so furnished and provided. The officers of roads not promptly complying with the law shall be guilty of a misdemeanor.

PITTSBURGH NOTES.

PITTSBURGH, APRIL 6, 1895.

THE OHIO VALLEY ELECTRIC LIGHT & POWER COMPANY, of Avalon Pa., has received the contract for lighting the borough of Bellevue.

THE SECOND AVENUE TRACTION COMPANY of this city has completed its new power house at Glenwood in the Twenty-third Ward, and the additional power has given the company much needed facilities for the rapidly growing traffic on its lines.

AN ORDINANCE has been presented in Councils of this city having for its object the placing of electric light and telephone wires under ground. A similar measure was adopted some years ago compelling electric light and power companies to place their wires under ground in the lower portion of the city, but the present measure is of a more extensive scope and takes in the principal thoroughfares throughout Pittsburgh.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has now completed the removal to its new shops at East Pittsburgh, and the old place on Garrison Alley looks quite deserted. The task of removing such large shops was a gigantic undertaking but it was accomplished without the operation of manufacture being interrupted. The new shops are certainly the finest and most complete plant for the production of electrical apparatus in the country, if not in the world.

CANADIAN NOTES.

TORONTO, CAN.—It is reported that the street railway lines are to be extended in various directions in this city. John Brown, J. C Morgan and others are interested.

WATERLOO, QUEBEC.—A local war is on between the Bell Telephone Company and the Citizens' Company.

ST. JOHN, N. B.—St. John Gas Light Company has been absorbed by the St. John Electric Street Railway Company.

SARNIA, ONT.—An act to revive the charter of the Sarnia & Lambton Southern Railway is now before the legislature.

MONTREAL.—At the annual meeting of the Auer Incandescent Light Company the report presented showed a net profit of $41,000 on the year's work.

TORONTO, ONT.—The Toronto Street Railway Company has taken over the Scarboro Electric Railway, which, it is understood, will be operated as an independent line.

OTTAWA, ONT.—J. C. Mullin, late foreman of the Electric Car Works in this city, has resigned his position and left for Valparaiso, Chili, where he goes into the electric supply business.

ST. JOHN, N. B.—Sealed proposals will be received until April 16, by Robert Wiseley, director of the Department of Public Safety, for the lighting of the streets of this city with electricity.

OTTAWA, ONT.—Thos. Ahearn has been succeeded as resident manager of the Bell Telephone Company, in this city, by D. C. Dewar, who for many years has acted as Mr. Ahearn's assistant.

HAMILTON, ONT.—The Hamilton Storage Battery Company, with a capital of $10,000, has applied to the Ontario legislature for a charter for the purpose of manufacturing storage batteries and electrical apparatus generally.

ST. LAURENT, QUE.—The Council has granted the Montreal Park & Island Railway Company a 30-year franchise for an electric railway and lighting plant to serve the whole municipality, covering a territory of 54 square miles.

TORONTO, ONT.—A bill is before the Ontario legislature to incorporate a company to build an electric railway from Toronto to Niagara Falls by the Dundas road. The power will be derived from the Niagara Power Aqueduct at Hamilton.

NIAGARA FALLS, ONT.—The Niagara Falls & Lundy's Lane Electric Street Railway Company, with a capital of $50,000, is applying for a charter to construct a street railway in the town of Niagara Falls and the township of Stamford.

MONTREAL.—At the annual meeting of the Bell Telephone Company of Canada a report was presented showing that the revenue for the past year had been $1,012,834, and expenses $729,611. The following directors were elected: C. F. Sise, G. W. Moss, W. H. Forbes, Hon. J. R. Thibaudeau, J. R. Hudson Robert Archer, Robert Mackay, W. R. Driver and Hugh Patton.

NIAGARA FALLS.—The Niagara Falls Electric Street Railway Company, with a capital of $250,000, is applying for a charter for the purpose of constructing street railways and supplying electricity for light, heat and power purposes, in the town of Niagara Falls, and the village of Stamford, with power to acquire the Niagara Falls, Wesley Park and Clinton Tramway Company's lines. Alexander Manning, Chas. Black and A. Lash are to be the first directors.

OTTAWA, ONT.—The comptroller of customs has decided that electricity introduced into Canada for power purposes must pay a duty of 20 per cent. A commercial value will be placed upon each horse power, based upon the price paid, and on this the duty will be assessed.

OTTAWA, ONT.—The question of the right of the Dominion Government to impose a duty on electricity will be raised in Parliament next month. The clause under which the 20 per cent. duty has been imposed reads thus: "All goods not enumerated in this act as subject to any other rate of duty, nor declared free of duty by this act, and not being goods the importation of which is by this act or any other act prohibited, shall be subject to a duty of 20 per cent." The point involved is a nice one, and the discussion promises to be exceedingly interesting.

ENGLISH NOTES.

From Our Own Correspondent.)

London, March 27, 1895.

THE TELEPHONE COMMITTEE.—The select committee of the House of Commons appointed to consider the condition of the telephone service of the United Kingdom held its first sitting yesterday, and will commence work seriously on Friday.

MUNICIPAL PURCHASE.—The Liverpool Town Council has for some time past had its eye on the Liverpool Electric Supply Company, which has for several years been building up a prosperous business in that city. Negotiations are now in active progress for the municipal purchase of the company's business. I hear that the company has asked for half a million sterling. As it has not spent more than half this sum, has never earned a larger dividend than 5½ per cent., and is liable to be purchased in a summary manner by the Town Council in about two years' time, it must be admitted that the sum demanded is a handsome one.

THE TELEPHONE SERVICE OF THE UNITED KINGDOM.—On Friday last the select committee of the House of Commons sat to hear evidence on the condition of the telephone service of the United Kingdom The first witness was Mr. J. C. Lamb, assistant secretary of the post office in charge of the telegraphs department, who gave an interesting history of the introduction of telephony into this country, and of the wild oscillations of policy adopted toward Graham Bell's invention by successive postmaster generals. It is small wonder that we have arrived at the presenst *impasse* in view of the obvious inability of the post office officials to see further ahead than the tips of their noses, and to adopt a broad and definite policy even for this limited field of vision.

LAMP REVENUE.—As an instance of the revenue which our electric supply companies in London are now deriving from each 8-cp lamps installed, the figures recently quoted at the meetings of the City of London Electric Lighting Company and Notting Hill Electric Lighting Company are of interest, illustrating as they do the widely different conditions under which the various London companies work. The City of London Electric Lighting Company during the year 1894 derived a revenue of about 12s. 6d. per lamp; the Notting Hill Electric Lighting Company is struggling to make both ends meet on a revenue of about 6s. per annum. The Metropolitan Electric Supply Company, the biggest of our electric supply companies, so far as lamp connections are concerned, derived, if I remember rightly, in 1893, a revenue of about 8s. per lamp installed. Judging by the dividends paid by the various companies a revenue of 10s. per lamp per annum is an irreducible minimum below which it is not likely anything in the shape of a substantial dividend will be paid.

TRANSFORMER CHAMBERS.—Your readers may possibly remember that just before Christmas there was a battle royal between the London County Council and an electric lighting company, now about to set to work, called the County of London & Brush Provincial Electric Lighting Company, the bone of contention being the right of that company to excavate pits under the pavement, and to place therein the apparatus necessary for transforming their 2,000-volt current into one of 200 volts for distribution to their proposed three-wire alternate current network. No agreement could be reached, and the Board of Trade was appealed to. The government department, after a lengthy hearing, decided in favor of the company. The last word, however, seems likely to be with the London County Council. The company is now seeking powers for districts in London other than those which it already covers, and a *sine qua non* of Parliamentary sanction is that the powers asked for should have the assent of the local authorities concerned—one of whom, in this case, is the London County Council. They have, indeed, agreed to the demand of the County of London Company, but with the proviso that it should not make excavations under the footways of greater dimensions that 3 ft. span and 2 ft. 6 in. depth, thus practically prohibiting the making of transformer sub-stations under the pavements.

SUPERHEATERS.—The desire to economize heat in electric supply and other steam using works is fast developing into such a mania that it seems likely that every little unit of heat which manages to elude being put to any useful purpose will form the basis of a more or less gigantic financial manœuvre for its prompt recovery. From the coal bunker to the exhaust pipe or condenser there is nothing but one chain of ingenious economizing devices, the number of which is daily increasing. The latest financial scheme is on rather a large scale considering the scope of its action. It proposes to place a somewhat well-known superheater more firmly on the market, with a capital of no less than £416,000, of which all but £94,000 will be paid to the vendors. Whether a few degrees of heat justify so large an amount of capital it is difficult to say, for although the superheater concerned, viz., that of McPhail & Simpsons', is one which has been used in a great many works for some time, yet it is difficult to believe that there can be justification for so much capital even in the case of an ideal superheater. On the other hand, I do not in any way wish to deprecate the use of superheaters, for there can be no doubt that a considerable economy can often be introduced in electric supply stations by their use. There is more than one good superheater on the market beside that of Messrs. McPhail & Simpsons', and it is probable that the competition with these would alone be enough to make it rash to raise so much capital for the development of a single type.

STREET BOX EXPLOSIONS.—Maj. Cardew, an inspector of the Board of Trade, has just issued his report on the explosion which took place on Southwark Bridge on Feb 1, in several street boxes connected with the system of the City of London Electric Lighting Company. The inspector "can confidently assert" that electricity had nothing whatever to do with exploding the gas which had found its way into the electric light conduits. The cause of the explosion was in all probability a lighted match dropped down a gulley in which there was an explosive mixture due to a fractured gas pipe. The inspector, however, thinks that the Southwark Bridge explosion gives grave cause for anxiety, owing to the proof it afforded of the great distance a series of explosions may travel, and also on account of the proof it afforded of the inadequacy of mere ventilation unless the conduits and street boxes are more or less impervious to gas. The report concludes with some severe remarks on the slowness with which the City of London Electric Lighting Company has adopted previous recommendations of the Board of Trade, but at the same time recommending practically a new policy. Previous to the Southwark Bridge explosion, the Board of Trade laid great stress upon thorough ventilation. Great stress is *now* laid upon filling up the street boxes with incombustible material, and on the thorough plugging of the ducts at each street box, ventilation being no longer considered of primary importance; it is indeed suggested that it may be dispensed with provided the latest panacea of the Board of Trade be adopted. It is somewhat fortunate under the circumstances that the City of London Electric Lighting Company has been slow in adopting the Board of Trade's earlier recommendations. Had it spent several thousands of pounds in arranging for an elaborate system of ventilation it would now have the agreeable consolation of knowing that this was all wrong and would have had to spend more money on an entirely new cure

General News.

NEW INCORPORATIONS.

THE STAUNTON MUTUAL TELEPHONE COMPANY, Staunton, Va., capital stock $25,000, has been incorporated by R. S. Turk, W. L. Oliver and others.

THE MAINE LIGHTING COMPANY has been incorporated at Portland, Me., with a capital stock of $10,000. Arthur C. Libbey is president and L. W. Tibbetts is treasurer.

THE HINTON TELEPHONE COMPANY, Hinton, Va., has been incorporated by J. T. McCreery, Harvey Ewart, P. K. Litsinger and others to establish a telephone system.

THE MUTUAL AUTOMATIC TELEPHONE COMPANY, Brooklyn, N. Y., has been incorporated by David A. Boody, Silas B. Dutcher and others. The capital stock is $6,000,000.

THE WOODLEY LAND COMPANY, Washington, D. C., has been incorporated with a capital stock of $87,000,000, by Jno. J. Hemphill, Alex. S. Porter, and others, to establish an electric light plant.

THE STEUBEN COUNTY ELECTRIC TELEPHONE COMPANY, Angola, Ind., capital stock $5,000, has been incorporated by Lorenzo Taylor, Sol. A. Wood, J. E. Naught and N. W. Gilbert, of Angola.

THE RAWSON LIGHT & POWER COMPANY, Leicester, Mass., capital stock $25,000, has been formed to supply light, heat and power. Those interested are E. L. Watson, W. C. Watson and W. F. Wittemore.

THE INTERSTATE TELEPHONE COMPANY, Durham, N. C., capital stock $100,000, has been incorporated to manufacture telephones, etc. Edgar L. Miller, J. S. Carr and Dr. Fahrney, of Frederick, Md., are interested.

THE MULTIPHASE MOTOR COMPANY, New York, capital stock $200,000 has been incorporated by Alfred S. Brown, George. W. Gardanier and Watson D. Schrain, to make and sell electric motors and other electrical machinery.

THE HARRISON TELEPHONE CONSTRUCTION COMPANY, Louisville, Ky., capital stock $100,000, has been incorporated by G. A. Dole, Minneapolis, Minn.; J. C. Strother F. H. Barney, H. K. Cole and D M. Goodwin, Louisville

THE WESTERN MARYLAND TELEPHONE COMPANY, Westminster, Md., has been incorporated with P. J. Bennett, president; Chas. E. Fink, vice president; J. M. Reifsnider, secretary and treasurer, and H.B Hazlett, general manager.

THE GREENVILLE ELECTRIC LIGHT, HEAT & POWER COMPANY, Greenville, Mo., has been incorporated with a capital stock of $25,000. E. Bruckman and Samuel D. Bruckman are among the incorporators, and can be addressed.

THE AUSTIN ELECTRICAL COMPANY, Austin, Tex., capital stock $5,000, has been incorporated to deal in electric fixtures and to do all kinds of electrical work. Among those interested are E. B. Fisher, Q. C. Horton and J. E. McGillevary.

THE LOCK HAVEN TRACTION COMPANY, Lock Haven, Pa., capital stock $10,000, has been formed to operate passenger railways by cable, electrical or other means. Chas. A. Bragg, H. I. Mitchell and George Breed, Philadelphia, Pa., are interested.

THE BRISTOL GAS & ELECTRIC COMPANY, Bristol Va., capital stock $100,000, has been formed to operate a gas and electric light plant. The organizers are J. H. Wood and H. C. Wood, of Bristol; R. W. Crenshaw and Wm. Hurt, of Lynchburg, Va.

THE PARKERSBURG TRACTION COMPANY, Parkersburg, W. Va., maximum capital stock $1,000,000, has been incorporated to build and operate a street railway in Parkersburg. D. B. Judd, Wm. R. Hurd and Wm. C. Spring, of Bristol, Conn., are interested.

THE SARANAC LAKE (N. Y.) ELECTRIC LIGHT COMPANY, has been incorporated with a capital stock of $30,000. Orlando Blood, Wallace Murray and Orville S. Morse, of Saranac Lake, are among the incorporators, and can be addressed for details.

THE LOCK HAVEN TRACTION COMPANY, of Lock Haven, Pa., has been incorporated with a capital stock of $10,000. Charles A. Bragg, M. J. Mitchell and George Breed, of Philadelphia, are among the incorporators, and can be addressed for further information.

THE RAWSON LIGHT & POWER COMPANY, Leicester, Mass., capital stock $25,000, has been formed to furnish light, heat and power. The promoters are Edwin L. Watson, Walter C. Watson, Wm. F. Whittemore, J. S. Whittemore and Lory S. Watson.

THE COTY & ALBERTSON COMPANY, Atlantic City, N. J., capital stock $10,000, has been formed to do a plumbing, gas-fitting, hardware, electrical and other business. The promoters are Richard B. Albertson, Jos. Young and Clifton C. Shinn, Atlantic City, N. J.

THE MASCOT ELECTRIC LIGHT, HEAT & POWER COMPANY has been organized at Ouray, Col., with a capital stock of $100,000, to produce electricity for light, heat and power. B. B. Clauson, Chas. A. Armstrong, and T. W. Emerson, all of Ouray, are interested.

THE NEWTOWN, LANGHORNE & BRISTOL TROLLEY STREET RAILWAY COMPANY, Newtown, Pa., capital stock $60,000, has been formed to build an electric street railway. Geo. C. Worstall, Newtown; Henry Lovett, and Wm. B. Parry, Langhorne, Pa., are all interested.

THE SNYDER ELECTRICAL COMPANY, Cleveland, O., capital stock $5,000, has been formed to manufacture and deal in chemicals, electrical and plating machinery, supplies, etc. The promoters are Edward Snyder, Chas. E. Watson, M. M. Zellers, Geo. A. Burke and A. V. Cannon.

THE PROVIDENCE ELECTRIC THERMOSTAT COMPANY, Kittery, Me., capital stock $100,000, has been incorporated to manufacture and deal in heat and damper regulators. Lorin M Cook, Frank M. Burrough, Providence, R. I., and Buron S. Cowles, Meriden, Conn., are interested.

THE PORTLAND & YARMOUTH ELECTRIC RAILWAY COMPANY, Portland, Me., has been incorporated, with a capital stock of $200,000, for the purpose of building an electric railway between the points named. Edward S. Perry, of New Haven, is president of the company, and can furnish details.

THE ELECTROLYTIC INSULATING & CONDUIT COMPANY, Springfield, Ill., capital stock $5,000,000, has been formed to manufacture, use and sell electric conduits, cables and all electrical apparatus. The promoters are H. Clay Wilson, Benj. Knudson and Jas. E. Henderson.

THE UNIVERSAL TELEPHONE COMPANY, Indianapolis, Ind., capital stock $25,000, has been formed to manufacture and sell telephones, telephone devices, electrical supplies, etc. The promoters are E. B. Martindale, Chas. Martindale, and Robert Martindale, Indianapolis, Ind.

THE TALLAHASSEE SHOALS ELECTRIC COMPANY, Athens, Ga., has been incorporated, with a capital stock of $50,000, for the purpose of developing the water power of the Tallahassee Shoals for electrical purposes. The secretary of the company can furnish detailed information.

THE MARKET STREET, RICHMOND & FRANKFORD ELECTRIC RAILWAY COMPANY, of Philadelphia, has been incorporated for the purpose of building an electric elevated railway between the points named. The secretary of the company can be addressed for detailed information.

THE PLYMOUTH COUNTY RAILWAY COMPANY, East Weymouth, Mass., has been incorporated, with a capital stock of $250,000, for the purpose of building an electric railway between this place and Brant Rock, a distance of 25 miles. John F. Simmons is president and Charles H. Killam treasurer.

THE KELSEY ELECTRIC RAILWAY SPECIALTY COMPANY, New Haven, Conn., capital stock $20,000, has been formed to manufacture electrical supplies and specialties and car supplies, hardware and machinery. Frank N. Kelsey, Chas. L. Wright and Wm. W. Miner, New Haven, Conn., are interested.

THE STREET RAILWAY COMPANY OF SAVANNA, Savanna, Ill., capital stock $25,000, has been formed to construct, maintain and operate a street railway by animal, electric or pneumatic power. W. W. Cargill, J. B. Canterbury, Edwin B Magill, A. D Appleby and B Pulford are the interested parties

THE KANSAS TELEPHONE & ELECTRICAL COMPANY, Parsons, Kan., capital stock $10,000 has been formed to maintain and operate a system of telephones and electrical alarms and calls. The promoters are A B Kerlin, Freeport, Ill.; D. S. Stewart, Shelbina, Mo., and C. W. Ryan, Parsons, Kan.

THE BERWYN & DEVEN PASSENGER RAILWAY COMPANY, Philadelphia, Pa., has been organized to build a street railway in Chester county. The promoters are Geo. Boney, 1,925 North seventh street John A Barry, [illegible] South 38d street; Russell Hawkins, 3,238 Chestnut street, Philadelphia, Pa. Capital stock, $10,000

THE MIDDLEBURG & OAK HILL TELEPHONE COMPANY, Middleburg, N. Y., capital stock $50,000, has been incorporated to contruct a line from Middleburg to Livingstonville, Lawyersville, Preston Hollow, Oak Hill and Durham. The organizers are Elias W. Dutton, Azano B. Brayman, W. J. Chase, William Earle and others.

THE DOVER ELECTRIC LIGHT & POWER COMPANY, Dover Plains, N. Y., capital stock $10,000, has been formed to carry on the business of lighting cities, towns, villages by electricity, and to supply same for heat and power. The promoters are Adolph Reimer, Catherine Reimer, of Dover Plains, and J. C. Muick, of Brooklyn, N. Y.

THE PROSPECT STREET RAILWAY COMPANY, Chester, Pa., capital stock $50,000, has been formed to build a street railway operated by electricity or other power than locomotive. Geo. Rodgmen, 815 West Second street; Wm. D. Pullon, Jr., 614 West Sixth street, and Edw. L. Nugent, 540 East Eighth street, Chester, Pa., are interested.

THE ENBALM CONDUIT TROLLEY COMPANY, New York, maximum capital stock $5,000,000, has been incorporated to manufacture, acquire and sell all sorts of machinery and inventions, and to construct and equip steam and electric railways, etc. Glenn S. Smith, of Brooklyn; Oscar A. Enbalm and Clarence E. Sherin, of New York, N. Y., are interested.

THE TELEGRAPHIC PAGE PRINTING COMPANY, New York, maximum capital stock, $500,000, has been incorporated to manufacture, operate and sell electric printing telegraph machines and all other electrical and mechanical devices, etc. The incorporators are Edw. T. Hickey and Chas. H. H. Cottrell, of New York, and Chas. F. Sesinger, of Philadelphia, Pa.

THE CHASE ELECTRIC CYCLORAMA COMPANY, Chicago, Ill., has been incorporated with a capital stock of $100,000 to manufacture, buy and sell and operate electrical, photographic and optical machines, instruments and apparatus, stereopticon slides, lime-light and all other lighting apparatus. Chas. A. Chase, D. Wiley McCaughey, and Geo. E. West are the promoters.

THE TOPEKA WATER & ELECTRIC POWER COMPANY, Topeka, Kan., capital stock $1,000,000, has been incorporated to develop and improve water power from Kansas River and other places; construct dams, electric works, water works, etc, etc. The incorporators are F. A. Session, Ionia; L. H. Withey, Anton C. Hoclenpyl and T. F. McGarry, Grand Rapids, Mich.

THE MORAGA VALLEY RAILWAY COMPANY, San Francisco, Cal., capital stock $500,000, has been formed to build and operate railways in Contra Costa County by steam, electricity or other motive power, and to lease, purchase and sell railways. Angus A. Grant, Albuquerque, N. M.: Archibald J. McDonald, San Francisco, and John T. Williams, Oakland, Cal., are the incorporators.

THE CHICAGO WESTERN COAL & MINING COMPANY, Chicago, Ill. capital stock $500,000, has been formed to manage, operate and conduct the business of mining and selling coal and other minerals, to construct and operate plants, power houses, and all necessary appliances for producing electricity for light, heat and power. Edw. W. Russell, Frank H. Russell and Lawrence Browne are interested.

THE SAN JOAQUIN ELECTRIC COMPANY, Fresno, Cal., capital stock $800,000, has been formed to buy, sell and deal in electrical inventions, patents, etc., also to buy, sell, lease, maintain and operate electrical plants of all kinds, to generate and sell electricity and to deal in real and personal property. John J. Seymour, John S. Eastwood, Henry Sherwood, O. W. Woodward, and L. L. Cory, of Fresno, are interested.

TELEGRAPH AND TELEPHONE.

FREDERICK, MD.—The Interstate Telephone Company is about to construct its system.

GREENVILLE, TENN.—The East Tennessee Telephone Company, of Knoxville, will construct a telephone system here.

CHATTANOOGA, TENN—The East Tennessee Telephone Company will extend its lines to Jasper, South Pittsburgh and Bridgeport.

FREDERICKSBURG, VA.—The Woodbridge & Occoquan Telephone Company has obtained a franchise and will establish a telephone system.

FLORENCE, ALA.—Steps are being taken to establish a telephone system. Robt. Andrews, W. M. Price, Jno. W. Hall and others are interested.

WARREN, TEX.—The Warren Land & Lumber Company contemplates constructing a telephone system including a 15-mile line to its logging camp.

NASHVILLE, TENN.—A bill has passed the House which limits telephone rentals in Tennessee to a maximum of $3 per month on each instrument.

ELIZABETH, N. J.—The City Council will purchase a quantity of electrical apparatus for the use of the fire department. The clerk can be addressed.

ROME GA.—A telephone system is being organized by J. W. Dodds, of Cedartown, and G. G. Leake, of Marietta; over 100 subscribers have been secured.

COLUMBUS, GA—The Bell Telephone Company will construct a long distance telephone line from Griffin to Columbus by way of Warm Springs, Greenville, Hamilton and Chipley.

THE WINNSBORO & RIDGEWAY TELEPHONE COMPANY, Winnsboro, S. C., has been granted a charter to construct a telephone line twelve miles in length. W. D. Douglass, Jas. Q. Davis, E. C. Heins and M. W. Doty are interested.

PHILADELPHIA, PA.—The electrical department will shortly begin laying conduits on Second street from Market to Diamond; on Callowhill street from 23d to 25th street, on 25th street from Callowhill to Brown, on Brown street from 25th to 26th; on 26th street from Grand avenue to Ridge avenue, and on Ridge avenue from Columbia avenue to Diamond, so as to enable the different telegraph and telephone companies to place their wires underground and utilize the city conduits instead of erecting poles and stringing overhead wires.

MISCELLANEOUS NOTES.

THE TELEGRAPHERS' MUTUAL BENEFIT ASSOCIATION has published a financial statement which shows the organization to be in a most satisfactory condition, the reserve fund being reported at $115,000. The association is heartily endorsed by the officers of both the Western Union and Postal Telegraph companies.

THE ELECTRICAL ENGINEERING SOCIETY, School of Electrical Engineering, Lehigh University, South Bethlehem, Pa., at its last meeting listened to two well prepared papers by Messrs. Klinck and Blehl. The subject of Mr. Klinck's paper was "The Jablochkoff Candle." Mr. Blehl's paper considered "Vector Analysis as Applied to Alternating Current Problems." Mr. E. C. Brown supplemented this paper by explaining a few problems to which the principles enunciated in Mr. Blehl's paper apply.

YALE TO THE FRONT.—A press dispatch from New Haven, Conn., reports that J. J. Hogan, employed in the mechanical department of Yale Scientific School, has invented an apparatus by means of which the use of the motor dynamo, invented by Edison, is obviated. The apparatus, according to the dispatch, reduces the voltage of a current without lessening the amperes. At a test made on March 25 we are informed that the machine reduced an electric light current of 100 volts and four amperes to seven volts, without affecting the amperes.

LANDING OF CABLES.—The New York State Supreme Court of the first department has recently decided the case of Hector de Castro vs. the Compagnie Française du Telegraphe de Paris à New York in favor of the latter, which was represented by Edward W. West as counsel. The plaintiff claimed a large fee for having obtained an opinion from the United States Secretary of State disclaiming authority in the matter of a State granting permission to land a cable, but the court decided that such a disclaimer was not a performance of the contract to procure a declaration of the Federal Government, assuring to the French Company "the enjoyment, without restriction and unattackable, of the landing rights which it holds from the separate government of the State of Virginia."

AN ELECTROTHERAPEUTIC CLINIC.—On Saturday of last week the New York Electrotherapeutic Clinic, Laboratory and Dispensary was opened at 327 East 25th street and will be conducted under the direction of Dr. Margaret Cleaves. This clinic is thoroughly equipped with all the modern electrical apparatus used in medicine, such as influence machines, alternators, induction coils, constant current apparatus (with primary batteries of cells, and with adapter for street current), storage batteries for cautery, illumination and trans-illumination, constant current and electric light baths, as well as with appliances necessary to determine with exactitude the action of electrical energy upon the human economy. Its object is to assist in the development of scientific electrotherapeutics, and instruction will be given in this branch and in electrophysics and physiology.

THE EXECUTIVE COMMITTEE OF THE NATIONAL ASSOCIATION OF MANUFACTURERS held its first meeting at the Manufacturers' Club, Philadelphia, last month, at which the following vice-presidents were elected: For Delaware, Mr. H. G. Morse, president of Edge Moor Bridge Works; for District of Columbia, Mr. John T. Campbell, of Washington; for Kansas, Mr. J. L. Abernathy, of Leavenworth; for Louisiana, Hon. James H. Shakespeare, of New Orleans; for Massachusetts, Mr. Elwyn W. Lovejoy, of Lowell; for Minnesota, Mr. S. B. Foote, of St. Paul; for Montana, Mr. J. T. Carroll, of Butte City; for Washington, Mr. Thos. E. Evanson, of Seattle. The association is to be composed of other organizations representing the various industries, but its purpose is not in any way to interfere with or absorb existing societies and associations, but to consolidate them into one powerful representative body.

REDUCTIONS IN TELEPHONE CHARGES.—The Wisconsin Telephone Company, commencing on April 1, reduced its rates 25 per cent., the charges for business houses now varying from $36 to $18 per year, and for residences from $30 to $15, the highest rate being for private lines, and the lower rates for party lines. The Michigan Bell Telephone Company, on the same date, reduced its rates to $36 and $24. The company supplying the territory about Steubenville, O., has announced a reduction from $50 to $36 and $30. At Washington Pa., the rates have been reduced from $60 to $36 and $30, and the Central Union Company, of Illinois, has changed from $36 to $30 for dwellings, and from $48 to $42 for business places. The New York & New Jersey Telephone Company, whose territory includes Brooklyn, Jersey City, Newark, etc., have adopted a new schedule which lowers rates considerably, if party lines are used.

Trade and Industrial Notes.

FRANK H. STEWART, 20 North Seventh street, Philadelphia, has taken Mr. P. Logan Bockius into partnership, and the business will hereafter be conducted under the name of Frank H. Stewart & Co.

THE PACKARD ELECTRIC COMPANY, LTD., of Montreal, Can., has been incorporated and succeeds to the business of the Dominion Electric Company, Ltd., and the Packard Lamp Company, Ltd., assuming all the obligations of the two old companies.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., has just closed a contract with the Berlin Iron Bridge Company, of East Berlin, Conn., for equipping its new forge shop with electric power. A 40-kw generator and 60-hp motor will be used.

CHAS. E. CHAPIN, 136 Liberty street, New York, is selling the Perfection woven wire dynamo brush and reports a large number of orders recently received. It is claimed that the Perfection brush will not cut the commutator, and has an unusually long life.

MR. E. PECKHAM, president of the Peckham Motor Truck & Wheel Company, of New York, has returned from a two months' trip to California, whither he had gone for a little rest and recuperation. Mr. Peckham says he feels first-class, and certainly his appearance corroborates this statement.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY, 50 Broadway, New York, reports business good and steadily improving as to both the Manhattan arc lamp and gauze dynamo brushes. The difficulty formerly experienced with the inner globe of the Manhattan lamp is said to have been entirely overcome.

THE HOGAN BOILER COMPANY, Middletown, N. Y., is distributing a set of sheets illustrating its water-tube boiler, both "manifold" and cylindrical types, in various stages of construction. Plans, front and back elevations and cross-sectional views are also presented. The engravings are printed on heavy plate paper.

JAMES. BOYD & BRO., 14 North Fourth street, Philadelphia, have issued a very handy and substantial catalogue of electric railway supplies, which is comprehensive in scope and logically arranged as to contents. The size of the book, 4½x8 inches, is a most convenient one for handling as well as for filing away in a cabinet or desk.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has issued a handsome calendar for the fiscal year ending March 31, 1896. There are eleven distinct engravings lithographed in colors, showing various styles and types of work turned out by the company, including suspension, truss and cantilever bridges, iron doors, roofs, etc.

THE ROYAL ELECTRIC COMPANY, of Peoria, Ill., has completed arrangements with H. B. Coho & Co., 203 Broadway, New York, to handle its alternating current apparatus in the East. Messrs. Coho & Co. have secured the services of Mr. George C. Hoffman, formerly of the Westinghouse Company, who will have charge of their alternating current department.

THE PARTRICK & CARTER COMPANY, 125 South Second street, Philadelphia, has just issued a new catalogue of house goods and general supplies, which is complete in every detail. Among other new things noted are a very ornamental pear-shaped push, a high and low water alarm, and an automatic electric programme clock. The book is gotten up in the same excellent style which has characterized the P. & C. catalogues for several years.

THE FRANKLIN ELECTRIC COMPANY, of Kansas City, Mo., has recently completed the installation of the electric light plant at Hamilton, Mo., and a lighting plant for the State Industrial School at Lancaster, Ohio. The latter contract included erection of building and steam plant. The Franklin Company has also secured the contract for an electric light plant at Plattsburg, Mo.

H. B. COHO & CO., 203 Broadway, New York, announce that pending an adjustment of inside affairs the Mather Electric Company will be managed by Mr. Jarvis, of the Berlin Iron Bridge Company, as temporary receiver, and that with this exception there will be no change in the affairs of the Mather Electric Company, that any bids or prices quoted will stand, and that H. B. Coho & Co. are prepared to guarantee deliveries on this excellent apparatus.

F. E. BAILEY & COMPANY, Philadelphia, who for a number of years have handled the Ideal engine for the Harrisburg Foundry & Machine Works in this vicinity, have moved from 701 to 913 Betz Building, and are now representing the Armington & Sims Engine Company, of Providence. Their territory extends over quite a number of states and judging from the former success they have had, their prospects are very good for a large portion of first-class engine and boiler business.

THE ELECTRIC POWER STORAGE COMPANY, of 166 Elm street, New York, has appointed Wm. Hood as its Western representative, with headquarters at Chicago. Immediately upon the acquisition of Mr. Hood the company secured, through his management, a contract from H. H. Porter, president of the Chicago & Eastern Illinois Railway Company, for 120 350-ampere-hour accumulators for a lighting plant at Mr. Porter's summer residence at Lake Geneva, Wis. Mr. Hood is a man of unqualified ability, and there is no reason why his appointment should not be mutually satisfactory in every respect.

J. HOLT GATES, Monadnock Building, Chicago, reports the following sales of electrical apparatus for March: One 50-kw multipolar machine to Swartschild & Schulzberger Packing Company, Kansas City, Mo.; 250-hp in motors to the Bucyrus Steam Shovel & Dredge Company, South Milwaukee, Wis.; one 110-kw., one 85-kw and one 60-kw multipolar machines for Pennsylvania; one 65-kw generator, direct-connected with an Ideal engine, to J. H. Garaghty, Columbus, O.; one 250-light machine to St. Paul, Minn.; one 100-light machine to Two Rivers, Wis.; two 15-kw machines to Arlington, Minn., and two 20-hp motors to the B. F. Sturtevant Company, Chicago.

THE NEW YORK & OHIO COMPANY, Warren, O., reports a large demand for its well-known Packard lamps, and in order to accommodate its rapidly growing Eastern business has recently opened a New York office at No. 1 Broadway, which will be in charge of the president of the company, Mr. J. W. Peale. The company has recently published a diagram showing graphically the increase of efficiency and candle power of its new lamp, which is claimed to give, after some hundred hours' burning, a greater amount of light with a smaller consumption of energy per candle power than when new. This is a pretty strong claim, but the company declares its readiness to back it up.

M. T. DAVIDSON, 77 Liberty street, New York, is building a pair of air pumps for the Johnson Company, Johnstown, Pa., which are believed to be the largest ever constructed in this country. The pumps are arranged to be operated singly or as compound duplex pumps. The high pressure steam cylinder is 16 x 24 inches, low pressure 30 x 24, and the air cylinder 36 x 24 inches. There are two sets of these pumps, each provided with a jet condenser 6 ft. in diameter by 12 ft. 9 in. high. They are to be used in the Johnson Company's mills at Lorain, O. The Davidson works have just completed a pair of compound double plunger pumps for the same company, and reports business as being very good.

THE HEINE SAFETY BOILER COMPANY, St. Louis, Mo., feels encouraged in the character of business that is coming in, though the volume is not yet satisfactory. The last week in March the company closed contracts for both the street railway boiler plants of New Orleans, aggregating over 1,100 hp. which competitors have been working on for many months. Among other sales are the following: R. H. White & Co., Boston's big dry goods house, three boilers, 610 hp; The Equitable Building, Denver, Col., three boilers, 750 hp, to replace another type; New Planters Hotel, St. Louis, one boiler, 200 hp. and De Lamar's Gold Mining Company, De Lamar, Nevada, one boiler of 120 hp. The widespread nature of this business is certainly a favorable indication.

THE MATHER ELECTRIC COMPANY, Manchester, Conn., owing to the inability to collect accounts due, on April 6 was placed in the hands of a receiver. Chas. M. Jarvis of the Berlin Iron Bridge Company was appointed by the Superior Court of Hartford, Connecticut, as receiver in charge of all property, and as soon as possible will issue a statement of the assets and liabilities. By order of the court the company is allowed to proceed with the manufacture of electrical apparatus in order to close out the large amount of machinery and material now on hand, nearly all of which is already sold. It is hoped that the receivership is but temporary, but an inventory is now being taken and as soon as completed all creditors will be fully informed as to the exact condition of affairs. All material in the shape of supplies received by the company after 10.10 a. m. on Saturday, April 6, 1895, will be paid for by the receiver. Material and supplies received before that time will be credited on the accounts of the Mather Electric Company.

Business Notice.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 10[illegible] South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 2, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

536,608. ELECTRICAL TRANSFORMER; M. Dickerson, Fort Wayne, Ind. App. filed Nov. 26, 1894. The combination of primary and secondary coils with a continuous surrounding envelope of laminated iron, each lamina having a cross plate entering within the coils, so arranged that by the abutting edges of the plates being out of coincidence with those of each reversed adjacent or alternate lamina they will break joints.

536,655. TERMINAL ATTACHMENT FOR FLEXIBLE CONDUCTORS; W. L. Richards, Malden, Mass. App. filed Sept. 10, 1894. The combination with a flexible cord having conducting and non-conducting terminal stands of a rigid terminal attachment therefor, combining in itself a fastening device for the said conducting stand and a suspension support for the said non-conducting stand, relieving the electrical conductor from all strain.

536,684. SELF-LOCKING CLEAT FOR ELECTRIC WIRING; F. O. Creager, Marseilles, Ill. App. filed Jan. 14, 1895. The combination of a cleat having a transverse wire, a recess contiguous to said wire recess, and a dog in said contiguous recess arranged loosely therein and adapted to engage and hold taut the electric wire.

536,689. ELECTRIC BATTERY; H. W. Libbey, Boston, Mass. App. filed Feb. 23 1894. The combination consisting of two outer discs or plates having inwardly projecting rims of insulating material, a central ring of insulating material, two perforated discs forming the negative elements and a central divided positive element, absorbent material on each side of said elements, and means for supplying the exciting fluid to the said absorbent material.

536,705. TELEPHONING APPARATUS; W. B. Robertson, Philadelphia, Pa. App. filed Sept. 7, 1894. The combination in a telephone of a receiver, and an alarm or indicator, with means for operating the alarm or indicator, and a controlling device thrown into operation by the weight of the receiver for putting the alarm into action, consisting of a switch device connected with the flexible conductor cord of the receiver whereby the weight of the receiver acting through the cord operates the switch device.

536,730. ELECTRICAL CONTROLLING SYSTEM FOR ELEVATORS; C. O. Mailloux, New York, N. Y. App. filed Dec. 20, 1894. The combination with the elevator and its starting mechanism of two controlling circuits, one causing the car to go up, and the other down, an automatic switch at each landing actuated by the car for closing the one or the other branch according as the car is above or below the said switch and adapted to stand in an intermediate position to break the circuit when the car is at a landing, and manual circuit closing device or devices at each landing whereby either branch may be closed at will.

536,748. DYNAMO DRIVEN FROM AXLES OF RAILWAY CARS; W. Biddle, Brooklyn, N. Y. App. filed May 31, 1894. The combination with the car axle and a dynamo of a dynamo frame extending up over the axle and having a journal box, an oil box below the axle and bolts for connecting the parts, a bearer upon which the distant end of the dynamo frame rests, and upon which it is free to move in any direction.

536,763. TELEPHONE; J. Serdinko, San Antonio, Tex. App. filed Dec. 4, 1894. The combination with the magnets of a magnetic call, the bobbin, the diaphragm fixed in front of the latter, the iron disc and core in proximity to the said magnets, the said core extending through the bobbin, into close proximity to the diaphragm, the said magnets of a magneto call having an iron extension piece on one side only and the magneto call armature.

536,764. ELECTRIC BLOCK SIGNAL; F. P. Snow, Lynn, Mass. App. filed April 27, 1894. The combination of electric railway track between two stations, a trolley wire accompanying such track, an electric signal at each station, an electric switch and switch magnet at each station, a normally open local circuit from the track through such signal and magnet to the trolley wire at each station, and a normally open circuit controlling said local circuit, which is capable of being closed at either station from the trolley wire at that station through the signal and magnet at the other station to the track at such other station, and also with car-operating circuit-controlling mechanism at each station.

536,766. TYPEWRITING MACHINE ATTACHMENT; C. Spiro, New York, N. Y. App. filed Oct. 15, 1894. The combination of a key lever, a universal bail, a rotatable shaft, interposed gearing, a ratchet wheel fast on the shaft and carrying a pin, means movable independent of the shaft for rotating said ratchet wheel in one direction, and a vertically movable arm having a cam-portion at its lower end and a hook at its upper end.

536,787. TELEPHONE EXCHANGE SYSTEM AND APPARATUS; H. V. Hayes and T. Spencer, Cambridge, Mass. App. filed Sept 10, 1894. The combination of a telephone circuit extending between two stations through an intermediate station and divided by interposed induction coils into a series of independent conductively continuous sections, each containing a circuit controller, a signal current generator controlled thereby, and an automatic signal indicating device.

536,792. SOCKET FOR INCANDESCENT LAMPS; F. H. Soden, Chicago, Ill. App. filed Feb. 12, 1890. A socket consisting of a shell of porcelain or like material provided with grooves about its inner periphery, a partition of insulating material fitted removably in said grooves and dividing the socket transversely, lamp contacts mounted in the partitions to which the conductors are connected at one side, cement filled in about the conductors, thus sealing one end of the socket, and means for sealing the lamp in the other end of the socket.

536,794. ELECTRIC CONTROLLER; G. Valley, Cleveland, O. App. filed Dec. 3, 1894. The combination of a roller composed of a number of annular sections provided with the proper contact pieces and adapted to interlock laterally with each other, a central shaft carrying top and bottom clamping plates, which interlock with the end sections of the drum.

536,795. SWITCH FOR STREET CAR CONTROLLERS; G. Valley, Cleveland, O. App. filed Dec. 3, 1894. The combination in a multiple switch of a disc of insulating material and means for rotating the same, curved conducting pieces embedded therein at different levels and having both ends protruding to form contact points, the diametrically opposite conducting pieces being upon the same level and having their points alternating with those of the pieces upon a different level, and the spring contacts arranged around the disc at intervals equal to those of the contact points and in series corresponding to the different levels of the projecting contact points and in position to be engaged by said points as the disc is rotated.

536,803 CONTACT FINGER FOR ELECTRIC CONTROLLERS; S. Harris, Cleveland, O. App. filed Dec. 5, 1894. A reversible contact finger for electric controllers having the contact shoe rigidly affixed to an endless spring of flat metal to the opposite side of which is rigidly affixed a reversible contact piece.

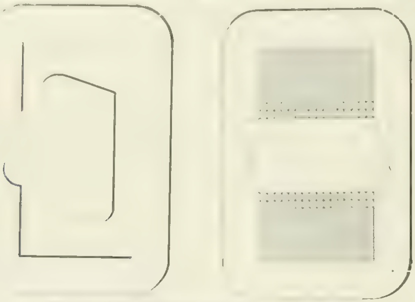
536,809. ELECTRICAL SWITCHBOARD; F. W. Jones, New York, N. Y. App. filed Jan. 22, 1895. The combination in a switchboard of parallel strips, a series of discs or buttons arranged in parallel rows between said strips, arc shaped notches in the adjacent surfaces of the strips and buttons to receive a metal pin or plug, a foundation or frame of fireproof insulating material, mica discs between said buttons and the foundation frame, and air spaces between said strips and the foundation frame, whereby insulation is increased and arcing prevented.

536,811. ELECTRIC MERCURIAL SWITCH OR CONTACT MAKER; H. Lemp, Lynn, Mass. App. filed July 26, 1888. The combination of a branching, hermetically sealed, exhausted receptacle containing separate bodies of mercury, electrodes of platinum or other non-amalgamating metal extending into said receptacle, a core of a magnet in one branch of said receptacle and having a forked end for engagement respectively with said bodies of mercury and said core, and acting thereupon to cause making or breaking of circuit between said electrodes.

536,816 COMBINED DYNAMO-ELECTRIC GENERATOR AND CURRENT DIRECTOR; J. F. McElroy, Albany, N. Y. App. filed Jan. 2, 1892. The combination of a circular range of alternate generating magnets and alternate positive and negative magnets, an outer casing magnetically connecting the magnets, a revolving armature shaft, a series of unwound armatures, one for each adjacent pair of magnets, peripherally secured upon a supporting armature core, alternating current leads from the generating magnets, a second circular range of electromagnets within the same casing and comprising resistance coils included in branches of one or both leads from the generating coils.

536,828. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS; A. C. Crehore, Ithaca, N. Y. App filed July 22, 1893. The combination of a sectional working conductor normally insulated, an auxiliary sectional conductor arranged parallel to the former, and also normally out of connection with the power line, a contact carried by the car and arranged to be always in connection with one or more of the sections of the auxiliary conductor, and switches for connecting the sections of working conductor with the supply line, and switch operating magnets each energized to close the switch by a branch of the power current passed over a section of the auxiliary conductor, as the car enters each section.

[illegible] SYSTEM OF ELECTRICAL PROPULSION FOR RAILWAY CARS: L. Dion, Natick, Mass. App. filed June 14 1894. The combination of a conduit having a cover on top capable of electrical conductivity, a main conductor of electricity and an auxiliary conductor superimposed thereon and composed of members or portions connected together by links of conducting material.



No. 536,608—Electrical Transformer.

536,867. MEANS FOR THE INSULATION OF CONDUCTORS OF ELECTRICITY: L. Dion, Natick, Mass. An insulation for electric conductors consisting of a sheath or cover of rubber and glass balls interposed between the same and the conductor.

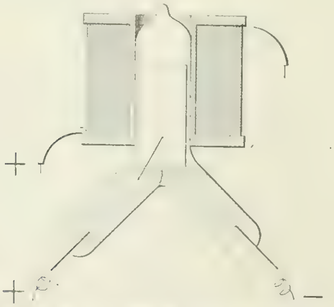
536,871. ELECTRIC DOUBLE SEMAPHORE BLOCK SIGNAL: N. O. Goldsmith, Cincinnati, O. App. filed March 24, 1894. The combination in an electric signal apparatus of an electric motor, a crank shaft operated by the motor, two signal circuits having terminals controlled by the crank shaft, and magnets and armatures in track circuits for making and breaking signal circuits at appropriate times automatically by the movements of a train.

536,872. ELECTRIC BLOCK SIGNAL; N. O. Goldsmith, Cincinnati, O. App. filed March 24, 1894. The combination in an electric signal apparatus of a series of track circuits made through the train, and duplex signal circuits in parallel connection with the same motor and provided with signal moving mechanism for operating the same signal, each signal circuit having independent terminals on the armatures of the magnets of two or more track circuits.

536,914. TELEPHONE; F. H. Brown, Chicago, Ill. App. filed Oct. 17, 1894. In a receiving telephone the combination with a suitable casing and a diaphragm, of a centrally located permanent magnet projected into the casing with its pole adjacent to the diaphragm, and a semi-circular permanent magnet arranged within the casing with its body and poles remote from the other magnet, so that the interior magnet is charged with the same polarity as the contacting pole of the other magnet.

536,915. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS; J. J. Byron, New York, N. Y. App. filed June 16, 1894. An electric railway comprising a trolley rail made up in sections insulated from each other and a contact between the sections, a main line wire, a switch consisting of a tilting armature and a contact arm, with magnets arranged at opposite ends of the switch armature, connections between contact of the trolley rail and two magnets of the next switch behind, and the return and connections between the main line, switch arm and next trolley rail section ahead.

536,918. CLOSED CONDUIT SYSTEM FOR ELECTRIC RAILWAYS; E. D. Chaplin and L. Dion, Natick, Mass. App. filed June 14, 1894. The combination of a conduit, or subway, entirely closed at all points, a main conductor or feeder arranged therein, and an auxiliary conductor consisting of a series of strips having conductivity and susceptible to magnetic attraction, their ends being overlapped and connected by a slot in one and a tongue and cross-head on the other.



No. 536,811 Electric Mercurial Switch.

[illegible] TELEPHONE SYSTEM; F. R. Colvin, New York, N. Y. App. filed Dec. 29, 1894. A telephone system comprising a plurality of subscriber's circuits leading to a common station, a call receiving instrument in each subscriber's circuit, a direct current tansmitter and telephone receiver adapted to be cut in at each subscriber's station, connectors at the common station for coupling two subscribers' circuits in series relation to each other, and a source of continuous current between the connectors for charging the transmitters.

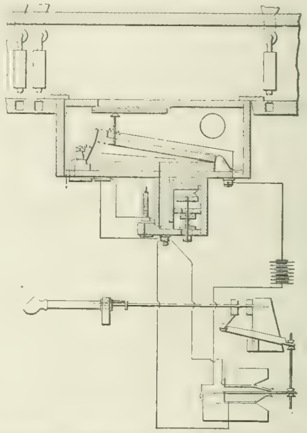
536,923. SAFETY DEVICE FOR ELECTRIC RAILWAYS HAVING SECTIONAL CONDUCTORS; L. Dion, Natick, Mass. App. filed June 14 1894. The combination with a car taking current from a series of contact plates, electrically operated signals arranged at both ends of the car, a centrally supported bar, and devices mounted upon the ends, and electrically connected to the signals.

536,926. ELECTRIC CLOCK WINDING MECHANISM; M. V. B. Ethridge and J. H. Eastman, Boston, Mass. App filed April 28, 1894. A circuit controller composed of an exhaust tube of insulating material, with circuit wires projecting into the tube and normally separated from each other, and a gravity circuit closing and breaking device, such as a body of mercury located in the tube, adapted to electrically connect the wires.

536,952. CONDUIT ELECTRIC RAILWAY; T. C. Hughes and A. W. Adams, St Louis, Mo. App. filed Feb. 12, 1894. An electric railway system with the combination of a bare working or trolley conductor made in sections and normally held out of circuit with the supply conductors by the weight of the working conductor, also a switch for making electrical connection between the working and supply conductors, operated by means of gravity or of a spring independent of the lifting power of the trolley, which becomes operative by the raising of the working conductor.

536,963. DYNAMO-ELECTRIC MACHINE; J. F. McElroy, Albany, N. Y. App. filed July 24, 1894. The combination of two field magnets arranged with unlike poles opposite each other in an armature revolving in the magnetic field between two magnets and an armature shaft passing through the fields and journaled in bearings outside of the magnets.

536,967. TROLLEY SUPPORT FOR ELECTRIC RAILWAY CARS; E. B. W. Reichel, Charlottenburg, Germany. App. filed Oct. 25, 1894. A support for a contact device for an electric car comprising an arm swinging on a vertically swinging frame, a spring resisting the pivotal movement of the arm from the vertical, and a spring resisting the downward movement of the frame



No. 536,978—Electro-Pneumatic Stop Action for Pipe Organs.

536,973. BRUSH HOLDER FOR DYNAMO-ELECTRIC MACHINES AND MOTORS; G. Valley, Cleveland, O. App. filed Dec. 15, 1894. The combination of a brush holder having a spring-actuated brush-feeder and a recessed wing piece, an insulating yoke having slotted end fitting the recess of the wing piece, and a bolt rigidly but adjustably securing the holder upon the yoke.

536,974. ELECTRIC ORGAN COUPLING MECHANISM; E. S. Votey, Detroit, Mich. App. filed April 7, 1894. A coupler provided with contact bars, one with the main electrical conductor, and the other with an independent electrical conductor, an independent key actuated spring bar for each of the contact bars to simultaneously open and close electrical connection through each of said contact bars, and a switch to open and close electrical connection.

536,975. ELECTRICALLY CONTROLLED MAGNET AND VALVE FOR PIPE ORGANS; E. S. Votey and W. D. Wood, Detroit, Mich. App. filed April 7, 1894. An electrical magnet having a metal base provided with communicating inlet and exhaust orifices, a core and its windings, a perforated plate uniting the terminals of the core with the inlet orifices, an armature operated by the core and its windings to control the communication, and a thimble uniting the core and its windings with the base.

536,977. ELECTROMAGNET FOR PIPE ORGANS; E. S. Votey, W. B. Fleming and W. D. Wood, Detroit, Mich. App. filed April 7, 1894. An electrical magnet provided with a metal cup or base having channels communicating with one another and opening through the cup upon the same side, an armature located within the cup to control the communication of the channels, a magnet core and its windings to attract the armature, and a cup having a threaded engagement upon the base to support the core and its windings.

536,978. ELECTROPNEUMATIC STOP ACTION FOR PIPE ORGANS; E. S. Votey, W. B. Fleming and W. D. Wood, Detroit, Mich. App. filed April 16, 1894. The combination in an organ of an electrical magnet constructed with a metal cup provided with communicable channels, an armature to control the communication, and air passages communicating with the first named channels.

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THE STANDARD TELEPHONE COMPANY.

There have been no developments during the past week with respect to the Standard Telephone Company, the officers stating that they are engaged in completing their organization and will have no technical details to communicate until that work is finished. It is understood that negotiations are pending with several persons controlling switchboard patents, but, beyond the patents described in our last issue, no further official announcement has been made in regard to those now held, and for which such sweeping claims have been made. As this is the first instance in which such secrecy has been observed with respect to electrical patents, further information will be awaited with interest, but it is scarcely to be expected that anything of a very startling nature at this stage of the art of telephony can be disclosed. The great reductions in rates now being made by Bell companies throughout the country will doubtless, it may be added, forestall some of the plans of the new company.

GENERAL ELECTRIC AND WESTINGHOUSE.

As we go to press no official statement has been made in regard to the terms of the agreement supposed to be in process of negotiation between the General Electric and Westinghouse companies. The only information vouchsafed to the public is that the necessary details are being perfected, which necessarily, on account of the number and importance of the patents concerned, require time. The financial papers, on the other hand, have printed rumors to the effect that negotiations have been brought to a halt, one of them stating that the opposition of Mr. Geo. Westinghouse has been the cause. While Wall street appears to be dubious as to a successful issue, and inclined to consider the affair merely as a speculative move on the part of some of those interested, it is probable that this view is itself based upon speculative motives. In the meantime it is only fair to accept the assurances that the matter is being prosecuted in good faith.

GAS BATTERIES.

We print elsewhere the second article of Mr. C. J. Reed on gas batteries, which is particularly interesting from showing the influence of the nature of the surface of the electrodes on the electric action of such a cell, and the high efficiency that may be expected from a gas battery of the kind described. The experiments forming the subject of the present article demonstrate that the difference between plain platinum electrodes and those with a surface of platinum black is enormous with relation to their efficiency in a gas cell, it being stated that thousands of tons of platinum foil would be required to produce the same effect as a single ounce of platinum black. What is of still more interest, however, is the energy efficiency of a cell such as that described, the writer stating that it may exceed 33 per cent., and that one could probably be constructed with an efficiency of 80 or 90 per cent. While the experiments with oxygen and hydrogen have little direct practical value, they are, nevertheless, of importance in showing that a gas battery may possess a high efficiency, and therefore have a bearing on the general problem which includes the utilization of gases from ordinary fuel. The comparatively small capacity of a gas cell is apparent from the figures given, from which the deduction may be made that it would take over a year of continuous operation of a cell such as that described to deliver the amount of energy an ordinary dry cell will develop before exhaustion.

PATENTS FOR ELECTRICAL INVENTIONS.

In another column we print an interesting article pointing out the numerous evils incident to our present patent system, and suggesting some remedies. The conclusion to which one is forced by a consideration of the disadvantages under which the poor inventor labors is that patent law, as now administered, practically deprives him of the fruit of his labors instead of, as intended by its framers, securing him in its enjoyment. It is not alone the poor inventor who suffers, for the course of recent patent litigation shows that, even with the most powerful financial support, the delays of law frequently act as a bar to the establishment of rights until a favorable decision becomes of mere historical value. Where the injustice is so manifest it would appear that a remedy should exist near at hand, but this does not seem to be the case. The monopoly conferred by a patent is so complete that it would be unjust to the public and to the claims of prior inventors to permit it to be established upon the almost necessarily incomplete examination of a patent office examiner or a perfunctory adjudication of a court. The monopoly is granted as a reward for a meritorious service to the public, but possession cannot be secured in the face of denials of the performance of the service until their falsity is proved. As we believe that none would care to place the absolute grant of such a complete monopoly into the hands of patent office examiners, litigation is a necessary evil, and efforts should be directed to mitigating its consequences. It is true, as pointed out by Mr. Talbot, that the patent office might be more severe in its interpretation of the word "invention," but this would not affect the most important cases, in which there is a real doubt as to the claims of different inventors or of the right of the enjoyment of a monopoly. The plan proposed by Mr. Talbot would not only shorten the period of litigation and reduce legal expenses but also produce more satisfactory results should the official assessors proposed be men of technical as well as of legal qualifications. A further step in the right direction would be the institution of patent courts presided over by judges scientifically competent to appreciate the technical points upon which they are called to deliver an opinion, for it is only rarely that patent cases can be rationally decided upon purely legal considerations, without reference to the technicalities involved and expert knowledge of the state of the art.

ELECTRIC LEGISLATION.

Numerous bills affecting electrical interests, as will be seen from our account in another column, have been introduced before the Albany Legislature. While many of the measures are not antagonistic to the electrical industries, yet, the reverse is the case with some, particularly that whose object is to regulate the cost of lighting, and another providing for meter inspectors whose salaries are to be paid by electric light companies. The former is undoubtedly a "strike," while the latter, which may pass, is probably more in the interest of political patronage than intended to safeguard electric light purchasers. Another bill with nothing to commend it is the one requiring electrical workers to be licensed, which is an unwarrantable interference with the rights of both employees and employers. The interest of employers to secure good workmen, and of those having work done to see that it is properly executed are sufficient in other trades, and the element of danger in electric lighting work is so efficiently provided for by insurance inspection that the licensing of workmen can accomplish no other end than the usual one of securing advantage to the incompetent at the expense of employers and of really competent workmen. The proposed measure requiring the adoption of fenders on street cars is one that should be passed into law, and it is little less than disgraceful that there should be a necessity for legislative action on such a subject. Street railway companies are none too popular with the public in larger cities, and their refusal to adopt this reasonable precaution except under compulsion indicates a lack of both business sagacity and regard for humanity. A bill now before the legislature that should enlist the support of electric light managers is that permitting central stations to make and sell artificial ice and carry on a cold storage business, though if the latter provision were dropped, it is probable that the handicap under which the measure now seems to labor would be removed. The desirability of an adjunct to a central station that would permit the employment of its machinery during the hours of light load is evident, and an ice-making plant seems to offer in a high degree the necessary qualities. We see no reason why a bill to attain such a desirable end should be burdened with the proviso referred to, as the same object may be attained without thus jeopardizing the main end in view. The bill to create an Electric Light Commission is one that might accomplish a good end, if for no other reason than the benefit to be derived by station managers from the comparative data in the annual reports, provided a rational classification such as that of the English Board of Trade were specified. If, however, the requirements as to the form of station reports were modeled after those in use in Massachusetts, little or no professional service would be rendered, the only effect being to point out general weakness without giving a clue as to the underlying causes. With a proper classification, however, managers would be given valuable assistance in determining, by comparison with other stations, in what directions improvements are possible, and be provided also with means to satisfy the public in case of dispute as to prices, instead of, as at present, having no data to meet demands based upon the cheapest rate paid elsewhere for lighting, regardless of the conditions favoring the low price.

Stock Jobbing.

A most Mephistophelian iniquity, says the London *Electrical Review*, seems to have gotten hold upon engineers and quasi-engineers of late years. No matter how paltry the idea, every self-styled inventor of some new arrangement of furnace, smoke device, or other appliance seems to feel justified in appealing to the public to relieve him of the child of his brain, and the price to the public has steadily gone up. A few short years ago a quarter of a million sterling was looked upon as a big sum to ask. The inventor would get an eighth or so and the syndicate five-eighths, while the shareholders got a quarter as working capital. The provision of working capital is a grand idea. It keeps the thing going, pays cab fares, and finds a steady stream of fees for directors for some time, and enables the concern to go down hill so gradually that by the time the collapse has come about most original shareholders have cleared out and only a few—parsons and old maids—of the original holders bear the brunt of the whole drop from £1 to zero. Emboldened by the successes in the past and encouraged by dreams of wealth to come, a modest quarter million is scouted to-day and half a million or more is asked. A man who sells an addled egg for a shilling cheats the purchaser out of a shilling, it is true, whereas if the egg were sound he would be selling value, but even a sound egg is only worth a penny or so as an egg, though it may be treated in a way to become a chicken. There is a marked difference between patents for mere variations in mechanical apparatus, and patents for new processes such as the Bessemer steel process, which introduce entirely fresh methods and create new industries. Yet these creators of a variation in detail want to make in one or two years more money than the Bessemer patent made in many years. The whole business of company flotation is exceedingly deplorable, and is apparently leading up simply to the booming of a device for a period of a year, the expenditure of money for testing purposes and a general flare-up so as to get the thing on to the public while the boom lasts. After that the deluge.

The Early History of the Polyphase Motor.

In the columns of the London *Electrical Review*, Rankin Kennedy says that Prof. Thompson, having unearthed an early type of induction motor, made by one Bailey, has drawn forth some discussion on the subject. Mr. G. Giorgi, of Rome, claims an early date for Paccinotti as the inventor of the polyphase motor. In that, however, he is wrong, for as Prof. Thompson points out, Paccinotti did not work with *induced* currents, which is the essential feature of the induction motor. Paccinotti worked with shifting poles—a principle of working first introduced in 1849 by Wheatstone, as quoted by Prof. Thompson. It is necessary to draw a broad line of distinction between rotary polar motors and induction motors, and also between the two classes of induction motors, polyphase and single phase. Bailey's is certainly the first polyphase induction motor yet discovered; in every respect it works exactly as the very latest two-phase induction motor. As a two-phase induction motor Walter Bailey's would be self-starting, but it would also work as a single phase motor if the disc were first set in motion and an alternating current sent into one pair of magnets.

Death of George M. Phelps.

The news that Mr. George M. Phelps had died of pneumonia on April 11, after a short illness, was a great shock to an unusually extended circle of friends and acquaintances. Few men in the electrical field were more widely known than was Mr. Phelps, and few were held in higher personal esteem by those who had experienced the charm of his warmly sympathetic nature and the influence of his generous social qualities.

The suddenness of the sad event was startling to those who had known Mr. Phelps intimately. He died in harness, for he was at his desk in the office and apparently in good health until the day before he became ill. Music was one of his greatest pleasures, and he attended a concert on the last evening he was outside the house he was borne forth on the way to his last resting place.

The brief time that elapsed before the end came may be realized from the fact that the day the illness began was the one on which in the ordinary course most of the pages for last week's issue of THE ELECTRICAL WORLD were prepared for press. At 8 o'clock in the evening of the day that edition was dated the friends and neighbors of Mr. Phelps gathered to pay their last tribute of respect to his memory, and on the following morning—bright Easter Sunday—the casket containing his remains was taken to the home of his childhood and laid away forever in the family burying plot.

GEORGE M. PHELPS.

At the funeral the minister expressed the opinion that the wish of Mr. Phelps would probably have been that when his time came he should die comparatively suddenly and in the prime of life and vigor and usefulness, rather than in his old age, after a lingering illness. This is undoubtedly true. As a matter of fact the domestic and social side of the genial gentleman's nature was so highly developed that he must have felt pathetically forlorn since the death of his wife, which occurred but a short time ago, and of his mother, which took place recently. His own death seems to have been the culmination of a series of bereavements in his family within the past year which would have saddened a man of much less delicate sensibilities. Mr. Phelps leaves one child, a daughter, who is married. After the death of his wife he gave up housekeeping, and boarded in a hotel in Brooklyn, but lately lived with his sister.

When once enlisted in any cause, and particularly in those of a social character, George Phelps, as he was familiarly called, spared no effort in its advocacy, and hesitated at no personal sacrifice to insure its success. It was through his efforts that the New York Electric Club was maintained in existence long after it would otherwise have been discontinued, and the American Institute of Electrical Engineers also benefited from the unremitting interest he took in its welfare.

With a strong human interest in everything coming within the scope of his daily life, Mr. Phelps was one of the natures that make the world brighter. Many will miss his hearty greeting and the inspiration of his amiable presence.

George May Phelps was born fifty-two years ago at Troy, N. Y., and was educated at the public schools and high school of that city. His father was the well-known electrical inventor, G. M. Phelps, who invented the Phelps ticker, Phelps telephone, etc., the patents of which were acquired by the Western Union Telegraph Company, and many of whose inventions are still used by that company.

From 1861 until his death, with the exception of an interval of five years, Mr. Phelps was continuously engaged in electrical pursuits. His first position was in the shop of the American Telegraph Company, of which his father was superintendent from the organization of the company until its absorption by the Western Union in 1866. From 1863 until 1866 he served in the auditing department of the American Telegraph Company. From 1871 until 1879 he was his father's assistant in the conduct of the Western Union Company's factory in New York. When in April of the latter year that company gave up its own manufacturing and disposed of that branch of its business to the Western Electric Company, he was appointed superintendent of the factory by the latter company, which position he held until December, 1885.

Early in 1886 Mr. Phelps joined Mr. Franklin L. Pope in conducting the *Electrician and Electrical Engineer*, then published monthly, and acquired a proprietary interest in that journal soon after. When *The Electrical Engineer* was made a weekly and its business incorporated he became president of the company, and latterly added the duties of business manager.

He was a charter member of the American Institute of Electrical Engineers, and was elected one of its managers on May 19, 1885, in which capacity he served on the council until his election as treasurer on May 17, 1887; to this office he was re-elected each year, and at the time of his decease he was the council nominee for the same office for the term beginning May 14, 1895.

Mr. Phelps was for many years before his death a member of the Hamilton Club of Brooklyn and of the Reform Club of New York.

Electricity Before the New York State Legislature.

Legislation affecting electrical matters is somewhat slow this session, Possibly the hard times may have something to do with it, but certainly there is a notable lack of that vigorous demand for franchises and rights of way that characterized the session of 1894. The trend seems rather to be toward securing and perfecting the privileges already granted, and it is somewhat to be doubted if in the end much new legislation goes through.

But one demand for the establishment of a power plant has been made, and that is a renewal of the old "Genesee River Dam" scheme. It was supposed last year that the people of Rochester would decide to build the dam at Mt. Morris themselves and get the profit out of whatever power might be developed, but they seem to think that political influence will in time prevail to have that part of the work done by the State. This bill has passed the Senate and is soon to be brought up for passage by the Assembly. There is a rumor that the construction of the proposed dam by the State at a cost of hundreds of thousands of dollars was a part of a political deal made with certain Rochester politicians prior to the election last fall. Such being the case, it is just possible that the scheme may go through.

There have been no applications whatever for legislation to create electrical cities, such as Waddington, in St. Lawrence County, for instance, was to be. But there has been any amount of legislation proposed to regulate electrical matters in cities that actually exist. Very few divisions of electrical business have escaped the proposed intrusion of the alert lawmakers. Railways, lighting, power, telephone and telegraph plants, all have more or less legislation aimed at them. Out of the numerous trolley accidents, augmented by the strike in Brooklyn, have come demands for laws requiring better informed operatives on the cars, the equipment of all cars with proper fenders, and specific regulations as to speed. One bill provides that every motorman shall be first instructed at the power house as to the nature of the force he is to handle, then placed on a car with an instructor, and until fully capable shall run only on lines that are least traveled. He is also to be a strictly temperate man. Another provides for the licensing in Brooklyn by the Police

Commissioners of motormen and other similar employees, and prohibits policemen from conversing with them while on duty, except for purposes of caution. A measure having a similar purpose provides that the licensing shall be done in New York and Brooklyn by the steam boiler inspectors, who are to employ an electrical expert to do the examining. Inspectors are also to be employed by the cities to see that the trolley cars conform to this and other laws to govern them. It is proposed to secure the immediate adoption of fenders by having the Railroad Commissioners give an open competitive trial at once of the various inventions in the market. They are to select that which will "give the greatest security to life and the least possible injury to persons coming in contact with electric and cable cars while in motion." Street railways must then adopt the same "and shall not be permitted to operate without such fender." The proposed speed regulations provide for six miles an hour in busy sections, and not over eight miles per hour anywhere. It is to be noted in passing that these bills were all introduced early in the session, but are yet kept in the committees. They are not likely to be enacted into laws. A similar fate awaits the bill making a uniform $2 a day rate of wages for electric car employees, and that requiring all car platforms to be enclosed.

By far the most significant bill bearing on the electric railways, however, is that which is being pushed by Senator Stapleton, of Syracuse, and which if it becomes a law will enable those corporations all over the State to go into the business of furnishing power and light. This has been vigorously fought up to date and may be defeated. As it now stands, the measure applies only to places of less than 5,000 population, but it is asserted that this is only an opening wedge. The various power and lighting companies are up in arms against the bill even in its present form. It is also opposed by the interests that want the legislation asked for by another measure providing for an amendment to the law that allows a village to condemn a lighting plant in order to acquire it. The amendment strikes out the words giving the power of condemnation, and simply allows the president and trustees of a village to act. Another bill now a law exempts Richmond and Queens counties and the village of White Plains in Westchester county from the statute authorizing village trustees to contract for electric lighting. Several such measures as those just referred to are now awaiting action and their fate is uncertain. A bill fixing the price per hour to be charged for an incandescent light at one-half cent and for each arc light at not over four cents is buried in committee.

Several measures have appeared which provide for the inspection of electric meters, for the general government of electric light companies as railways are now governed by commissioners, and for establishing the qualifications of all persons installing or handling electrical apparatus of any form. Possibly the inspector of meters will be established, but the bill is not yet perfected. The object is to create an office and make the electric light companies pay for it. There is a bill creating a State gas and electric light commission, but it is practically dead. About the same may be said of the measure providing for an examining board in each judicial district, to consist of four persons, who are to pass on the qualifications of all electrical workers and issue licenses to them. A bill which has the same fate before it, apparently, empowers electric light, heat and power companies to make and sell artificial ice or carry on a cold storage business.

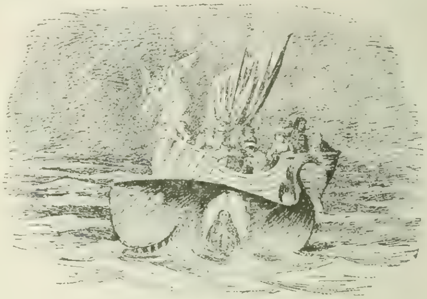
The old familiar attempts to reduce telephone and telegraph rates are not missing this session. The telephone rate bill appeared in the same form as last year, but has been much amended by its introducers, particularly in the way of raising the flat rates fixed, and is now in an uncertain condition. One telegraph bill proposed to reduce the rate to 15 cents for 10 words, with a half cent for each extra word thereafter, and to make the same rate for night messages of 20 words. It will not be heard from, nor will its associate, which made the rates from 7 a. m. to 7 p. m. 20 words for 10 cents and 1 cent per additional word, while night messages were to be 10 cents for 10 words and a half cent for each additional word.

A number of bills affecting electrical interests in various ways also appear on the files. One provides that all the elevated railway cars must be lighted either with electricity or gas after June 1, and another restricts the lighting solely to electricity, while both provide dire penalties for failure to comply with their requirements. One prohibits the employment of a railway telegrapher under 18 years of age and of at least one year's previous experience. One gives to electric light companies the same rights of condemnation to secure right of way as telegraph companies have. Another, which has become a law, gives the Canandaigua Electric Light & Railway Company the right to take condemnation proceedings. Another fixes a heavy fine for revealing any telegraph or telephone message, or for attempting to secure knowledge of the same. The latest to appear creates the Mayor and the Subway Commissioners of Brooklyn a board of electrical control whose duty it is to put all wires under ground in that city and pass on all extensions of present lines. Very few of these bills have escaped the committees and very few are likely to do so.

Antiquity of the Incandescent Lamp.

One of the most interesting sights of New York is a performance at one of the Jewish theatres on the Bowery, there being several near Canal street patronized exclusively by Russian Hebrews, in which the plays are produced in the Jewish-German-Russian jargon with a mediæval crudity. Each theatre has its own playright who, however, owing to the fondness of the audience for realistic scenes, has to divide the honors of the reproduction with the important personage who creates the realistic accessories.

How important the functions of the latter are will be evident from the following description and illustration, taken from last Sunday's *Herald*, of a scene from a play entitled "Jonah," now being produced at the Old Bowery Theatre. "After Jonah has been thrown overboard, for a moment," says the reporter, "it appears that nothing can save him. But just as he is sinking for the last time a great fish comes along, shaped something like a flounder, and deporting itself like a ball of rubber; it opens a very wide mouth and Jonah climbs in. Instantly the ship, which has been hammering the stage boards in its wild tossing, becomes still. The ballet sailors on the deck set up a jubilant chorus, and a gauze dressed angel drops down from the flies, while the fish—who has disappeared behind the scenes—turns about and re-enters with a new side presented to the audience. This new side is as open as the day. Through an oval window in the whale's larboard quarter Jonah is disclosed sitting in great splendor of red and green, with soft lights, and not a suggestion of discomfort." The anachronism of the incandescent lamp probably did not appeal to the enthusiastic audience.



JONAH IN THE WHALE.

Electricity Extraordinary.

The newspaper press is circulating a wonderful tale concerning a Chicago hotel which, it is gravely stated, is "heavily charged with electricity." The story runs that when one guest started to shave himself a huge spark leaped from the razor and startled him to such an extent that involuntary suicide nearly resulted. We are further informed that another guest stepped into a bathtub and immediately howled lustily for assistance, being assailed with a sensation of having thousands of needles unceremoniously jabbed into his person. The employes of the hotel broke open the door and rescued the victim who, however, is said to have experienced no bad effects from his marvelous bath. The tale concludes with the statement that the hotel is losing patronage, and will probably be pulled down!

Telegraph Tariffs in Turkey.

A uniform tariff for telegrams in the Turkish Empire has been drawn up by a specially appointed commission in Constantinople. The project has been submitted to the Turkish Posts and Telegraphs Department.

An Office Building Lighting Plant.

A FEW years ago the electric light equipment of office and other large buildings was more frequently than otherwise carried out in a haphazard manner, particularly with respect to the distribution; and even in recent buildings there may be found evidences of poor design and crude workmanship. In one of the most pretentious of the office buildings lately erected in New York, for instance, the risers are encased in common wooden moulding in the runways, the moulding being disposed in a number of layers, and each layer nailed to the one immediately beneath it. A good example of the opposite class of work is to be found in the electrical equipment recently installed in the fine new twelve-story building of the Fidelity and Casualty Company, located at the corner of Cedar and Church streets, New York. Here we find evidence on every hand of careful design, while the generating plant and distribution system are of the most modern character, including direct connected machinery and iron armored conduit.

The generating plant consists of two General Electric multipolar machines, each of 25 kw capacity, direct connected to Ames engines, as shown in Fig. 1. The engines are 10x10 inches, of the simple non-condensing automatic type, and rated at 50 horse power at an initial pressure of 80 pounds and a back pressure of five pounds when running at 300 revolutions per minute and cutting off at one-fourth stroke. While the normal working steam pressure is placed at 80 pounds, the engines are designed to work safely at a cylinder pressure of 125 pounds should it become desirable. The shaft and crank are forged in a single piece, and the shaft is extended at one end, the dynamo armature being mounted directly upon the extension, thus obviating an intermediate coupling.

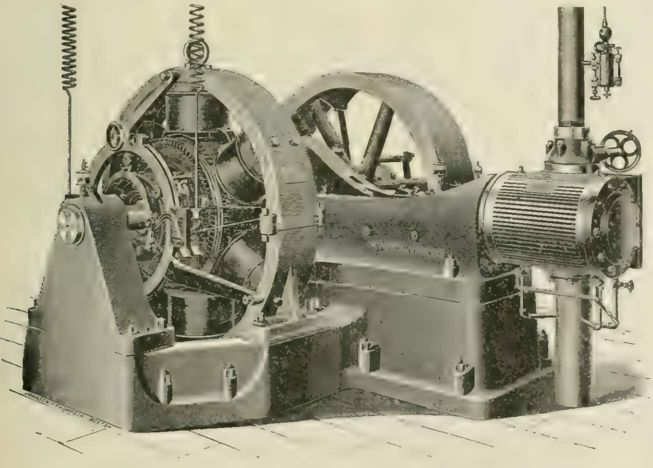


FIG. 1.—DIRECT CONNECTED GENERATING SET

Each dynamo stands upon a common base with its engine, insuring the preservation of alignment between the frame of the dynamo and that of the engine. The dynamos are wound for 110-125 volts and compounded for three per cent. drop; the heating limit is placed at 70 degrees F. above the surrounding atmosphere during a ten-hour continuous run under full load, and the dynamos are capable of carrying a 20 per cent. overload.

The switchboard is of polished white Italian marble mounted in a substantial iron frame, and rests upon a brick pier extending along its full length. This pier is faced with white marble tiling to correspond with the switchboard. By reference to the floor plan of the dynamo room, shown in Fig. 2, it will be noticed that the board is set in one corner of the room between one of the pillars and the wall, and that the conformation of the wall in the rear is most convenient, giving as it does a good sized passageway or working space back of the switchboard. The switchboard connections are shown diagrammatically by Fig. 4. The rheostats are mounted on the back of the board, in accordance with the latest practice, with handles and dials on the front. A differential voltmeter is provided for convenience in throwing the dynamos in parallel, the connections being such that when the machines are at equal voltage the voltmeter windings neutralize each other and the needle stands in the centre of the scale.

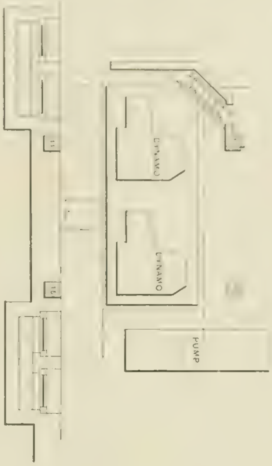


FIG. 2.—FLOOR PLAN OF DYNAMO ROOM.

An automatic magnetic circuit breaker protects each generator from injury through excessive overload; the feeder switches are all quick break, the fuses are laid in hard rubber channels to avoid disfiguring the surface of the marble, and all the appointments are of the latest and most approved patterns.

The main switch is double throw, one side connecting the building circuits with the street mains and the other with the local generating plant. The building is wired on the three-wire plan and when supplied from the street mains the connections are so made. The neutral wire throughout is, however, equal in cross section to the sum of the positive and negative wires, and when the lights are operated from the house plant the neutral feeders are connected to one pole of the dynamos and the two outside wires to the other pole, forming a split two-wire system. The bus bars have a minimum cross section of 1,000 circular mils per ampere and the connections are given a contact surface of 1,500 circular mils per ampere of current.

From the switchboard a three-wire feeder, each wire of which is of 300,000 circular mils cross section, goes to a meter at the street service entrance, and five feeders run to the various distribution points in the house wiring. The cellar feeder is quite small, handling as it does only the few lights in the cellar. Feeder *A*, consisting of two No. 2 outside wires and a No. 00 neutral, supplies the lights on the first, second and third floors; feeder *B*, comprising two No. 3 wires and one No. 0, supplies those on the fourth, fifth and sixth floors; feeder *C* serves the seventh, eighth and ninth floors, and feeder *D* carries current to the tenth, eleventh and twelfth stories. The last two feeders are of the same cross section as feeder *A*.

At each floor an iron cut-out junction box is placed, containing a slate panel board similar to that shown in Fig. 4, from which two sub-feeders run to distributing wall pockets. The wiring is run in iron armored conduit throughout the building, one wire in a tube excepting the branch mains, which are "duplexed."

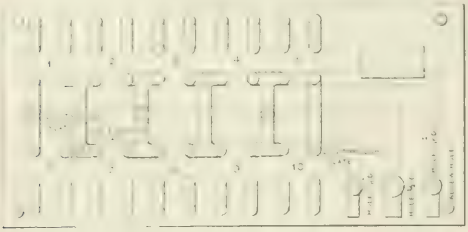


FIG. 3.—SLATE PANEL BOARD.

In addition to the electric light wiring the building is equipped with a complete system of telephone, telegraph and "ticker" circuits, comprising vertical "risers" from the cellar to the top floor, each pair of "risers" being provided on each floor with a branch connection for taking off distributing circuits.

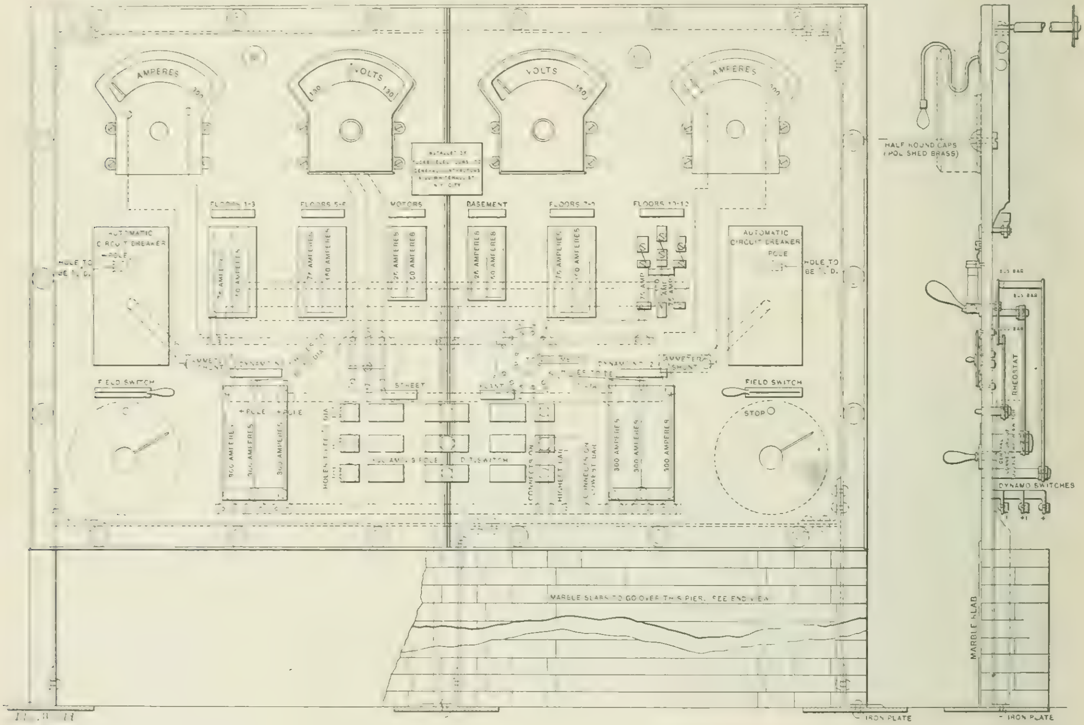


FIG. 4.—SWITCHBOARD CONNECTIONS.

It is notable as indicating the character of the workmanship that the first test after the completion of the wiring showed the entire system to be absolutely free from any trouble or defect. The plant was installed by the Tucker Electrical Construction Company under the supervision of Mr. H. A. Sinclair, to whom we are indebted for information concerning details.

Reorganization of the "Electrical Engineer."

It was announced on Monday that a reorganization of the *Electrical Engineer* corporation had been effected with the following officers: President, T. C. Martin; vice-president and treasurer, Joseph Wetzler; secretary and business manager, A. C. Shaw.

Patents for Electrical Inventions.

It is becoming a serious question at the present day whether the issuance of a United States patent confers any real right worth having, or whether it merely amounts to a mere license to indulge in the luxury of a long and expensive litigation with a very uncertain termination.

This is especially the case in connection with electrical inventions, and the objectionable results of the present system have been in the last few years very abundantly illustrated in relation to the electrical industry, though the present condition of affairs is eminently unsatisfactory throughout the whole of our patent system.

No one can foresee with any degree of certainty what will be the particular idiosyncracy of the judge who may have the deciding of a particular case, or how long it will take to obtain a decision, or whether or not the document he holds is so restricted in its scope by the state of the art that the rights conferred by it are of no practical or commercial value.

The impecunious man having a valid patent on an invention of possibly transcendent merit and enormous value is now practically at the mercy of a rich and unscrupulous corporation or individual, and it is notorious that if any person or body financially strong takes a fancy to appropriate the fruits of a patented invention, the patent laws of the United States exercise a very slight restraining influence in the matter. If the invention is worth taking it is probably also worth the additional expense of counsel and experts to delay and oppose.

"*The courts are open.*" Are they? Yes, when the suitor has paid a considerable sum for court fees, several hundreds of dollars to counsel, the like to expert and other witnesses, notaries, stenographers, and for miscellaneous expenses, and, perhaps, a hundred or two dollars for printing, and when he comes in with his counsel, two or three printed volumes of testimony and his completed case after a lapse of from one to three years, then he draws near to the Circuit Court of the United States, and is heard, that is, if the case does not "go over until next term." When the case is heard, it may be before a learned and experienced Judge, it may be before another who is at sea in mechanical or electrical subjects, and one whom the explanations of experts only bewilder. The court after hearing several hours of argument reserves its decision, and in a week or two or month or two or more files an opinion which, in all probability, only satisfies one side. Then, of course, the appropriate proceeding is to appeal to the higher court. In the days when appeals went to the Supreme Court of the United States, usually years in arrears with its work, the aggressor was safe for an indefinite period. Some amelioration was introduced by the establishment of the new Court of Appeals, but the delay in cases involving patents, and especially, perhaps, electrical patents, is still sufficiently serious to call for relief, if relief be possible.

The Patent Office, admirable as it is in many ways, is not in a position to issue some 20,000 patents a year and afford any satisfactory assurance or guarantee as to the degree of protection afforded by the grant. It has been hampered and rendered less efficient by the indifference of Congress for years, and it is that body which is principally to blame for defects in the issuance of patents. With proper facilities the Patent Office could approach much nearer to actuality in purporting to grant an inventor the exclusive right to manufacture, sell, and use an invention for a term of years—a grant which must at present be taken with a very important implied proviso.

Other circumstances are also responsible for the doubtful value of patents; among these are the fictitious worth in the eyes of the general public of the mere word, "Patented," regardless of the true value of the invention, and the consequent triviality of many inventions patented; then, again, many manufacturing corporations appear to regard the man whom they "hire" as an "inventor" or "electrician" in the light of a hen who is expected to lay so many "inventions" in the course of a year. As a result, many of these so-called inventions are the merest mechanical improvements of the most paltry nature. The ordinary stockholder, however, for whose benefit they are provided, is just as happy and parts with his money with the same eagerness as if they represented something of value.

The unprincipled horde of cheap patent "attorneys"—"no cure, no pay"—who will procure a patent on almost anything, are responsible for a very large number of utterly worthless patents. Usually they do not know, and do not care, whether the patent describes the true invention or not, and the client is almost as culpable—he wants a "cheap" patent, and he gets it; not until he wishes to protect himself by it against an infringer does he discover to what extent he has an "exclusive right." Only the general spread of education and common sense can be relied on to remedy this evil. To return, however, to what is, perhaps, on the whole, a more important trouble, the delay, expense and uncertainty of patent litigation, let us notice, briefly, some of the more noticeable instances Taking, for example, the case of the Edison incandescent lamp patent, it was not until after years of enormously expensive litigation that a final decision, if final it can be called, was reached, and now the electrical world is anxiously awaiting the decision of the United States Supreme Court upon a question, raised in an entirely distinct case, which will settle authoritatively whether or not that patent has really expired.*

The Thomson regulator patent of 1881, in deference to which thousands of dollars had been paid in tribute, has been recently held invalid, although previously sustained, and now we must wait for a decision of the appellate Court before knowing "for good" whether it is to be respected or not.

The Edison feeder and main patent has met with a like fate, and on similar grounds; it remains to be seen what will happen eventually to the three-wire patent, attributed in this country to Edison and in England to Hopkinson, when it shall be presented for decision, as no doubt it will be some time in the future.

The Brush double carbon patent and the Bell telephone patent cost years of time and very large sums of money to uphold.

Litigation of this character can only be maintained by the very wealthiest corporations, and it is hardly too much to say that the uncertainty, delay and excessive cost amount to a practical denial of justice in very many cases. Most undoubtedly the legitimate course and development of the business are seriously hampered and impeded.

To what is this condition of affairs due? In the first place, largely to the fact that it is practically necessary in patent suits to proceed in *equity* rather than at *law*, principally for the purpose of obtaining an *injunction* against the manufacture of the alleged infringing apparatus, as well as the recovery of profits and damages, and this involves the application in such cases of the old English chancery procedure, which, however well adapted to arrive eventually at the true merits of a question, is neither expeditious nor economical, even as modified by the appropriate rules of court.

Under these rules there is a very comfortable and convenient way of taking the testimony in such cases, viz: before a notary public at any convenient place, usually the office of one of the counsel, and these proceedings largely assume the aspect of a comfortable family party, with intermissions of conversation and good stories, watching a game of chess between counsel and the "expert witness." The method permits of frequent adjournments for the convenience of any one concerned, and is a very agreeable one to all but the unfortunate individual who has to "pay the piper." Rich corporations who can afford to indulge in such luxuries are, perhaps, not to be pitied, but to the man of moderate means it is a serious matter, so serious that he oftentimes prefers to put up with his loss rather than to embark upon the sea of litigation.

Moreover, the *onus* of deciding, practically without assistance, the facts, as well as the law, in matters involving possibly delicate scientific or mechanical questions, is too serious a one to be placed on the shoulders of an individual judge devoid of special technical training, and also charged with the duty of dealing with the other mass of litigation coming before a Federal tribunal. Such a judge is practically without assistance of a technical character, as the opinions of expert witnesses employed by the respective parties must from the nature of things be more or less biased, even though unconsciously and with no intention to mislead. If the court were able to hear only one side, a conclusion could be much more readily reached, but that plan also is open to objection. Such a judge occupies the position of Captain Macheath, and is unable to eliminate for himself the factor of bias from the substratum of scientific truth.

Another cause of the delay in patent cases is the fact that except in the case of an application for an injunction on a patent already sustained, and where infringement is clear, there is no prompt intermediate proceeding readily available for the decision of some comparatively simple question of fact which might dispose of the whole case. It is true that there is a provision in the Act of 1875, for referring questions of fact to a jury, but the fact that this proceeding is so seldom employed indicates that it fails in some way to satisfactorily meet the requirements of the case. As the law now stands the decision of all questions, except as above stated, practically has to await the final hearing of the case, at which time possibly the larger portion of the testimony is useless, the patent, perhaps, being held invalid on, for instance, the ground of "prior publication," the merits of the invention, and other defences not being considered at all. If there were some expeditious interlocutory proceeding by which such questions could be disposed of there seems little doubt but that a mass of protracted litigation could be avoided. It may be well to remember the principal grounds of defence to a suit for infringement of a patent:

1. Non-infringement.
2. Prior patent or publication.
3. Public use for more than two years prior to the application for a patent.
4. Absence of the quality of "invention."
5. Abandonment of the invention to the public.
6. *Laches.*
7. Patentee not the original and first inventor.
8. Fraud.

Now, it seems evident that certain of these defences, several of which are usually set up in the answer, may be entirely unnecessary in the final decision of the case, which may hinge, for example, on the point whether a prior description did or did not anticipate the invention in question. It is quite conceivable that that question may be capable of easy and prompt decision; under the present system, however, it awaits final hearing upon the whole testimony introduced in the suit, upon not only that point, but also upon all the other defences which may be raised. Is it not possible to discover some plan by which such "preliminary" defences can be satisfactorily disposed of at an early stage of the case? In many cases the exact extent and scope of the patent sued on would be agreed on by both sides, and the decision of such a question as, for example, that suggested above, might be readily dealt with by a judge "in chambers," assisted, if need be, upon technical questions by independent expert "official assessors" appointed *pro hac vice* by the court. The system of "official assessors" is employed across the water with, it is understood, satisfactory results, and would relieve the court of a vast amount of labor and assist materially in the disposal of questions of a scientific or technical nature. Their duties need not end with the preliminary matters in case the suit is found to be such as must proceed to final hearing, but they could inform and advise the court at any stage of the proceedings. Their communications to the court could be as confidential as the deliberations of the members of a court consisting of a plurality of judges, and, in view of the suspicion of corruption which, unfortunately, attaches to almost every public official, it were better that this should be so.

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* Since the above was written the U. S. Supreme Court has decided that an invention patented abroad before the *issue* of the U. S. patent for it is entitled to protection only until the expiration of the foreign patent.

Such official assessors would not be invested with any judicial character, but would merely act in an advisory capacity, and obviate the necessity for the education and instruction of the court in an unfamiliar art, a process which, under the present system, is imperfectly effected in a slow and expensive manner.

By some plan of the nature suggested the technical portion of the testimony could be "boiled down," and the essential portions only considered by the court, the assessors submitting their conclusions and advice, to receive such weight in formulating the decision as the court thinks they merit. Such an arrangement would involve no serious disruption of the present procedure, and would, it is believed, relieve litigants of much of the present uncertainty, delay and expense.

With regard to the issuance of patents, it can hardly be contended that more than a very small proportion of the enormous number turned out from the Patent Office represent really meritorious "inventions" of practical value to the community, a vast number covering trivial mechanical improvements or mere changes of an almost obvious nature. If primary examiners assumed an attitude of greater stringency in rejecting applications for want of the peculiar element of "invention," and for want of utility, the number of worthless patents might be largely curtailed without injustice to the meritorious inventor, as the right of appeal to the board of examiners, and so on, would still be available.

It is not advisable to "tinker" too much with our patent system, as the "granger" element is always waiting an opportunity to attack all patents, good, bad or indifferent, and capital has generally an ax to grind whenever the question of patents arises. The above suggestions, however, if carried out, would not, it would seem, injure any one, and at the same time would afford a certain measure of relief.

Electricity in Factories and Workshops.

Some important installations recently carried out in England and on the Continent afford excellent illustrations, says the London *Electrical Review*, of the varied uses to which electricity can be successfully and economically put in mills, workshops, factories, and similar establishments, more especially where large quantities of machinery require to be driven. At the extensive ribbon and silk manufactories of Messrs. James Forrest & Co., at St. Etienne, is one of the more interesting of recent electric driving installations carried out in France. The factories, which employ 500 people, contain 100 looms for weaving special articles, quadruple and sextuple plushes and ribbons, all of which are driven by electric motors. The spinning room machinery is likewise all driven electrically, as are also the winding machines for raw silk. It required a certain amount of confidence on the part of the owners of these factories to embark upon so extensive a scheme, and it was only after considerable hesitation, and weighing carefully and comparatively the various points for and against, that electricity was selected as the motive power for driving the many machines. The question of efficiency, loss incurred in transmission, and picturesque appearance, all told in favor of electricity when compared with the out-of date system of overhead shaftings, pulleys, etc., which absorb so much power, and also in so many factories present an appearance of inextricable confusion.

Electric Traction in France.

The municipal authorities of Lyons have voted in favor of the application of the Lyons Omnibus and Tramways Company for permission to convert the Lyons St. Fonsvénissieux tramway into an electric line. Plans have been prepared, and are at present receiving the consideration of the local authorities, for the construction of four lines of electric tramway in the town of Rennes.

Electrodynamic Machinery.—XXXII.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

176. In the operation of a dynamo-electric generator considerable difficulty is frequently experienced from the sparking which occurs at the commutator, that is to say, instead of the current being quietly carried off from the armature to the external circuit, a destructive arc which produces burning occurs between the ends of the brushes and the commutator. The tendency of this sparking, unless promptly checked, is to grow more and more marked from the mechanical irregularities produced by the pitting and uneven erosion of the commutator segments. It becomes, therefore, a matter of considerable practical importance to discuss the causes of sparking at the commutator, and the means which have been proposed and are in use to overcome the difficulty.

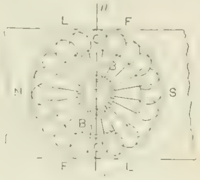


FIG. 145.—GRAMME-RING ARMATURE IN BIPOLAR FIELD ON OPEN CIRCUIT.

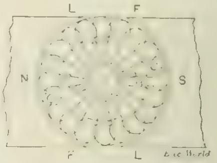


FIG. 146.—GRAMME-RING ARMATURE WITH BRUSHES DISPLACED FROM NEUTRAL LINE.

177. When a Gramme ring armature, such as that shown in Fig. 145, is rotated on open circuit in a uniform bipolar field, the brushes, if placed on the commutator, must be kept at points diametrically opposite corresponding to the line n n. If applied to the commutator at any other point, sparking would probably occur, although the armature is on open circuit. The reason for this is seen from an examination of the figure, which represents a pair of coils C, C', about to undergo commutation; *i. e.*, about to be transferred by the rotation of the armature from one side of the armature to the other, and being short circuited by the brushes as they bridge over the adjacent segments of the commutator, to which their ends are connected. Since the coils C, C', at the position shown, embrace the maximum amount of flux passing through the armature, there will be no E. M. F. induced in them, and, consequently, there will be no current set up during the time of short circuit under the brushes. In other words, the prime condition for non-sparking at the commutator is that the coils shall be short circuited only at the time and in the position where no E. M. Fs. are being generated in them.

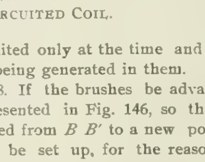


FIG. 147.—DIAGRAMMATIC REPRESENTATION OF FLUXIN MAGNETIC CIRCUIT OF SHORT-CIRCUITED COIL.

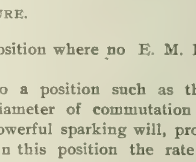


FIG. 149.—DIAGRAMMATIC REPRESENTATION OF FIELD FLUX PASSING THROUGH ARMATURE.

178. If the brushes be advanced into a position such as that represented in Fig. 146, so that the diameter of commutation is shifted from B B' to a new position, powerful sparking will, probably, be set up, for the reason that in this position the rate of change in the flux linked with these coils is considerable, and, consequently, there is a considerable E. M. F. induced in them, so that when they are short circuited by the brushes heavy currents tend to be produced in the circuit of these coils according to Ohm's law. If, for example, a bipolar Gramme ring armature gives rise to a total useful flux of one megaweber, and there are 1,000 turns on the armature and 50 segments in the commutator, then, if the speed of rotation be 10 revolutions per second, the E. M. F. set up between the brushes will be

$$\frac{10 \times 1{,}000 \times 1{,}000{,}000}{100{,}000{,}000} = 100 \text{ volts},$$

and, since there are 25 commutator bars on each side of the diameter of commutation, there will be an average of four volts per coil of 20 turns. If the resistance of each coil be 0.01 ohm, the current which tends to be set up in a short circuited coil having the average E. M. F. is

$$\frac{4}{0.01} = 400 \text{ amperes.}$$

179. It now remains to be explained how the existence of a powerful current in the short circuited coil will produce violent sparking at the commutator. It is well known that the presence of a spark indicates a higher E. M. F. than the four volts which we have assumed in this case to be generated in a short circuited coil. The increase in the voltage at the moment of sparking is due to the *inductance* of the coil.

At the moment of short circuiting the coil by the bridging of the brushes across the two adjacent commutator segments a powerful magnetic flux is set up in the coil, owing to its M. M. F This flux is so directed through the coil as to set up in it an E. M. F. which opposes the development of the current. On the cessation of the current, owing to the breaking of the coil's circuit at the commutator, the coil is rapidly emptied of flux, and a powerful E. M. F. is set up in the same direction as the current, sufficiently powerful to produce sparking between the brush and the edge of the segment it is leaving. The E. M. F. so generated during the filling or emptying of the loop by its own flux is called *the E. M. F. of self-induction.*

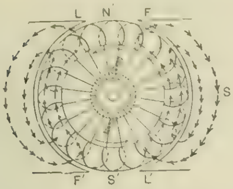


FIG. 148.—DIAGRAMMATIC REPRESENTATION OF MAGNETIC CIRCUIT OF ARMATURE.

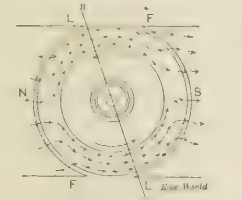


FIG. 150.—EFFECT OF SUPERPOSING ARMATURE FLUX ON FIELD FLUX.

180. Fig. 147 diagrammatically represents the flux produced in the short circuited coils C, C', by the M. M. F. of the current produced during the short circuit. This flux passes principally through the air gap and neighboring pole face, a small portion passing through the air in the interior of the armature between the core and the shaft. The greater the flux produced by the coil the greater will be the E. M. F. developed in the coil, when the flux is suddenly withdrawn. The capability of a conducting loop or turn for producing E. M. F. by self-induction is called its *inductance*, and may be measured by the linkage of flux with the turn per ampere of the current it carries, that is, by the amount of flux passing through it.

181. We have thus far considered the coils C, C', as being composed of a single turn. If, however, each of these coils is composed of two turns, and the same current strength passses through each of these turns, then the M. M. F. of the coil will be doubled, and if the iron in the armature core and pole face is far from being saturated, the amount of flux passing through the two turns will be twice as great as that which previously passed through one. When this flux is introduced or removed, it will generate E. M. F. in both turns, and, consequently, will induce twice as much E. M. F. in the two turns together as in a single turn. The inductance of the coil, or its capacity for developing E. M. F. by self-induction, is thus four times as great with two turns as with one, because there is double the amount of flux, and double the number of turns receiving that flux.

182. It is evident, therefore, that the inductance of a coil increases rapidly with the number of its turns, although not quite proportionally to the square of the number, since, with a large number of turns, although the M. M. F. is increased in proportion to the number, yet the amount of flux passing through each of the turns, owing to leakage, is not the same. The E. M. F. of self-induction generated in each coil depends:

(1). First upon the E. M. F. induced in it by the revolution of the armature.

(2). Upon the resistance of the coil or its capability for allowing a large current to flow through it.

(3). Upon its inductance or capability for permitting that current to induce a powerful E. M. F. when the circuit is made or broken.

The E. M. F. induced on making the circuit at the commutator is advantageous, since it checks the development of the current; that on breaking the circuit is harmful, since it enables a spark to follow the brush.

If, therefore, no sparking is to occur in a dynamo-electric machine at no load, the brushes must rest on segments connected with coils in which no E. M. F. is being generated.

183. If the external circuit of the armature be closed through a resistance, so that current flows through the armature coils and brushes into the external circuit, the former conditions become considerably modified.

Fig. 148 represents the condition of affairs in which a current is flowing through the armature coils and the brushes are resting on the commutator with the diameter of commutation at the neutral points, or in a plane at right angles to the polar axis.

In this figure the direction of the armature rotation is the same as shown in previous figures, namely, counter-clockwise. Here the flux produced by the M. M. F. of the armature coils takes place in the circuits diagrammatically indicated by the curved arrows. The magnetization, therefore, produced by the current circulating in the armature turns is a *cross magnetization*, or a magnetization which is at right angles to the magnetization set up by the field flux. The field flux through the poles and armature is diagrammatically indicated in Fig. 149, where the north pole is assumed to be situated at the left hand side of the figure, and the average direction of the field flux is at right angles to the average direction of the armature flux. An inspection of Figs. 148 and 149 will show that at the *leading edges of the pole piece*, L, L', that is, at the edges of the pole piece, which the armature is approaching, the direction of the flux produced by the armature is opposite to that of the flux produced by the field, and that, consequently, the effect of superposing these fluxes is to weaken the flux at the leading edge as is shown in Fig. 150. On the contrary, at the following edges F' and F, of the pole piece, the direction of the armature flux coincides with the direction of the field flux, and the superposition of these two fluxes will have the effect of intensifying the flux at the following edges. Consequently, the *neutral line* in the armature, or a line symmetrically disposed as regards the entering and leaving flux, will no longer occupy the position N, N, at right angles to the polar axis, but will occupy a position N, N'; therefore, in order to set the brushes so that they may rest upon commutator segments connected with coils having no E. M. F. generated in them, it is necessary to bring the diameter of commutation into coincidence with the neutral line, or to give the brushes a *lead; i. e.*, a motion forward in the direction in which the armature is rotating.

184 This, however, will not in itself, as a rule, prevent sparking, for the reason that induced E. M. Fs. are produced in the coil under commutation at load, even although the coil being commuted has no E. M. F. set up by rotation. This E. M. F. is due to the inductance of the coil and to the load current that it carries. An inspection of Fig. 151 will show that as the coil C approaches the brush B the current in the coil, as shown by the arrows, is directed upward on the side facing the observer, while on leaving the brush after having undergone commutation, the current in the coil will be flowing in the opposite direction or downward. The sudden reversal of the current in the coil under commutation produces a sudden reversal of the magnetic flux linked with the local magnetic circuit of that coil, and this sudden change in the magnetic flux through the coil induces in it a powerful E. M. F., causing a spark to follow the brush.

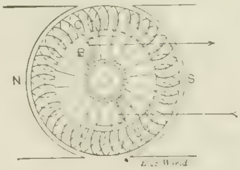


FIG. 151 —REVERSAL OF CURRENT IN ARMATURE COILS DURING COMMUTATION.

In order that no spark shall be produced from this cause, it is necessary that before the brush leaves the segments the current in the coil shall have become reversed, and will, therefore, be flowing in the same direction as that which will pass through it during its passage before the pole face N. In order to effect this, it is necessary to bring the coil that is being commutated into a field of sufficient intensity to induce in it, while short circuited, a current strength equal and opposite to that which passes when it first becomes short circuited by the brush. It is not, therefore, usually possible to keep the brushes on the neutral line as shown in Fig. 150 at $n' n'$, but their lead must be increased, until the coil under commutation is in a sufficiently powerful field beneath the pole face to produce or nearly produce this reversal of current. The amount of lead necessary to give to the brushes in order to effect this will depend upon the inductance of the coils and also on the strength of the current in the armature.

185. The conditions which favor marked sparking at the commutator of a generator are, therefore, as follows; namely,

(1). A powerful current in the armature; *i. e.*, the sparking increases with the load.

(2). A large number of turns in each coil connected to the commutator; *i. e.*, sparking increases with the inductance.

(3). A great distortion of the neutral line through the armature, or a powerful armature reaction.

(4). A high speed of rotation of the armature, since the current in the coil has less time in which to be reversed during the period of short circuiting.

The conditions which favor quiet commutation, or the absence of sparking, are as follows; namely,

(1). A small number of turns in each commuted coil or a large number of commutator bars.

(2). Decrease of current strength through the armature.

(3). A lead of the brushes.

(4). A powerful field or a high magnetic intensity in the entrefer due to the M. M. F. of the field magnets.

Gas Batteries.—II.

BY C. J. REED.

While the experiment described in THE ELECTRICAL WORLD of April 6 does not prove conclusively that there is no combination of oxygen and hydrogen in the presence of ordinary platinum electrodes, it shows that if such a reaction takes place it requires a more exact experiment to prove it. Such an experiment is now in progress.

Experiment II.—*Electrolytic oxygen and hydrogen with electrodes of platinum foil.* The object of this experiment was to determine the effect of electrolytic oxygen and hydrogen in a cell similar to that shown in Fig. 1, but used as an accumulator instead of a primary battery. The wires, C and C', were, therefore, dispensed with and an electric current of one ampere was passed through the platinum foils until the hydrogen depressed the surface of the solution to a point 10 mm above the bottom of the foil; the volume of oxygen formed being about half that amount. In other respects, the form and dimensions of the apparatus, strength of the solution and all conditions of the experiment were as nearly as possible like those of Experiment I. The circuit was closed through a Weston voltmeter (resistance 356 ohms) and the following observations were recorded:

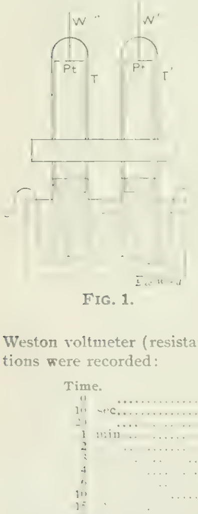


FIG. 1.

Time.	Volts.
0	.75
10 sec	.04
20	.035
1 min	.025
2	.02
3	.015
4	.011
6	.007
10	.006
15	.005
20	.004
25	.003
30	.002
35	.001
40	.001
45	.001
[illegible]	.001
60	.001
[illegible]	.001
100	.001
6 hours	.0005 (?)

At the end of 40 minutes the circuit was opened and quickly closed. There was a throw of the needle of .10 volt, falling rapidly to .001. At the end of six hours, on opening the circuit about five seconds and closing again, there was a throw of the needle of half a scale division, returning instantly to zero or less than .0005; showing that the cell had arrived at the same condition as in Experiment I. That is, the electrolytic product, whatever it may have been, was consumed and the cell was acting no longer as an accumulator. The experiment was, therefore, discontinued at this point.

The experiment shows that the action in this case is undoubtedly that of a galvanic cell during at least half an hour. The energy evolved was due either to the combination of ozone or hydrogen peroxide with hydrogen, or else to some reversible change in the platinum foil produced by electrolysis, and not to the combination of ordinary oxygen and hydrogen.

The total output of the cell up to the time when it had returned to the permanent condition, similar to that of the cell in Experiment I., could hardly have exceeded .052 ampere second and could not have consumed more than 5.4×10^{-7} gramme (.0065 cc) of hydrogen.

Experiment III.—*Hydrogen from zinc, atmospheric air and electrodes of platinum foil.* The apparatus and conditions were the same as those of Experiment II., except that no electrolytic gases were used. The hydrogen was obtained by treating pure zinc with dilute sulphuric acid and purifying the gas by thoroughly washing it, first with argentic nitrate to remove traces of hydric sulphide and lower oxides of sulphur, then with sodic hydrate to remove traces of nitric acid.

Twelve cubic centimetres of this hydrogen was admitted by displacement into the hydrogen tube and an equal amount of air into the other tube. The solution, as in the other experiments, was dilute sulphuric acid of specific gravity 1.125.

On closing the circuit through the voltmeter (resistance 356 ohms), there was a throw of the needle indicating nearly .02 volt, but returning instantly to zero. On opening the circuit five seconds and closing again the same deflection was obtained. This was repeated a great many times, and there appeared to be no difference between the action of the chemically prepared hydrogen on atmospheric air and that of heated electrolytic hydrogen upon heated electrolytic oxygen.

The cell was short circuited and allowed to stand for eight days. At the end of this time the hydrogen appeared to have diminished about .075 cc. This corresponds to a steady current during the eight days of 8.75×10^{-7} ampere and an electromotive force on short circuit (about 6 ohms) of 5×10^{-6} volt.

Admitting that in this experiment there was a loss of .075 cc of hydrogen in eight days and that this loss may have been due to voltaic combustion, there is still no certainty that it was due to combustion of oxygen and hydrogen; since in this case there were present both nitrogen and oxygen. There is no reason to believe that nitrogen and hydrogen would be less likely to undergo cold combustion than oxygen and hydrogen, especially since it has been shown by W. E. Donkin (see Proc. Roy. Soc XXI., 281) that nitrogen and hydrogen combine directly under the influence of the silent electric discharge.

Experiment IV.—*Electrolytic oxygen and hydrogen with electrodes of platinum foil and platinum black.* The apparatus was identical in size and construction with that shown in Fig. 1 in all respects, except that the foil was covered with platinum black. This was done by electroplating the foil with zinc and immersing them in a solution of platinic chloride containing an excess of hydrochloric acid. About 10 milligrammes of platinum black were deposited upon each foil. This was done after the electrodes were sealed into the tubes and the platinum black was formed also on the leading-in wires. The tubes were filled with dilute sulphuric acid of specific gravity 1.125 and inverted in a beaker of the same solution. They were then filled with electrolytic gases by means of extra wires, C and C', exactly as in Experiment I. The apparatus was then heated as in Experiment I. to destroy ozone and hydrogen peroxide.

After cooling the cell was short circuited and allowed to stand.

At the end of five hours the hydrogen had diminished to such an extent that the solution had risen to the top of the platinum foil. The oxygen had also diminished by about half that volume. There remained in the hydrogen tube about one cc of hydrogen above the platinum foil and in contact with the leading-in wire. At the end of four days all the hydrogen had disappeared except a small bubble estimated to contain about 40 cubic millimetres. At the end of seven days the bubble appeared to be no smaller and it was considered to be nitrogen. Without removing this bubble the tubes were re-filled as before and left on short circuit. In five hours the hydrogen had again receded to the top of the platinum foil and in four days had all disappeared except a bubble now estimated to contain about 80-100 cubic millimetres.

The tubes were again re-filled and short circuited. The hydrogen again receded to the top of the foil in above five hours. But after seven days there was still left a bubble containing more than 0.1 cc. The tubes were filled once more, and again the hydrogen receded to the top of the foil in about five hours, and after three weeks there remained a large residual bubble of the gas. The apparatus was now emptied and re-filled with new solution, then filled with the gases as before; the gases extending this time within two millimetres of the bottom of the platinum foils. The level of the solution in the tubes was one inch higher than the level of the solution in the beaker. The circuit was then closed through the voltmeter of 356 ohms resistance and the cell allowed to stand. The following observations were recorded:

Time.	Volts.
0 sec.	.85
10 "	.60
1 min.	.51
2 "	.50
3 "	.50
4 "	.50
5 "	.50
6 "	.50
15 "	.498
45 "	.498
55 "	.495
105 "	.492
145 "	.486

At this point the tubes were slightly shaken and the electromotive force rose to .50 volt. The tubes were then lifted up two inches, bringing the level of the solution inside of the hydrogen tube three inches above the level of the solution outside of the tube. This caused the electromotive force to fall rapidly to .48 volt. On pushing the tubes down again to the original height the electromotive force instantly rose to .52 volt.

After fifteen minutes the tubes were again raised and the electromotive force fell to .484 volt. On lowering the tubes again the electromotive force rose to .53 volt. In raising the tubes up they were brought into a vertical position. In pushing them it was necessary to incline them at an angle of about 30 degrees from the horizontal. In the latter position there was probably a larger surface of foil exposed to the gas. This may account for part of the increase in electromotive force, but it must have been due largely to the difference in pressure, a result naturally to be expected.

The solution was then diluted with five per cent of water and the tubes again raised. The electromotive force fell rapidly to .46 volt and in fifteen minutes to .455. The circuit was now (180 minutes after the beginning of the experiment) opened and left open half an hour. It was then closed and the following observations recorded:

Time.	Volts-
0 sec	.85
10 "	.50
5 min.	.465
50 "	.445
1 hour 35 min	.44
2 " 45 "	.438
4 " 25 "	.43
5 " 15 "	.424
7 " 00 "	.42
9 " 20 "	.425 (?)
11 " 00 "	.36
11 " 25 "	.34
13 " 20 "	.21
14 "	.166
15 "	.145
19 "	.06

The area of foil exposed to the hydrogen at the end of 11 hours was estimated to be about 40 sq. mm, at the end of 13 hours and 20 minutes it was about 10 or 12, and at the end of 19 hours it was about four square millimetres.

The results plainly indicate that the galvanic action depends upon the surface of platinum black exposed to the gas; also that a constant current and electromotive force could be maintained indefinitely by the exposure of a constant area of platinum black to the action of the gases at a constant pressure.

The results indicate further that 20 milligrams of platinum black will maintain a current of $\frac{.50}{360} = .0014$ ampere and $.0014 \times .50 = .0070$ watt, and that the efficiency of such a cell may exceed 33 per cent. A cell containing one pound of platinum black would have a discharge rate of 18.6 watts. By working such a cell at a lower rate a much higher electromotive force and efficiency could be maintained. A cell could probably be constructed that would have an efficiency of 80 or 90 per cent. It would, however, be expensive in first cost.

The difference between the action of platinum black and ordinary platinum foil is worthy of particular notice. When we consider that it requires at least thousands of tons of platinum foil to produce the same effect as a single ounce of platinum black, it does not seem probable that the difference is entirely one of degree. It indicates that there must be a qualitative difference between the actions of the two kinds of platinum.

Polyphase Systems.

To the Editor of The Electrical World:

SIR:—The letters and editorials bearing on this subject in THE ELECTRICAL WORLD for March 23 and 30 have been extremely interesting. They have shown a wide divergence of opinion on the definition for a polyphase system. The books treating of this subject deal principally with the relations of the polyphase components and afford but slight aid by way of definition. So far the literature of the subject has dealt with mathematical relations rather than the physical conceptions underlying these phenomena. This may in part account for the scant attention given to mere definition. It does not seem strictly scientific to employ the condition of constancy of energy in such systems for their definition. The term polyphase applies to a group of phenomena, capable of complex combinations and modifications. The definition then should rest on some property which remains constant through all possible variations. Now the property of constancy of energy belongs only to the case in which the phase difference is symmetrical. Since this is the condition which has thus far been chiefly employed, it is but natural that constancy of energy should be regarded as a fit definition, but should an unsymmetrical phase difference be employed, the definition would have to be modified. A more rational definition for a polyphase system is one based solely on physical properties. Such a system is one in which two or more currents or E. M. Fs, differing in phase by a certain fundamental portion of a period, are co-ordinated into one system, each varying as a sine function of the time. The objection urged against such a definition is that phase difference is often present in single phase working, but these should be regarded somewhat as the harmonics present in a tuning fork. Such auxiliary phase differences should occasion no real difficulty when dealing with fundamental phase differences.

If the definition for polyphase currents given by Mr. Steinmetz be accepted, the error in naming the so-called "monocyclic" system is apparent. From a polyphase standpoint a motor operated on this system runs under some conditions as a single phase synchronous motor, under others as an ordinary polyphase motor. In the case in which the reversing transformer is employed, the energy to the motor is constant because the phases are symmetrically displaced. The transformer acts as a spring, converting the pulsating shocks on the mains into a constant energy supply to the motor. So far as the power feature of such a system is concerned it is undoubtedly polyphase rather than monocyclic. The employment of this reversing transformer seems strange in view of a statement made by Mr. Steinmetz in THE ELECTRICAL WORLD for July 16, 1892. He there states: "Since energy cannot be stored economically by means of electromagnetism, on account of the high iron losses in the hysteresis, the attempts to split up a simple alternating current by means of transformers into currents having a difference of phase have proved to be unsuccessful from an economical standpoint." This statement is not quoted in criticism of the position now taken by Mr. Steinmetz, but rather as a comment on the evident improvement made in transformers during the past three years.

CHICAGO, ILL. W. M. STINE.

A New Method of Deducing the Expression for Electromagnetic Force.

To the Editor of The Electrical World:

SIR:—May I add a word to Prof. Thompson's courteous note in your issue of March 30, commenting on a deduction of the expression for electromagnetic force, which Mr. Carichoff and I recently published?

Prof. Thompson's deduction had not come to our notice when ours was written. An examination of his deduction on page 335, article 343, shows that he begs the entire question by assuming the definition of unit current. Nor does he deduce the expression for the force within a circle and within a solenoid. This last was our chief object.

I wish also to correct two errors in the printing. In the paragraph beginning "Faraday's Law," etc., the phrase of "4π times" should be omitted; and "$K = \frac{1}{2}$," should be $K = 2$.

NEW YORK, N. Y. CARY T. HUTCHINSON.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors, or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 927 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French, or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Alternators.—The discussion of Mr. v. Dobrowolsky's paper which was abstracted in the Digest March 9 is published in the "Elek. Zeit.," March 21. Mr. Goerges recognizes that a single exciting coil for alternating fields has great advantages, but points out that the lines of force have different lengths and that it will not be possible in such machines to increase the axial length of the poles beyond a certain amount; if alternators are built according to the older design with radial poles it is quite easy to construct the machines longer in an axial direction and the armature winding will then be utilized to much greater advantage as the relation between the useful and the dead portions of the wire will be more favorable; it is therefore very easy to build types for the same speed but for different outputs, without having too many different models. Mr. v. Dobrowolsky replied that the advantages claimed for the old type are easily balanced by the disadvantages of an increased magnetic leakage; if the poles are very long the surface of leakage becomes great and as leakage causes a loss in voltage, especially when the load consists of motors, he believes that that form of cross section of the poles should be chosen which involves the smallest leakage surface, that is, it should be square. He does not agree regarding the utilization of the armature wire as he considers it to be greater with a square or not very long rectangular cross section of the core; the wire is utilized better, the less is required in order to generate the desired voltage and for a square cross section the amount is therefore the least; the total length of wire and not the active or inactive length should be considered; he does not agree with the statement that it is difficult to design such machines for large outputs without involving a high circumferential speed; with the large 400-hp machine at Strassburg the speed is only 20 to 21 metres per second. Dr. Zickermann believes that in such machines the magnets become very large for large ouptuts, so much so that the question of transportation becomes important; he believes what is gained in the magnetic winding is lost again in the armature winding.

Theory and Properties of Synchronous Motors.—Prof. Blondel's serial is concluded in "L'Ind. Elec.," March 25. In this series of articles he pointed out the utility of bipolar characteristics in questions relating to alternators and showed how greatly they simplify the treatment of the subject; calculations are rendered almost unnecessary; it appears that such bipolar characteristics are to alternators as the rectangular ones are to continuous current dynamos; he studied the compensation of the effects of phase shifting on the lines and generators by a method which he believes to be new and which leads to interesting conclusions.

Compensating Coils for Armatures.—Mr. Sayers replies in the Lond. "Elec.," March 29, to the letter of Mr. Menges mentioned in the Digest last week and states that he was aware of the existence of the patent specification referred to and claims that it is essentially different from his.

LIGHTS AND LIGHTING.

Arc Lamps.—A well illustrated description of a number of arc lamps of recent design is published in "L'Eclairage Elec.," March 9.

Arc Light for Municipal Street Purposes.—In an article with this heading by Mr. Wood in the "Elec. Eng.," April 10, he discusses the best locations and method of placing an arc lamp, and concludes that the two having the fewest faults and most advantages are, to fix it at the top of a pole on the sidewalk and to suspend it from a long arm from the top of the pole on the sidewalk over the middle of the street, the second method being considered the better of the two. Regarding the measurement of arc lights he ridicules phonometric measurements intimating that no one knows how much light one candle power is; he approves of measuring the lights by the current and voltage. Regarding the shadows from the lamps he suggests that in order to avoid as much as possible the shadow of the supporting rod in a double arc lamp it should be as far away from the carbons as possible and may be placed in the middle between the two carbons.

Municipal Lighting in Chicago.—"Elec. Ind." for April abstracts some of the data from the paper of Mr. Myers in the March number of "Political Science Quarterly," enumerating items which should be added to the cost per lamp as contained in Mr. Barrett's report, to make it comparable with the cost of the light furnished by private companies.

Classification and Selection of Lighting Systems.—An article under this heading by Prof. Crocker is published in the "Elec. Eng.," April 10. He admits that such a classification must be more or less arbitrary; he discusses the four classsifications: central stations and isolated plants; incandescent and arc lighting; alternating and direct currents; high and low potential; he discusses also the relative advantages of incandescent and arc lighting and those of the direct and alternating currents.

Lighting of the Brooklyn Bridge Cars.—An illustrated description of the system, already referred to in these columns, is published in "Elec. Eng.," April 10.

Electric Lamps in Coal Mines.—The article abstracted in the Digest last week is reprinted in the "Eng. & Min. Jour.," April 6.

POWER AND HEAT.

Transmission of Power System.—A new system adapted to a special case is described by Mr. Hoegerstaedt in the "Elek. Zeit.," March 28. It was designed to meet the requirements of a special case in which the ordinary systems could not have been used; one of the requirements was that a small 6-hp motor was to be run with absolutely constant speed although there was a large motor of 20-hp which was thrown on and off repeatedly as also 14-hp represented in lights; furthermore the efficiency should be very high and the cost of the installation very low. A diagram of the system is given; there is a small constant current generator of about 158 volts and about 10-kw and a large one of 525 volts and 32-kw the current in both cases being 61.3 amperes; these are connected in series, a third or neutral wire like in the three-wire system being connected to that junction; the lights are connected in multiple between the low volt mains and in groups of five in series between the high volt mains, the latter must therefore be cut out in groups of five; the small constant speed motor is connected between the low volt mains and the large motor betwen the high volt mains, the small motor is therefore entirely independent of the large one or of the majority of the lamps; each motor is provided with a resistance which can either be used for starting or, when the motor is cut out, it is capable of carrying the whole current which the motor would have taken; the cost of this installation is given.

Hydraulic Power from High Falls.—"L'Ind. Elec.," March 25, contains an illustrated article by Mr. Thivel in which he discusses the advantages of high falls for the production of electric energy and refers to some European installations.

Electric Welding.—The "Elec. Eng.," April 10, reprints a brief report of a committee of the National Railway Blacksmiths' Association regarding electric welding. The Thompson system is well spoken of particularly for small work; there are about 25 wagon and carriage manufacturers who are using this system and are well pleased with the results; the report admits that a portion of the work can be done better by the older process; many things can be done which it is not possible to do by the older process, as for instance tube welding for ice machines, in which it has been used quite extensively without experiencing any trouble through bad welds; the arc process is merely referred to but not commented upon.

Tesla Two-Phased System.—An illustrated description of some length by Mr. Perry, of the application of this system in the Westinghouse works, is published in "El'ty," April 10.

TRACTION.

Braking of Cars.—In an article by Mr. Baumgardt in the "Elek. Zeit.," March 28, he discusses mathematically the subject of braking cars electrically by using the motor as a generator and endeavors to find whether such system could be modified so as to make it practical to stop a car within its own length. He finds from his mathematical deductions that the distance within which the car will be stopped increases faster than the third power of the velocity; the effect of the electric brake decreases rapidly with the velocity, more rapidly than the square of the velocity, and therefore to obtain a powerful action very strong current must be used; the electric system becomes practical however if the current generated is kept as long as possible at the same value; this he discusses mathematically and finds that with the same load on the motor which in the first case produced sudden braking in a distance of two car lengths, in the second case produced a quiet braking action in a single car length; he suggests two methods by which the rapid decrease in the brake action can be prevented, the first is to insert a decreasing resistance in the circuit, for instance by having the motion of the lever regulating the resistance dampened by placing it in oil; a second way is to provide contact rings on the motors by means of which an alternating current can be obtained, which is then led through a self induction coil which is specially well adapted for this purpose, as the apparent resistance of it diminishes with a decreasing velocity; this however requires shunt winding of the magnets, which is a great disadvantage.

Electric Railways.—A paper recently read before a society by Mr. Kapp is reprinted in the "Elek. Zeit.," March 28; it is chiefly of local interest and contains data for several European lines. In a comparison between Boston and London he gives the following figures: in Boston there are 430 km of track and in London, although a ten times larger city, there are 400 km on all of which horses are used; the number of car-km per year is 30 millions for Boston and 35 millions for London; the cost of operation for the year 1893 is as follows in marks (about 24 cents): London 17.8, Boston 18.4 millions; the total income, London 21.5, Boston 26.9 millions; costs in comparison of income 82.7 and 68, capital invested 71 and 89 millions, dividends 3.33 per cent. and 9 per cent. At present there are in Germany 340 klm track, 555 motor cars and 420 trailers, representing a total of 9,500 horse power.

Roller Bearings.—Lond. "Engineering," March 29, contains an illustrated description of the Meneely tubular bearing (American) as made by the Siemens Company, including a table of the results of comparative tests made on a street railway with this and with the ordinary bearing which show a considerable saving of energy in favor of the tubular bearing; the power required to drive a loaded car was reduced by 24 per cent. while the speed was increased 20 per cent. and the starting effort was diminished to less than half.

Calculation of Overhead Conductors for Electric Traction.—An abstract of some length of the article by Mr. Dierman from "L'Eclairage Elec." is published in "Jour. Inst. Elec. Eng." for March.

Electric Traction on Steam Roads.—The "St. Ry. Gaz.," April 6, gives briefly some data regarding the Burlington branch of the Pennsylvania Railroad. The track will be relaid with 70-pound T rails; the generator will have an output of 250 kw; combination cars will be used, two will be equipped with a pair of 75 hp motors each, and a third will have four motors of 50 hp each; the motor cars will draw two or three coaches; the line is 67 miles long and will probably be in operation by June 1.

Railway Accidents.—The "St. Ry. Gaz.," April 6, abstracts a part of the report of the Massachusetts Railroad Commissioners regarding street railway accidents; the total number of accidents during the year was 1,341 of which only 29 were fatal, a decrease of 16 fatal accidents as compared with the previous year; on the railroads of the State there were 232 fatal accidents, the number of miles traveled being about three times as great; the total number of accidents was 1,114; it is suggested editorially that the comparison is not fair as the steam roads report only accidents of a serious nature, while trivial accidents are reported in the case of street railways.

Belt vs. Direct Coupling in Small Railway Stations.—The "St. Ry. Jour." for April contains replies from a number of engine builders and engineers to a request to give their views on the relative advantages of direct and belt connection in stations for 10 to 100 cars; no general summary is given.

Legal Aspect of Electrolysis.—An article by Mr. Townsend abstracted in the Digest last week is reprinted in full in the "St. Ry. Gaz.," April 6.

Flexible Conduit System.—The Grant system, in which the contact is made by the car with a conductor in a closed compressible flat tube, is described and illustrated in the "Elec. Eng.," April 10.

Conduit System in Washington.—A brief description of the system to be used by the Metropolitan Company in Washington, which is said to be substantially like the one in Budapest, is given in "Elec. Rev.," April 10.

Welded Joints.—According to the "St. Ry. Gaz.," April 6, cast welded and electrically welded rail joints have stood the severe test of the past winter very satisfactorily, the fractures were few and the contractions were not appreciable.

Newark.—The new power station of the Consolidated Traction Company is described in the "St. Ry. Gaz.," April 6.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electric Light for Railroads.—A long Institution paper by Mr. Langdon on "The Employment of the Electric Light for Railway Purposes" is published in full with illustrations and a brief description in the Lond. "Elec. Eng.," March 29. He discusses the use of arc and incandescent lights in railroad stations, offices, yards, etc., the greater part of it referring to the plants of the Midland railway which are described in detail with various data, including costs; the plants include more or less expensive installations in a number of different towns and cities. Regarding incandescent lighting in general he lays stress on the sanitary features, which he claims outweigh the somewhat increased cost, in small installations at least, over that of gas. Regarding the arc lighting he believes that it is destined to be of great advantage in railway workings as it is an invaluable adjunct in the loading and unloading of stock and the marshalling of trains, its greatest utility being in yard shunting. In the description of the installation he gives some data regarding a gas plant for generating the current with Dowson gas. In conclusion he states that the experience so far gained establishes beyond a doubt the great advantages in favor of the electric light in railroad work wherever a large amount of light is required. A copy of the rules and regulations relating to restrictions, duties and management, adopted by this railroad is appended; also the precautionary instructions which have been issued for the avoiding and treatment of accidental shocks. In the discussion Mr. Fletcher gave some data regarding the installation of the Waterloo station, Liverpool. Dr. Preller stated that from his own experience he finds that if city gas can be obtained for 56 cts. per thousand it is preferable to Dowson gas if only for the reason that the first cost of installing a gas plant is saved; regarding the placing of arc lamps experience on the continent had shown that the universal rule was to place lamps 50 to 60 feet high and 80 to 90 feet apart; the rules regarding the treatment of a person who had received a shock are similar to those recommended by D'Arsonval and in this connection he cited one or two cases where these rules had been unsuccessful.

Three-Phase Installation.—A 40-kw installation is briefly described in the "Elek. Zeit.," March 21; it includes 200 incandescent lamps which it is claimed can be connected or cut out of circuit without affecting the voltage or the brightness of the other lamps.

Rules and Regulations.—The "Elek. Zeit.," March 21, contains a discussion by Messrs. Kapp and Siemens of the set of rules for German installations, which are at present under consideration.

Amortization.—The "Elek. Zeit.," March 28, contains a long communication by Mr. Sonnenschmidt forming a continuation of the discussion on this subject.

Hanover.—The data for the operating of the station at Hanover are given at some length in the "Elek. Zeit," March 7.

Electric Plants.—"Elec. Ind." for April contains an article by Mr. Armstrong on "Some Hints on the Building of Electric Plants," another by Mr. Woods on "Some Faults in the Operation of Electric Plants."

Power and Lighting Plant.—An illustrated description of the plant at the Illinois State Penitentiary is given in "Elec. Ind." for April.

WIRES, WIRING AND CONDUITS.

Protection for Overhead Circuits.—In the "Elek. Zeit.," March 21, Mr. Moritz describes and illustrates a comparatively simple method which has been used with great success in Budapest; it refers to the protection of bare overhead wires carrying high tension currents and provides for rendering them harmless if they should break or sag too much, which it accomplishes by short circuiting the line under these circumstances. The system consists essentially of attaching two wires to the conductor which is supported on the left hand side of a pole and leading them to a common insulating support placed on the right hand side of the pole, above the other conductor; the same is done with the other conductor, thus forming a system of wires which cross each other but are not in contact; when one of the conductors breaks or sags too much these wires will come in contact with each other, thus short circuiting the circuit thereby blowing the fuses and rendering the line harmless. If instead of a single circuit there are a number on the same pole it would be a great objection to the system to have all the wires cut out in case of accident to one circuit and to provide against this he uses the following device which has been found to be effective; instead of inserting fuses of like capacity at the two ends or junction of a circuit, he inserts two of different capacities, the smallest of which will blow first and is so constructed that it forms an arc which continues long enough to blow the second fuse of that particular circuit, the terminals of this second fuse being so far apart that an arc cannot be formed; the first fuse is best formed of a lead wire passing through the holes in two-cored carbons whose distance apart is properly adjusted. The cost of this new system is said to be very small and by using it one can reduce the factor of safety against breaking of the wires, the saving in poles alone is then said to be greater than the cost of the protecting device.

Southwark Bridge Explosion.—Major Cardew's report is published with illustrations in the Lond. "Elec. Eng.," Mar. 29, and in abstract with a different illustration in the Lond. "Elec.," March 29. He advances the theory that it was caused by a spark struck by a horse's foot or a wheel, close to the covering; it affords proof of the insufficiency of any ordinary system of ventilation unless it be accompanied by measures tending to render the boxes and conduits gas tight; very thorough ventilation of the culvert did not prevent it from being the locus of a serious explosion when once gas found free access to it.

Air Insulated Cable.—The Clouth system is described briefly in the "Elek. Zeit.," March 21; a very low capacity is obtained without increasing the diameter or the weight; with a copper resistance of 5 ohms per km at 15 degrees C. the mean capacity was only 0.052 microfarad per km and the insulation resistance 10,000 megohms; the insulation consists of cotton enclosing the wire in the form of a gauze having large air spaces; the figures for a number of wires are given and are reprinted in the Lond. "Elec. Eng.," March 29.

Large Telephone Cable.—According to "Der Techniker" for April the largest telephone cable is probably that from 38th street, New York, to Long Island; the outside diameter is 2.5 inches, length 15 miles, weight 21.5 tons; it is said to contain 20 wires, but this is doubtlessa mistake.

ELECTRO-PHYSICS AND MAGNETISM.

Magnetism of Hollow and Solid Cylinders.—"L'Eclairage Elec.," March 9, translates an article by Mr. Ascoli from "Il Nuovo Cimento" for January on 'The Distribution of Induced Magnetism,'' only the first part of which is given and refers to hollow and solid cylinders. He gives references to a number of recent articles of Grotrian, Schulz and DuBois (all of which have been noticed in the Digest) which he discusses together with experiments of his own. According to Grotrian, Faraday and others, the magnetic moment of a hollow cylinder is not much less than that of the same cylinder having the hollow part filled with iron, from which it seems that the magnetization is superficial, but the present author does not accept this; the superficial distribution is only apparent but not real and is explained by the reaction of the free magnetism induced in the interior field, a reaction which increases with the metallic section and which can reduce the resultant magnetizing force so as to compensate for the increase of this force due to the increase of the metallic mass; he discusses mathematically the possibility of the appearance of an ununiform distribution in spite of the existence of a real uniform distribution with the aid of ellipsoids of revolution and gives a table of values for the magnetic moments. The small difference which is observed experimentally between the moments of different cylinders of sufficiently great section can therefore very well be due, like in ellipsoids, to a reaction of the induced magnetism on the interior field, a statement which he will demonstrate in the second part of his article; in the present portion he shows that the variation of the magnetizing force in solid cylinders of different relations of diameter and length is quite analogous to that in ellipsoids; he gives a table of the magnetizing forces at the centre of cylinders of various lengths. In passing to hollow cylinders he states that experiments have shown that hollow cylinders act like solid ones of the same metallic cross section; the small observed differences could be due to the reaction of induced magnetism on the magnetizing fields. He describes experiments made with cylinders composed of the same number of iron wires which may be made into hollow cylinders by placing them around cylinders of wood, the cross section always remaining the same; with this he made ballastic galvanometer measurements. Let r be the ratio of the length to the diameter, T the galvanometer deflection for the hollow and C that for the solid cylinder, then the ratio of T and C tends to be unity when r increases and as rapidly as the magnetizing force increases. Other measurements were made with cylinders of the same diameter and length but made up of a different number of iron wires, some hollow and some solid, and he finds that the ratio of T to C tends toward unity for the same current and more rapidly as the thickness of the cylinder increases. Other tests were made with cylinders whose lengths were 25 times the diameter, the results showing that a hollow and a solid cylinder of the same (metallic) section act the same for sufficiently large magnetizing currents. Regarding dynamos he states that the effects obtained in these experiments by increasing the length can be produced by any other means which will diminish the reaction, one of which is to make nearly a closed magnetic circuit, like in dynamos, it is therefore easy to predict the results obtained by Schultz concerning the approximate proportionality between the flux and the section of the metal and it is not necessary in order to explain results to assume any special method of magnetization.

Model of Molecular Magnetism.—The Lond. ''Elec.,'' March 29, published an illustrated description of a new model exhibited by Prof. Ewing at a recent meeting, to illustrate the molecular action which occurs in iron when caused to revolve in weak or strong magnetic fields; the action is of special interest since Mr. Bailey showed that in a sufficiently strong field the hysteresis of revolving iron disappears. In the model a number of pivoted magnetic needles are placed on a glass plate between two coils, the glass plate itself being pivoted so that it may be revolved, the action therefore resembles that which occurs in a dynamo armature. If the plate carrying the needles is made to revolve slowly in a field of moderate strength the lines in which the magnets tend to arrange themselves become strained and break up, new lines being formed which in their turn break up as the plate goes on revolving; this breaking and rearrangement of the grouping involves dissipation of energy, shown by the violent swinging of the needles, a process which is associated with hysteresis and corresponds to the case of an ordinary dynamo armature; but when the field is quite strong so that the needles are parallel there is no longer any violent breaking of molecular ties as the plate revolves and consequently there is no dissipation of energy. When the field is weak, in which case there is hysteresis, the model shows that the expenditure of work is not continuous but is in a series of spasms, it sometimes even happens that the new lines assumed by the magnets immediately after breaking away from the earlier grouping are so inclined that the turning moment becomes negative. With a strong field the model shows a remarkably complete disappearance of hysteresis, the glass plate carrying the needles could be spun around quite rapidly without causing the magnets to oscillate.

Electromotive Force of Magnetization.—A translation in abstract of Mr. Hurmuzescu's paper is published in the ''Jour. Inst. Elec. Eng.'' for March.

Temperature of Transformation of Iron and Steel.—The ''Jour. Inst. Elec. Eng.'' for March abstracts a paper by Mr. Charpy from the ''Comptes Rendus,'' Vol. 119, No. 18. He applied Osmond's method for studying the dissipation of heat at different temperatures for several samples of steel; the apparatus consists of a recording pyrometer and a furnace heated by an electric current passing through platinoid wire; a table of the critical temperatures is given as also some brief references to the magnetic properties.

Experiments with Alternating Currents.—Referring to the recent article by Mr. Griffiths, abstracted in the Digest March 23, Mr. Sadowsky in a communication to the ''Phil. Mag.'' for April communicates an abstract of a paper published by himself, in which he gives the results of some experiments similar to those of Mr. Griffiths, with the Lenard bismuth spiral. The following results agree very well with those of Mr. Griffiths: in a strong field absolute silence in the telephone is never obtained but only a minimum of sound; the superficial distribution of alternating currents is without influence on the resistance; the resistance of bismuth depends upon the phase of the current. The following do not agree entirely with those of Griffiths: bismuth spirals have something like the self-induction but not equivalent to it; he finds the difference of resistance with a frequency of 500 without field to be as stated by Lenard and Zahn. He also found that Lenard's statement that the difference of resistance is due to the currents of great frequency is erroneous; this he discusses mathematically.

Theory of Alternating Currents.—An anonymous article is begun in the Lond. ''Elec. Eng.,'' March 29, intended for electrical engineers who have not had an opportunity to attend a course of instruction at a technical college; it proposes to give the principles underlying the subject, to explain the physical facts, etc., using as little mathematics as possible; the present portion is on induced currents and self-induction.

Passage of an Oscillator Wave Train Through a Plate of Conducting Dielectric.—The Physical Society paper by Mr. Yule mentioned in the Digest Feb. 9 is published in full in the ''Phil. Mag.'' for April; it is mathematical in character and quite long.

Double Refraction of Electric Rays.—Mr. Mack's paper mentioned in Digest last week is abstracted more fully in the ''Elek. Zeit.,'' March 21, and still more so in ''L'Eclairage Elec.,'' March 9.

Propagation of Variable Currents in Conductors.—''L'Eclairage Elec.,'' March 9, contains a mathematical article of Mr. Lamotte on this subject.

Energy Movements in the Medium Separating Electrified or Gravitating Particles.—The ''Phil. Mag.'' for April published in full the Physical Society paper by Mr. Allen; (a reference to an abstract of this paper was given in the Digest April 6 where it was incorrectly credited to Prof. Minchin).

Glow Discharge.—The results of a research by Mr. A. Herz described in ''Wied. Ann.,'' Vol. 2, 1895, are given in the ''Phil. Mag.'' for April.

Electric Causes of Earthquakes.—''L'Elec.,'' March 30, contains an article by Mr. Dary in which he shows that the idea that earthquakes are of electric origin is not a new one; he gives the results of a number of observations and among them cites some cases showing the effect of the geological composition; these he believes can be explained only by the action of electric discharges the effect of which is more violent at points which offer greater resistance to the passage of the current.

Electric Currents of High Pressure and Periodicity.—Mr. Swinton's paper abstracted in the Digest last week is reprinted in full with the illustrations in ''El'ty.,'' April 10.

Conductors and Insulating Compounds.—An alphabetical list of materials compiled from patents is published in ''Elec. Rev.,'' April 10.

Liquefaction of Gases.—A long article by Mr Olszewski with illustrations of the apparatus is published in ''Eng. & Min. Jour.,'' April 6.

ELECTRO-CHEMISTRY AND BATTERIES.

Plant for the Extraction of Gold by the Cyanide Process.—A paper by Messrs. Butters and Smart with this title was recently read at the ''Inst. of Civ. Eng.;'' it does not appear to have been published in any electrical journals. Regarding the electrical process of Siemens & Halske they state that 110 hours are required on account of the weak solution with which it could be worked, while the zinc process occupied from 60 to 84 hours. A detailed account is given of the Worcester cyanide works where this electric process is used.

Electricity in the Chemical Industry.—A recent lecture by Prof. Haeussermann is reprinted in the ''Elec. Zeit.,'' March 7; he gives a general summary of the subject without apparently including anything new.

Remarkable Electrolytic Phenomenon.—A paper with this title by Mr. Reed is published in the ''Jour. Frank. Inst.'' for April. Metals used as negative electrodes are never dissolved or are seldom affected chemically by the action of the current; in the present paper he shows what appears to be an exception to this rule. With certain solutions, as borax for instance, with a negative electrode of lead, a high E. M. F. (about 100 volts) and a high current density, a precipitate appearing like a cloud of black smoke is formed around the electrode; the negative electrode is eaten away rapidly showing that the precipitate was formed at the expense of the lead; the precipitate was found to be an impalpable powder resembling lead; the electrode is reduced to a point with a smooth polished surface. A list of a number of electrolytes is given with which this can be produced and another with which it is not produced; with ammonium oxalate and a positive electrode of platinum, what appeared to be a lead peroxide was deposited on the platinum although no lead was originally in the solution. A number of other metals were tried but among them only arsenic acted in a similar manner; in that case a film of brown solid arsenic hydride was formed which floated on the liquid. The formation of the lead precipitate was found to be most rapid with a solution of borax; sodium thiosulphate gave a deposit of sulphur at the positive pole; strontium nitrate instead of giving the lead powder gave a blue flame around the point of the cathode. These results seem to indicate the possibility of obtaining, by the use of high electromotive force and high current density in electrolysis, products of an entirely different nature from those of ordinary electrolysis.

Electrolysis of Copper Sulphate.—The results of the investigation of Mr. Chassy mentioned in the Digest April 6, referring to the electrolysis of a hot solution, are given in the "Eng. & Min. Jour.," April 6.

Electrochemical Progress During 1894.—Mr. Swinburn's short article abstracted in the Digest Feb. 2, is reprinted in the "Elec. Age," April 6.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Researches with the Induction in Cables.—Dr. Breisig's long article is continued in the "Elek. Zeit.," March 21 and 28; it contains a large amount of data and a number of curves and illustrations of the apparatus used. Some of his conclusions are as follows: the co-efficient of mutual induction of two conductors diminishes very rapidly with an increased number of impulses when the conductors are surrounded by a metallic casing like the lead covered cables with which the experiments are made. One of the curves shows that the quantity of electricity induced per second at first increases with the number of impulses, that at 22 impulses per second it reaches a maximum after which it diminishes; the curves for two other double circuits coincide up to 15 impulses with the tangent at the beginning and nearly so up to 26 impulses, at which the protecting action of the metallic shield begins to show itself but only in a small degree. The results of the measurements with alternating currents are quite complicated and extended experiments in that direction were therefore not carried out. He considers that these researches prove that a metallic shield for a conductor does not necessarily mean that it is protected from induction from the outside, it depends very greatly on the number of changes in the current, if this number is small a shield of appreciable cross section has no decided protecting action; referring in particular to the tin foil covering, the results show that with a moderate number of current changes the conductor acts practically as if it was not shielded, but the shielding action becomes very great when the current variation is very rapid, as for instance in telephone transmission. The continuation in the issue of March 28 describes experiments with long underground circuits and includes a number of curves.

Artificial Telephone Line.—The "Elek. Zeit.," March 7, reprints a paper by Dr. Breisig in which he describes with the aid of several illustrations an artificial line for testing purposes, which has recently been constructed for the German government telephone department; the line contains resistance, capacities introduced at successive points, and self-induction; it was concluded to be unnecessary to have artificial leakage as that was of little importance in telephone testing; the self-induction however is very important as the apparent resistance depends chiefly on it. The construction is described and illustrated, the greatest difficulty being encountered in giving it self-induction; a number of coils are wound on a U-shaped core of iron having an armature whose distance from the core can be varied.

Determination of the Ohm.—A paper by Mr. Himstedt from the "Wied. Ann.," vol. 54, p. 303, is abstracted briefly in the "Elek. Zeit.," March 21. He describes a method which is said to be very convenient and can be recommended because it requires the measurement of only two angles, a determination of the number of current interruptions per second and the co-efficient of mutual induction of the two coils. The mean value found was 1.06282.

Electrochemical Actinometer.—An abstract of some length of the recent paper (in French) by Mr. Marechal is published in "Jour. Inst. Elec. Eng." for March.

A Simple Form of Harmonic Analyzer.—The Physical Society paper by Mr. Yule mentioned in the Digest last week is published in full in the "Phil. Mag." for April.

The Clark Cell when Producing a Current.—In the "Phil. Mag." for April Mr. Skinner replies to the recent criticism of Prof. Thielfall mentioned in the Digest March 23.

Useful Approximate Units.—The following are given in the Lond. "Elec.," March 29. The ohm is very close to the resistance of a pure copper wire 10 mils in diameter and 10 in. long at about 60 degrees F. A volt is approximately $\frac{7}{10}$ of the E. M. F. of a standard Clark cell; 687 standard cells give very nearly 1,000 volts.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone Rates.—The leading editorial in the "Elek. Zeit.," March 21, discusses the proposed reduction of the telephone rates in Germany. It appears from the data that the cost per communication in Berlin is slightly less than one cent, which is lower than anywhere else; the conclusions are that the rates should be reduced according to the size of the system and the extent of its use.

Origin and Development of the Telephone Switchboard.—The paper by Mr. Kingsbury mentioned in the Digest Feb. 16, 23, March 2, is published in full with the illustrations and discussion in the "Jour. Inst. Elec. Eng." for March.

Interior Block System of Telephone Wiring.—A brief description with some illustrations is given in the "Elec. Rev.," April 10.

Historical.—"El'ty," April 10, reprints an article by Mr. Syme on Sir Francis Ronalds from Lond. "Lightning," Sept. 1 and 8, 1892.

MISCELLANEOUS.

Electric Compass.—"L'Elec.," March 30, contains an illustrated description of the Bersier system in which a vessel is steered automatically by the compass by means of an electric device; the system has already been described in the Digest.

Educational.—The discussion which has been going on for some time in the Lond. "Elec." is continued in the form of a long editorial in the issue of March 29; the purport of it is that a decided distinction should be made between scientific education and technical instruction.

Crompton's Address.—The address of Mr. Crompton, which was abstracted in the Digest Feb. 16, is published in full in the "Jour. Inst. Elec. Eng." for March.

Abstracts.—The "Jour Inst. Elec. Eng." for March contains abstracts of a number of recent electrical papers all of which have been noticed in these columns.

Fiske's Range Finder.—A well illustrated description with diagrams of connections of the latest improved form is published in the "Elec. Eng.," April 10; the instrument has been in use for more than five years in various forms and has finally been adopted by the U. S. Navy in the present form. Among the improvements are that the bridge wire is not in the form of an arc but is wound on a cylinder of insulating material and may thereby be completely protected from the effects of water; there is also an automatic adjustment of the contacts and a temperature corrector.

New Books.

THE SCIENCE AND MODE OF SOLAR ENERGY THROUGHOUT THE UNIVERSE. By I. W. Heysinger, M. A., M. D. Philadelphia: J. B. Lippincott Company. 363 pages, 61 illustrations.

The aim of this work is to present to the world a new hypothesis which shall account for the accumulation and continuance of supply of the vast amount of energy stored in and unceasingly poured forth from the sun and other so-called fixed stars of the universe.

After briefly analyzing the seven different hypotheses now in vogue, pointing out their fallacies, and reviewing the principal astronomical and physical phenomena bearing on the subject, the author proceeds to formulate his theory essentially as follows:

Highly attenuated vapors, principally aqueous, and capable of conducting electricity with very slight resistance, are assumed to be diffused throughout interstellar space. In the molecular tensions of these vapors are locked up vast stores of potential energy. The planetary bodies, having opposite electrical polarity from that of the relatively fixed sun, by their orbital and axial motions in connection with the induction of their highly electrified atmospheres, act, in some way not very clearly explained but likened to the action of an influence machine, to unlock or release the potential energy contained in the regions through which they pass, causing it to appear as electrical energy in the form of currents of enormous quantity and electromotive force flowing in a constant stream to the sun, there to disappear as electricity and reappear as solar light and heat. These electric currents decompose some of the aqueous vapor concentrated by gravity about the solar bodies, depositing hydrogen at the sun and oxygen at the planets; while, at the same time, by forcing their way through the hydrogen envelope of the sun, they produce its intensely heated and highly incandescent condition. The sun's radiant energy, in its transmission through vast distances, is gradually retarded and finally disappears in the restoration or increase of the molecular tensions of the vapors of space, where it remains as potential energy ready to be again called into activity, perhaps ages hence, through the action of some distant world.

The phenomena of comets, of temporary, variable and multiple stars, and of the nebulæ are discussed, the author's hypothesis being applied to their treatment and also to that of the genesis of solar systems.

By the same process of reasoning based upon pure assumptions, we presume the author would not have the slightest difficulty in plausibly demonstrating that the moon is really made of green cheese.

ELECTRIC LIGHT INSTALLATIONS. A Practical Handbook. By Sir David Salomon. Vol. III.—Application. Seventh edition, revised and enlarged. New York: D. Van Nostrand. 235 pages, 33 illustrations. Price, $1.50

This is the last volume of a series of three handbooks on isolated electric light installations. The first volume deals exclusively with storage batteries and their management; the second volume is mainly descriptive of apparatus and the present one takes up the subject of installation of circuits and operation. In the first chapter the precautions necessary to be observed in installation are given, including the regulations of the English Institution of Electrical Engineers for the "prevention of fire risks." Chapter II. deals with conductors, including insulation jointing, calculation, installation, etc. We note a confusion in regard to the cause of the increase of drop with alternating current; the author quotes Prof. Hughes as having first called attention to this effect, whereas his classical paper referred to the ohmic increase of resistance due to alter-

[illegible], and not to inductive drop, the former being negligible with [illegible] and usual diameters of conductors. The data in the table given in this chapter of the relative amount of heat produced by various sources of illumination do not agree with those on the same subject from the authoritative experiments of Heim (contained in Palaz "Industrial Photometry") but the differences are not of practical importance.

Chapter IV. is on "Methods of Working," and contains much practical information on a wide range of topics, including the operation of storage battery plant motors. The arrangement of station devices is also treated, and some points of theory considered in a simple manner. Alternating currents and "estimates" are touched on in the two succeeding chapters, and the book concludes with a brief account of the Broomhill installation and of the wiring at the Grosvenor street (London) station, with results. The Broomhill plant contains many features of interest, and its extent may be judged from the fact that there are 60 or more motors in use for various purposes.

As in the case of the preceding volumes, the chief value of the present one lies in the many practical hints and discussions scattered throughout the pages, and as these are the result of the author's extended experience with his own plant, they have a direct bearing on every-day work. While the view of the art of electric lighting given in these three volumes is rather a restricted one, the work yet forms the most satisfactory one from a practical standpoint that has yet appeared.

The Work of Hertz and Some of His Successors. Being the substance of a lecture delivered at the Royal Institution, June 1, 1894, by Prof. Oliver J. Lodge, F. R. S. With additions and appendices. London: "The Electrician" Printing and Publishing Company, Limited. 58 pages, 32 illustrations and portrait. Price, $1.

After Hertz, Prof. Lodge has been most closely identified in the minds of the electrical public with the experimental development of the electric wave theory, and, therefore, coming from the pen of his English follower and co-worker, this exposition of the great work of the lamented young German scientist is peculiarly appropriate. The volume is based upon a lecture delivered by Dr. Lodge before the Royal Institution, but which, as printed, is considerably extended by foot notes and several appendices. We will add that the lecture first appeared in print in the columns of the London *Electrician.*

The greater part of the text consists of an account of the experiments made during the lecture to illustrate the character of Hertzian phenomena, and the illustrations in the printed volume with the accompanying explanations give the reader an excellent idea of the experiments performed. Intended for a non-scientific audience, the language and development of ideas are extremely simple to follow, and we strongly advise those who wish to keep pace with electrical science to read this book, for it is not too much to say that in a very few years the ideas here developed will completely supersede the conceptions upon which the present science of electricity is based.

The opening pages are devoted to a feeling tribute to the memory of Hertz, and to a resume of the knowledge on the subject of electric waves before the era of Hertz. A number of simple experiments are then described illustrating electric wave phenomena, after which Dr. Lodge introduces the apparatus and experiments originated by himself—among others his "coherer," which is claimed to be by far the most sensitive detector of Hertzian waves yet devised. The several appendices contain an account of the work of others in the Hertzian field who were not mentioned in the lecture, and of more extended notices of some points referred to in the body of the text.

Standard Methods in Physics and Electricity Criticised, and a Test for Electric Meters Proposed. By H. A. Naber. London: George Tucker. 114 pages, 2 illustrations. Price $2.

The book is chiefly written for men of science and laboratory experimenters, and is an erudite and judicious criticism of methods of measuring in physics and in electricity, and a careful review of the instruments used.

In electrical measures the author is a strenuous upholder of the gas voltameter, of which he has devised a special form fully described in these pages, and this latter should be of great value for testing electric meters, and for other purposes where it is necessary to take accurate note of the quantity of electricity passed through the meter.

Practical Telegraphy. By F. E. Wessels. Philadelphia: Bloomingdale & Company. 24 pages. Price, 50 cents.

This little pamphlet has for its object the instruction of those wishing to become practical telegraph operators.

Beginning with a brief outline of the work of Prof. Morse, the book next considers the fundamental principles of the telegraph and the construction and maintenance of batteries. Very full instructions are given for the guidance of the learner, with forms of commercial and railroad despatches and tables of abbreviations.

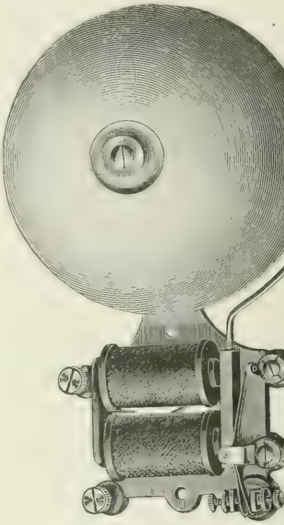
Annuaire du Bureau des Longitudes for the year 1895. Paris: Gauthier-Villars et fils. Price 1 franc, 50.

This little volume contains an immense amount of information useful to travelers and to scientists generally. The book is intermediate in character, between the Nautical Almanac of Great Britain and the World Almanac of New York. The tables throughout the book have evidently been carefully, and in many cases specially, prepared by eminent writers. The chapters devoted to "Lunar Atmospheric Waves," the "Geodetic Congress at Innspruck," "The Observatory of Mt. Blanc," "Photographic Photometry," the report upon the proposal to unite the civil and astronomical day, and the magnet charts of France, are of special interest, and convey the most recent information on these subjects, which it would be difficult to obtain elsewhere.

An Improved Skeleton Bell.

It would appear that the improvement of electric bells had reached its limit, but the new bell made by H. E. & C. Baxter, of Brooklyn, and which we illustrate herewith, effectually confutes such an assumption.

The parts are highly finished nickel, on a well japanned frame. The adjusting, contact, pivot and binding posts have a patent fastening which centralizes and securely holds them. The bell has both battery and stroke adjustment, provided with set nuts. By placing the double adjustment at the back of the armature, the adjustable contact screw is abolished, which is a decided improvement, as the make and break of the contact points are the same with either a long or short stroke, allowing the magnet to be fully energized throughout the whole forward movement of the armature. The principal styles of these bells are the "Standard," "No. 7,707," and "Style D."



Improved Electric Bell.

Asbestos Insulated Magnet Wire.

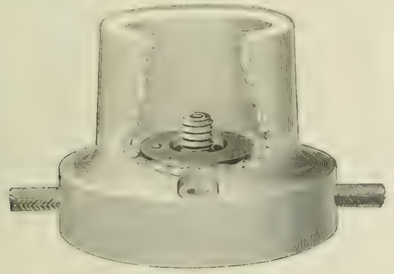
Patents have recently been issued to Mr. L. W. Downes, of Providence, R. I., for a new method of insulating wire with asbestos, the object of the invention being the production of a wire, suitable for winding all types of electrical machinery, the insulation of which will not be so readily destroyed by heat as that at present in use. Previous attempts have been made to insulate wire with asbestos, but the difficulty has been to reduce the coating to anything like reasonable dimensions. By the new process, however, this is largely overcome and a coating is produced which compares very favorably with double wound cotton, the thickness of the insulation on wires from No. 18 to No. 12, B. & S. gauge, being .016 inch, and that on Nos. 2 to 11 being .018 inch.

A sample card or exhibit was recently sent out illustrating the heat resisting properties of the new wire. Upon it is shown a sample of the finished wire having a smooth, even coating of very dense and compact fibre, so tough that it is difficult to make any impression upon it. Sample No. 2 is a piece that has been connected to a sample of ordinary double wound cotton, and subjected, with it, to the heating effect of a heavy current. The cotton coating is almost completely burned off, leaving but a small, charred fragment at the extreme end, while upon the asbestos absolutely no impression seems to have been made. Another sample is shown which is said to have been subjected to a temperature sufficiently high to raise the wire to a red heat; the covering is left apparently as smooth and flexible as before. Sample No. 4 represents yet another and more severe test, as in this the copper is claimed to have actually been melted for a short distance inside the insulation, leaving this, however, fairly intact except at the point of fusion. The insulating properties of the wire are said to be extremely high, and tests made upon samples after they have been raised to a red heat are reported as having shown an insulation resistance of over 95 megohms per foot. The claim is made that by using this wire for winding coils it will be possible to do away almost entirely with such material as oil paper, linen, etc., thus saving space, and at the same time producing a coil that is practically indestructible.

A Weatherproof Socket for Illuminated Sign Work.

We illustrate herewith a weatherproof lamp socket which has been put on the market by the Bryant Electric Company, of Bridgeport, Conn., to meet the increasing demand for a socket to be used for illuminated signs and kindred work.

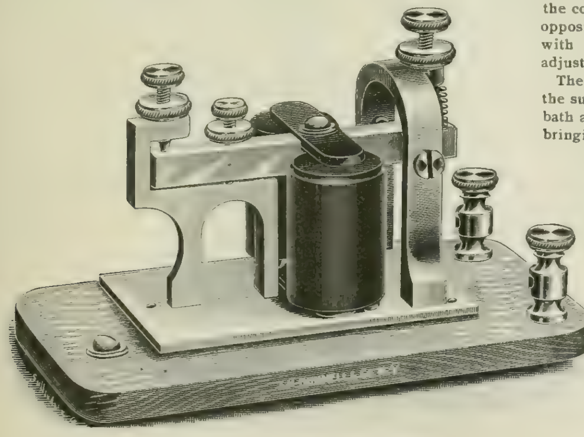
Much annoyance has been experienced heretofore from the failure of lamp receptacles to withstand the action of the weather, and the manufacturers of the socket here shown have taken particular pains to make it reliable in this respect.


New Weatherproof Socket.

It will be noticed that the terminals are brought out at the side instead of at the back, so as to avoid any trouble from the moisture which penetrates between the back of the socket and the face of the board upon which it is fastened.

A New Telegraph Sounder.

The accompanying engraving illustrates a new telegraph sounder, which has just been brought out by J. H. Bunnell & Co., of 76 Cortlandt street, New York. The features of the sounder are an improved winding, an elevated baseplate and an aluminium lever. As will be noticed upon a close inspection of the illustration, the metal base of the sounder is raised above the wood base, and rests upon three short metal posts; the result of this construction is a much greater volume of sound, for a given blow of the lever, than was obtained with the old hollow brass baseplate, which was the feature of the Giant sounder and was for many years considered the best construction known.


New Telegraph Sounder.

The combination of this baseplate with the aluminium lever and improved winding enables the sounder to give standard service with only one cell of gravity battery. The saving thus obtained in battery maintenance will naturally be quite a considerable item where a large number of sounders are in use.

Another improvement embodied in the new sounder consists of making the trunnion screws non-adjustable.

Electrolytic Heating.

A number of patents relating to various devices to be used in connection with the heating of materials in an electrolytic bath were issued on April 9 to Mr. George D. Burton, of Boston, Mass.

Patent No. 537,004 is on an invention relating to the art of heating metals for forging or other metal working purposes by immersing the portion to be heated in a bath and then passing an electric current through it of such a character as to form an incandescent gas envelope or electric arc at and below the surface of the solution and around the metal to be heated, whereby the heating of the metal is quickly effected.

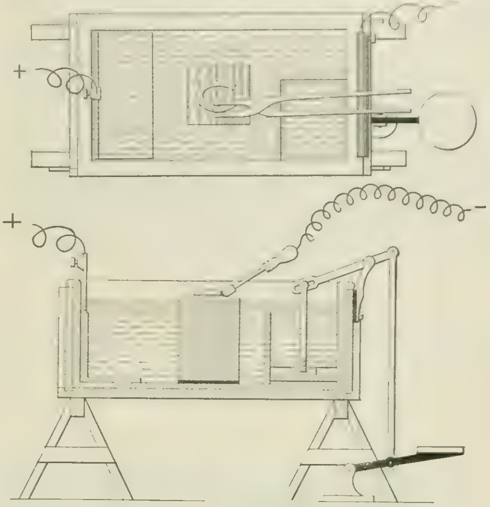


Fig. 1.—Electric Heating Bath.

The claim for this invention is on the art of heating metal, which consists in submerging or partially submerging a metal in a bath consisting of an aqueous solution of carbonate of soda and borax, passing a current through it and then subjecting the heated and softened metal to a metal working operation.

In another patent, No. 537,006, the invention relates to a clamping device whereby the metal is held while being heated, and includes the combination of a bath, an automatic clamp mounted on the edges of the containing tank and means for connecting the bath and clamp with opposite electric poles. The movable jaw of the clamp is provided with means for regulating its action, and to permit the bar to be adjusted in any desired incline.

The claims for patent No. 537,007 are on supporting the metal upon the surface of a non-conductive bed above the surface of an electrolytic bath and then by lowering the bed or raising the height of the liquid bringing the bath and the metal into electrical connection.

Fig. 1 illustrates the apparatus to which the specifications refer, another form being illustrated in the patent record on another page. The tank is preferably made of porcelain or fire clay, or earthenware lined with porcelain, and to protect it against breakage it is surrounded with a wooden jacket. The electrolyte consists of a solution of sal soda of a specific gravity of 1.305 at 84 degrees F. or of a solution of equal parts of sal soda and cream of tartar at a specific gravity of 1.255 at 77 degrees F. or of a solution composed of water, carbonate of soda and borax, in the proportion of three quarts of water to 12 pounds carbonate of soda and one pound of borax. The anode plate has a contact surface with the liquid much greater than the area of contact of the article to be heated. This plate is composed of lead, copper, carbon or other suitable conducting material, and is preferably of an angular form, one part resting on the bottom of the tank and the other being parallel with the end.

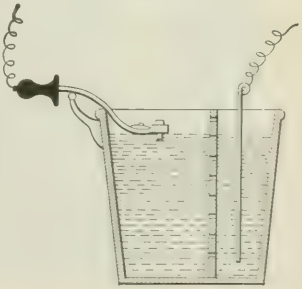


Fig. 2.—Boiler Rivet Heater.

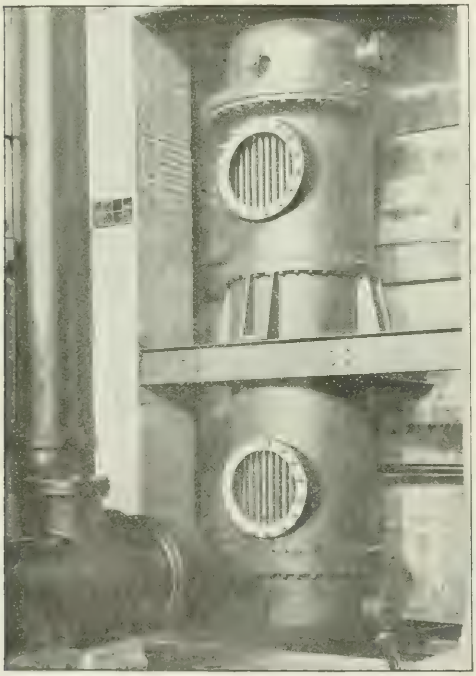
A work bed for the metal to be heated is disposed in the tank, the surface being normally above the surface of the bath; it is composed of non-inductive material, such as fire clay, stone or slate, preferably the latter, and its upper surface is corrugated or serrated, or otherwise roughened. This non-conductive surface has a rest for the metal which is to be heated, and its corrugated or roughened surface permits the liquid to intervene between the metal and the bed, whereby an arc or arcs are formed on the under side of the metal. The current used has a voltage of from 120 to 500 volts and is from six amperes upward, according to the size or quantity of the metal to be heated.

Another patent, No. 537,008, relates to an apparatus in which the working circuits are so arranged in connection with the main circuit and a resistance, that the latter will be automatically cut out while the work is being heated, and thrown in when the work is withdrawn, such resistance serving as a cushion to absorb the sudden shock incident to the removal of the work.

In patent No. 537,402 the claims are for a portable tank for heating metals, provided with a porous partition and a bracket at one side serving as a rest for the work holder; the latter is connected with an electric conductor and provided with an insulated handle and with holes for holding the metal to be heated, the holes being surrounded by raised rims. Fig. 2 is a vertical transverse section of a tank for holding the electric bath, and shows a holder supporting a rivet to be heated.

A 4,000 Horse Power Heater.

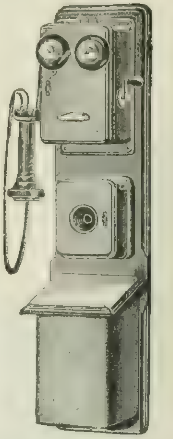
The accompanying illustration shows a mammoth feed-water heater recently installed in the Brooklyn Edison station by the Goubert Manufacturing Company, 14 and 16 Church street, New York. This heater is one of the largest ever built, having a capacity of 4,000 hp. As shown by the illustration, it is of the Goubert vertical type, built entirely of iron and brass with curved upper and lower tube plates and patent flexible expansion joint. This is the only joint in the heater that is not rigid, all the differential expansion between the shell and the brass tubes being taken care of at this point.



A Mammoth Heater.

This heater, like all the Goubert standard heaters, is built for a working pressure of 160 pounds per square inch, and is of the regular water tube type, the claims for which are that the pressure being inside, the tubes cannot collapse; they cannot leak at the ends because the greater the pressure the tighter are the tubes; the area for the passage of steam between the tubes is from eight to sixteen times as large as that of the exhaust pipe, and consequently back pressure is eliminated.

By removing one head all the tubes are easily accessible for examination and cleaning. There are ample provisions for the removal of scum and sediment. The outer shell of the heater is bolted to the lower water chamber, but is free to expand independently of the tubes, its only connection with the upper tube plate being made by means of a flexible copper gasket which serves to close up the space between the upper tube plate and shell, no parts under boiler pressure being weakened to provide for differential expansion. The expansion joint is entirely outside and only in contact with exhaust steam, can be replaced like an ordinary gasket, and is said to suffer very little deterioration from the fact that it never has to spring more than $\frac{3}{64}$ of an inch either way. Suitable surface and mud blow-outs and a hand-hole are provided for cleaning.



Phœnix Telephone.

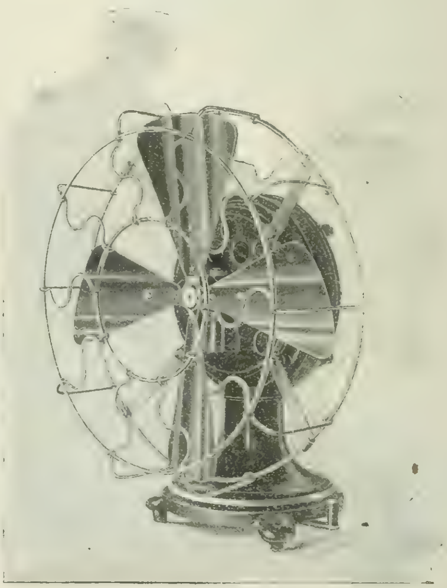
The Phœnix Telephone.

We illustrate herewith the standard telephone outfit manufactured by the Phœnix Interior Telephone Company, 131 Liberty street, New York. These instruments are furnished in any wood desired, and are guaranteed efficient over long or short lines. The transmitter is claimed to be one of the best of the Blake type on the market.

The Phœnix Company also manufactures desk sets, watchcase receivers, and other special forms and outfits, among them being an independent switch system for interior service.

New Lundell Fan Motor.

We illustrate below the new alternating current Lundell fan motor manufactured by the Interior Conduit and Insulation Company, 527 West 34th Street, New York, which embodies several improvements over last year's type. These machines are designed in two types, high frequency for from 14,000 to 16,000 alternations per minute and low frequency for 7,200 alternations per minute, and are made to run on either 52 or 104 volt circuits.

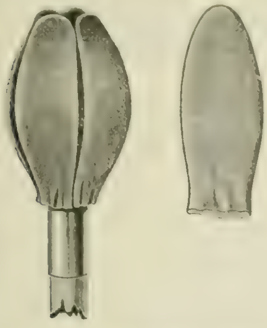


Improved Lundell Fan Motor.

The motors are handsomely finished in black Japan with gilt ornamentation, and all the outside fittings, fans, guards, etc., are either polished brass or nickel plated. The bearings are self-oiling and self-aligning. A switch is provided which enables the fan motor to be run at any of three speeds. Tests of the high frequency motor are said to show a consumption of 1 3-10 amperes at 52 volts, running a 12-inch fan at normal speed.

Incandescent Lamp Cleaner.

The illustration below shows a very simple and ingenious appliance for cleaning incandescent lamps, which has just been put on the market by A. A. McCreary, 136 Liberty street, New York. The cut is almost self explanatory and shows the device to consist of four curved wire fingers attached to the end of a stick; on each of these fingers is placed a flannel mitten. In operation it is only necessary to slip the cleaner over the bulb of the lamp and give it two or three turns in order to effectually clean off all the dust. For removing lamps from their sockets small rubber grippers are provided which are slipped over the outside of the mittens and by suction take a firm hold on the incandescent bulb, which may then be unscrewed in the usual manner.



INCANDESCENT LAMP CLEANER.

A Prominent New England Supply House.

The interior of the salesroom and executive offices of the Anchor Electric Company, Boston, Mass., is represented in the accompanying illustration, which shows also the faces of some of its clerical staff. The establishment of this young but enterprising company is located in the very centre of the "Hub" on one of the busiest streets, and is a model of completeness and convenience. Entering from the street are three spacious show windows where are the latest novelties in flush switches, sockets, cut-outs, etc., all manufactured by the Anchor Electric Company, together with the various novelties for which it is the exclusive agent in New England. A large show board covered with Anchor porcelain specialties, cleats, tubes, etc., makes a brilliant display, especially when lighted by successive pink and green lights in the evening. The main store is lighted by Helios arc lamps, for which the company is sole New England agent, while switches, sockets and cut-outs of every conceivable variety manufactured in the Anchor Electric Company's factory on Congress street are in daily use for lighting the private offices in the rear, show boards, etc. A wall of Acme wire, for which this company is also agent, occupies a central position in the rear, while Crescent ceiling fans are displayed in various places. To the left and rear is an immense stock of Anchor porcelain goods, tubes, cleats, etc.

A NEW ENGLAND SUPPLY HOUSE.

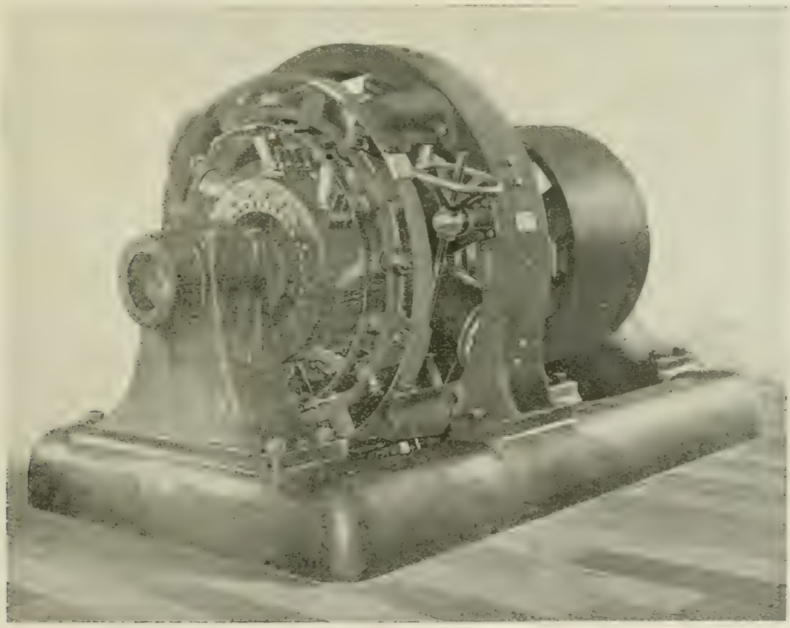
The Dow adjusting balls, woven wire brushes, wasteless zincs, etc., are all kept in large quantities for the trade in New England as well as retail buyers. In the basement is an extensive line of supplies.

Generator for Electrolytic Service.

The accompanying engraving represents a 200-kw eight-pole generator recently designed by the General Electric Company expressly to meet the peculiar requirements of electrolytic work.

The armature is of the smooth core type; the coils are machine wound of flexible cable, and are so arranged as to admit of ready replacement in case of injury. The armature is so thoroughly ventilated and the current density in the winding so low that the machine runs unusually cool, even under full load during a long period.

The commutator shell is divided into sections, allowing the removal of segments without removing the commutator or disturbing other segments. The frame and base of the machine are massive and the bearings self-oiling and self-aligning. The generator here illustrated gives 1,330 amperes and 150 volts at 300 revolutions per minute. A larger machine is now under construction which will have an output of 3,600 amperes and 75 volts at 280 revolutions per minute.



200 KW ELECTROLYTIC GENERATOR.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, April 13, 1895.

ELECTRICAL STOCKS were dull and uninteresting throughout the week The rumored deal between the General Electric and Westinghouse Companies remains apparently where it was when the report was first circulated. It is current talk in Boston that the General Electric people are giving the impression that the deal is off and that Mr. Westinghouse is responsible for the failure to carry it through, but it appears to be impossible to obtain any authentic information on the subject.

AMERICAN BELL fluctuated rather queerly during the week, opening at 179¾ on Monday, climbing to 183 on Wednesday and then gradually declining to the closing figure. Of course all sorts of rumors are rife concerning the new telephone organization and it is probable that some of these account for the fluctuation referred to. A prominent Boston banker said in a scoffing mood: "I am reliably assured that Mr.——, named as Boston director for the Standard Telephone Company, stands ready to put $4,000,000 into the enterprise if somebody will furnish the $4,000,000." A Bell Telephone director says: "I don't see what they want with $160,000,000. We would sell them the Bell Company for $60,000,000 and they could buy up the rest of the telephone stocks for $60,000,000 more, and have the whole thing and $40,000,000 of their $160,000,000 in their pockets."

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	97¾	98½
" " " Brooklyn	100	..	108
" " " Boston	100	..	..
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	..	30½
General Electric	100	33½	34
General Electric, pref	100	..	63½
Westinghouse Consolidated, com.	50	33½	34½
" " pref	50	51½	52

BONDS.

	Par.	Bid.	Asked
Edison Electric Ill., New York	100	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co. deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

	Par.	Bid.	Asked
American Bell Telephone	100	180	181
American District Telegraph	100	30	40
American Telegraph & Cable	100	89	91
Central & South American Telegraph	100	117	120
Commercial Cables	100	137	..
Erie Telephone	100	53	53½
Gold & Stock Telegraph	100	105	
New England Telephone	100	67	69
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63½	
Western Union Telegraph	100	87½	87¾

ELECTRIC TRACTION STOCKS.

	Par.	Bid.	Asked
Baltimore Traction	25	15½	15¾
Binghamton RR. com	100	100	..
Brooklyn Traction	100	9	11
" " pref.	100	..	53
Buffalo St. Ry	100	66	69
Cleveland City Ry.	100	68	70
Cleveland Electric Ry.	100	59	60
Chicago City Ry	100	305	315
Columbus St. Ry	100	46	49
Consolidated Traction of N. J.	..	30	33
Electric Traction, Philadelphia	50	77¼	77¾
Long Island Traction	100	7½	8¼
Louisville St. Ry. com.	100	37	39
" " " pref.	100	87	88
Metropolitan Traction, Philadelphia	100	91	91¼
New Orleans Traction	100	15	18
" pref.	100	56	60
North Shore Traction	100	..	..
" " pref.	100	74	83
People's Traction $30 pd	25	57⅝	57¾
‡Philadelphia Traction	50	82⅜	82½
Rochester St. Ry	..	38	..
Union Ry. (Huckleberry)	100	112	115
West End, Boston	100	63	63½
" " pref.	100	87½	..
Worcester Traction	100	..	13
" " pref.	100	77	80

BONDS.

	Par.	Bid.	Asked
Buffalo St. Ry. 1st con. 5s	100	101	..
*Binghamton Railroad Co. 5s	100	99	100
*Columbus St Ry 1st 5s	100	9	..
Rochester St. Ry. 1st. 5s.	100	95	97
*Union Ry. 1st. mtge 6s.	100	105	108
*Westchester Electric 1st. mtge. 5s.	100	98	101

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* With accrued interest.

‡ Ex-rights.

Special Correspondence.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, April 13, 1895.

THE PETTINGELL-ANDREWS COMPANY, Boston, has accepted the New England agency for the well-known "Brodie" tree insulators, manufactured by the Brodie Electric Company, of Manchester, N. H.

MR. F. E. GILBERT, of the Columbia Electric Company, Worcester, Mass., was a recent visitor to this office. Mr. Gilbert is a young man, but full of energy and ability, qualities which are bound to win for him continued success.

THE BRODIE ELECTRIC COMPANY, of Manchester, N. H., reports a good demand for its new automatic motor switch, and the "Brodie" tree insulators are also meeting with large sales. This company will very soon place some other specialties on the market.

MR. GEORGE THOMPSON, JR., president of the Thompson-Brown Electric Company, of Boston, accompanied by his wife, sailed from New York last Wednesday on the steamer Teutonic for Europe. He will be absent about five weeks and will combine business with pleasure.

THE COLUMBIA ELECTRIC COMPANY, of Worcester, Mass., is doing a nice business in the line of general electrical supplies. It has always on hand a complete and varied assortment and its prices compare favorably with larger competitors. Central station officials and contractors are rapidly recognizing this company as the supply house for Central New England.

THE ADAMS ELECTRICAL CONSTRUCTION COMPANY, 27 Snow street, Providence, R. I., has recently opened up for business with good prospects. N. F. Adams is general manager and Wm. Halstead treasurer. Mr. Adams is well up in the electrical business, having been connected with the old Edison General Company both in New York and Boston, as well as other corporations. He is well and favorably known in Providence, where he has been actively engaged for some time.

MR. C. W. KNIGHT, traveling representative of the American Electrical Works, of Providence, R. I., favored this office with a call this week, and reports business as being very good indeed, which isn't at all astonishing when one considers the excellent reputation of the company he represents, and the various wire manufactures it produces, together with the fact that Mr. Knight is a salesmen of the first order, popular and energetic, and has had an experience of about 16 years in wire manufacture.

BIBBER, WHITE & CO., 620 Atlantic avenue, Boston, have secured the New England agency of the Columbia Incandescent Lamp Company and the Wagner Electric Manufacturing Company, of St. Louis, Mo., which, with the general selling agency of the wire and cable products of the Crefield Electrical Works of Pawtucket, R. I., and the representation in New England of the specialties of the Cutter Electrical Manufacturing Company, of Philadelphia, has necessitated the enlargement of their business offices.

MR. GARDINER C. SIMS, of the Armington & Sims Engine Company, Providence, R. I., is one of the few men with whom a conversation relative to the past and present of the electrical business may be regarded as a treat. He has always been in close touch with the business from the early days of electric lighting, because of the immediate recognition given the Armington & Sims engine, owing to its general value and efficiency, and which recognition is continued to-day to a large extent, notwithstanding the most formidable competition. The briefest of interviews with Mr. Sims will readily reveal the fact that he has improved all the opportunities afforded him, and is a veritable encyclopedia on the business, at least from the commercial standpoint. It was our pleasure a few days ago to happen in upon him while he was consulting one of the old record books of his company, and which disclosed facts to him even that he had almost forgotten, as to the conspicuous part his engine has performed in the electrical industry. From August, 1881, to August, 1882, 97 of these engines were sold to the Edison companies, and in 1886 the record showed that 3 800 had been sold to various lighting companies—the output in manufacture increasing from 18 hp per day to 125 hp, and even more.

THE STANDARD THERMOMETER COMPANY, of Peabody, Mass., well and favorably known to the electrical trade, and enjoying an excellent reputation in the manufacture of arc lamps for incandescent circuits, is now placing before the trade a new arc lamp to be known as the "Upton" lamp and which is applicable for all circuits—direct current constant potential, constant current and alternating. This company has been actively engaged in the manufacture of arc lamps for incandescent circuits since 1888 and has produced successively the "Simplex" and "Knight" lamps, and more recently the "Ward" lamp, manufacturing its entire product in association with the Electric Construction and Supply Company, of New York. The "Upton" lamp is simple in construction, water-proof without the use of hoods, and conforms to all the requirements of the fire underwriters. It is made to consume four, five, six, seven, eight or ten amperes at the proper voltage. It is claimed that the "Upton" lamp possesses valuable improvements and merits over any of the lamps heretofore manufactured by this company. The factory of the company is one among the most complete to be found anywhere, well equipped in every way and possessing all the necessary facilities in the line of manufacture. The New York office is at 39 Cortlandt street, and is in charge of Mr. Charles A. Bramhall.

Western Notes.

Branch Office of the Electrical World,
936 Monadnock Building, Chicago,
April 13, 1895.

J. HOLT GATES is busy hustling for the Elwell-Parker Electric Company, of Cleveland. Mr. Gates is one of the men who is always busy.

THE BELDING ELECTRIC ALARM MAIL BOX COMPANY is now comfortably located in the Unity building A remarkably wide interest in this new device is reported

CHAS D. JENNEY, president of the Jenney Electric Motor Company, Indianapolis, was a recent visitor to Chicago. He reports that the new works are nearing completion, and will give facilities for turning out work rapidly.

THE METROPOLITAN ELECTRIC COMPANY has added to its long list of specialties a portable hose bridge, a new and very clever device for insuring the running of cars during a fire. Mr. W. H. McKinlock of this firm is absent on an Eastern trip.

THE SUNBEAM LAMP COMPANY has only one thing to regret in connection with the recent decision—it hasn't lamps enough to fill the orders piling up; but the company is increasing its capacity, and within a few days can handle everything that comes in.

THE WALLACE ELECTRIC COMPANY, Chicago, will within a few weeks occupy its new and commodious quarters at 305 Dearborn street. The new store extends from Dearborn street through to Plymouth place, and the offices and storeroom will be fitted up in a handsome manner. The Wallace Company has lately added to its present line of specialties the overhead devices and specialties manufactured by the W. T. C. Macallen Company, of Boston. The Boston incandescent lamp has also been added, and the apparatus manufactured by the Electric Selector & Signal Company is also a new acquisition. The Habirshaw wires, Iona specialties Whittingham electric car heater, Wallace railway specialties, Wirt brush, etc., are making many friends, and stand high in their respective lines. Wood's flexible pole bracket is fast becoming the standard article of its kind. In fact, the entire line of overhead appliances manufactured and sold by this company is growing in popularity.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY has much of interest to report. Among new exchanges are mentioned Newark, O., 300 instruments. In this town the existing telephone company cut its rates to $10 and $15 a year, but the excellence of the Western system had the effect of making the exchange a complete success. At Winona, Minn., the company has completed an exchange of 300 telephones, which is considered one of the finest exchanges in the West. It is finishing up work on exchanges at Mattoon, Ill., 200 instruments; Marysville, O., 100; Johnstown, Pa., 200; Santa Rosa, Cal., complete exchange. A recent contract was signed for an exchange of 200 instruments at Mt. Vernon, O. The exchange at Two Rivers, Wis., is rapidly growing, and is a thorough success. The Union Stock Yards, Chicago, controlled by Armour & Co., has abandoned its present exchange and ordered a complete Western equipment. The shops of the company are working to their full capacity.

General News.

Electric Light and Power.

BARDSTOWN, KY.—O. Arnold will let a contract May 1 for an electric light system.

CHARLOTTE, N. C.—An electric lighting plant is to be installed by the Charlotte *Observer*.

VERSAILLES. KY.—Address the mayor concerning the establishment of a electric light plant.

SHEBOYGAN, WIS.—H. J. Weigand is inviting bids up to April 29 for lighting the city by electricity.

SCOTTSDALE, PA.—The Scottsdale Pipe Company is in the market for electric cranes for its new foundry.

MARTINSBURG, W. VA.—The Martinsburg electric light plant has been purchased by W. E. Tebo for $18,500.

FLUSHING, MICH.—George E. Heriman may be addressed concerning the erection of an electric light plant.

CORTLAND, N. Y.—The Cortland & Homer Traction Company is about to put in new dynamos for electric lights.

TEMPLE, TEX.—The Temple Electric Light Company is contemplating the addition of new electrical equipment.

MONROE, LA.—Address Chas. G. Madison concerning an electric light outfit, to be purchased for the Monroe Athletic Club.

SHELBYVILLE, TENN.—The Shelbyville Water Company has purchased the lectric light plant, and will add new machinery.

LIVINGSTON, ALA.—Address W. K. Smith, secretary Commercial Club, concerning the city's new electric light plant, about to be put in.

WALTHAM, MASS.—The installation of a new electric light system is contemplated. Address the clerk of the Council for further details.

CHELSEA, MICH.—It was decided at a recent election to establish an arc lighting system at this place. Address the clerk of the Council.

LONGWOOD, FLA.—Three electric power plants are required by B. W. Hencke, civil engineer. Two are to be of 100 hp each, and one of 300 hp.

RUTLAND, VT.—The Marble City Electric Company has decided to enlarge its plant on Post street. A 100-hp engine and 150-hp boiler will be put in.

DETROIT, MICH.—A power house is to be erected by the Detroit Railway Company, and will be equipped with the most modern electrical machinery.

BALTIMORE, MD.—The City Council has appropriated $100,000 for the purpose of burying the city's electric wires. Address the clerk of the Council.

SYRACUSE, N. Y.—It is reported that the electric lighting system is to be extended in this city. The clerk of the Council can be addressed for information.

PENNSBORO, W. VA.—An electric lighting plant is to be established here in the near future. Charles W. Sprinkle can be addressed for further information.

LOCKPORT, N. Y.—It is reported that a municipal electric plant is to be established in this city. The clerk of the Council can furnish additional information.

ELDORADO SPRINGS, N. J.—A 21-year franchise has been granted W. G. Lewis and others by the Board of Aldermen to construct an electric light plant at this place.

GREEN ISLAND, N. Y.—A bill has been passed authorizing the erection of a municipal electric lighting plant at this place. The village clerk can give further details

NORTH TONAWANDA, N. Y.—A bill has been passed authorizing the establishment of an electric lighting system. Address the clerk of the Council for detailed information.

CHESTER PA.—Bids will be received for the lighting of the streets and public buildings of the city for a term of one year. The clerk of the Council can furnish information.

INGERSOLL, ONT.—The Ingersoll Electric Power & Light Company, with a capital of $45,000, has applied for a charter for the purpose of supplying electric power, heat and light.

PHILADELPHIA, PA.—The Diamond Electric Company will put in all necessary equipment to enable it to furnish power for stationary motors. The work is to be completed by May 1.

KINSTON, N. C.—It is reported that an election is to be held to decide the question of establishing an electric lighting system at this place. The town clerk can be addressed for details.

MARION, VA.—C. A Sprinkle can give information concerning the establishment of an electric light plant to be operated by water power. The population is about 2,000. A 50-hp water wheel will be used.

CHATTANOOGA, TENN.—Address Thos. E. Brown, Jr., 38 Park Row, concerning an electric power plant, to be erected on Lookout Mountain for the St. Elmo & Lookout Mountain Railway Company.

NEW YORK.—A nine-story office building will be erected for the J. C. Ayer estate, to be wired and equipped throughout for electric lighting. Architect R. Naynicke, of 111 Fifth avenue, has charge of the work.

TAMPA, FLA.—The Consumers' Electric Light & Street Railway Company will remove its plant to the works on Hillsboro river, six miles from the city. Additional turbine wheels and electrical machinery will be added.

ST. LOUIS, MO.—A three-story store and office building, to be erected for G. Schuchmann at a cost of $25,000, after plans prepared by Architects C. W Kellogg & Son, will be wired and fixtured throughout for electric lighting.

NEW YORK.—The twelve-story business building to be built for H. O. Havemeyer, 107 Wall street, after plans prepared by George B. Post, is to be wired and fixtured throughout for electric lighting. Estimated cost, $1,000,000.

FAYETTESVILLE, N. C.—An election is to be held May 5 to vote on the question of issuing $10,000 worth of bonds for the erection of a municipal electric lighting plant. Address the clerk of the Council for detailed information.

NEW YORK.—Plans have been prepared by Architects Lamb & Rich, 265 Broadway, for a fifteen-story office building at Nassau and Liberty streets, to cost $1.000.000. Among the improvements introduced will be electric lighting.

NEW YORK.—Plans and specifications have been prepared for a 15-story office building to be erected for John T. Williams, 54 Franklin street, at a cost of $600,000. The structure will be wired and fixtured throughout for electric lighting.

ST. PAUL, MINN.—Plans have been prepared by Architect C. E. Dickerman for a five-story brick and steel business building to be erected for Smith & Farwell at Sixth and Monmouth streets. The structure will be wired and fixtured throughout for electric lighting.

BOSTON, MASS.—Plans are being prepared for a mammoth apartment hotel to be erected on the Charles River, between Ashley and Chilmark streets, at a cost of $3,000,000. The structure will be provided with an electric plant. Messrs. Balch & Rackemann are the architects, and can be addressed.

The Electric Railway.

LANCASTER, PA.—The Lititz New Holland & Terre Hill Road has been granted entrance into the city.

LOCKPORT, N. Y.—The Lockport City Electric Railway Company has applied for an extension of its franchise.

CENTRALIA, PA.—The construction of an electric railway between this place and Ashland is contemplated.

ROME, N. Y.—The Rome City Railway Company is contemplating the equipment of its line with electric power.

BUFFALO, N. Y.—Surveys are being made for the route of the Buffalo & Niagara Falls Electric Railway Company.

PHILADELPHIA, PA.—The Camden, Gloucester & Woodbury trolley line will not be built to Glassboro this spring.

ONEIDA, N. Y.—An electric railway is projected between this place, Canastota, Clockville, Merrilsville and Oniontown.

COLERAINE, MASS.—William Donelson is interested in the construction of an electric road from Coleraine to Shelburne Falls.

ORANGE, N. J.—The Central New Jersey Traction Company has applied for a franchise to lay tracks on certain streets of the city.

BUFFALO, N. Y.—The Niagara Falls & Lewiston Railway Company has applied for permission to lay tracks on certain streets.

UPLAND, PA.—The Media, Middletown, Aston & Chester Electric Railway Company has applied for right of way through this village.

PORT BYRON, N. Y.—The construction of an electric railway from Auburn to this place is projected. The town clerk can be addressed.

AUBURN, N. Y.—The Auburn City Railway Company has been granted permission to operate a street railway on certain streets of the city.

NIAGARA FALLS, N. Y.—Capt. Brinker will commence work soon on the construction of the Niagara Falls & Lewiston Electric Railway.

ANNISTON, ALA.—An electric street railway at this place is projected by Howard W. Sexton. Work will be commenced in the near future.

DUNKIRK, N. Y.—The extension of the Dunkirk & Fredonia Street Railway line is contemplated. The secretary of the company can be addressed.

TAMPA, FLA.—The board of directors of the Consumers' Electric Light & Street Railway Company have decided to extend the line to Ybor City.

CANASTOTA, N. Y.—S. G. Gano, of Geneva, will probably begin the construction soon of an electric railway from Canastota to Sylvan Beach.

LAKEVILLE, L. I., N. Y.—The construction of a railway between this place and Old Westbury is contemplated. Address the village clerk for details.

EDGEWATER, S. I., N. Y.—The Midland Company has applied for a franchise to construct a line through St. Paul's avenue to the ferry at St. George.

BROOKLYN, N. Y.—Work has been commenced on the construction of the Long Island Electric Railway system. A. R. Hart is president of the company.

ILION, N. Y.—The Mohawk, Herkimer & Ilion Street Railway Company has been granted permission to change its motive power from horses to electricity.

PENN YAN, N.Y.—An electric railway is projected from this place to Dundee, a distance of 12 miles. The town clerk can be addressed for further information.

CHARLESTON, S. C.—It is reported that the City Railway is to be purchased by a company who will equip same with electricity. John M. Riggs is president.

NORTH PROVIDENCE, R. I.—The Union Railway Company has applied for permission to lay tracks on Mineral Spring avenue, from the Pawtucket line to Charles street.

LANCASTER, PA.—An ordinance has been passed granting the Lancaster City Street Railway Company permission to extend its line through certain streets of the city.

LOCKPORT, N. Y.—The Common Council has granted permission to M. Johnson to complete the street railway. It is reported that the line will be extended to Olcott.

DANVILLE, VA.—The Danville Electric Railway is to be extended into the suburbs of this city. Arrangements are being made for the same, and S. F. Berkeley is interested.

CHATTANOOGA, TENN.—The Electric Street Railway Company will build a branch line to the baseball park. S. W. Divine is manager, and will furnish detailed information.

PHILADELPHIA, PA.—The Philadelphia & Ardmore Passenger Railway Company has been granted permission to extend its line. The general manager can furnish particulars.

WILKESBARRE, PA.—An ordinance has been passed authorizing the extension of the Nanticoke Street Railway. Address the superintendent of the company for detailed information.

LAKE CHARLES, LA.—A recently organized company has been granted a franchise to construct an electric trolley road through this city. The clerk of the Council can furnish particulars.

HOBART, IND.—The Hobart Electric Railway Company has been organized for the purpose of building a line from this place to Chicago. A. Morrison is president, and A. J. Smith, secretary.

NEWTON, MASS.—The Newton Street Railway Company has petitioned for a new location for the purpose of constructing a street railway line to be operated by electricity from Waltham to Newton.

EAST GREENBUSH, N. Y.—The highway commissioners of this place have granted F. R. Barnes a franchise to construct and operate an electric railway from Albany to Castleton, through this place.

PARKERSBURG, W. VA.—The Park City line is to be rebuilt for the use of trolley cars by the Parkersburg Traction Company. W. R. Hurd, 320 Eighth street, can be addressed for further information.

WORCESTER, MASS.—It is reported that the North End Street Railway Company is to extend its line through Prescott and North streets. C. L. West, superintendent, can be addressed for information.

SPENCER, MASS.—The construction is contemplated of an electric railway from this place to West Warren, a distance of 15 miles. L. L. Currier, of Worcester, and T. J. Comins are among those interested.

BALTIMORE, MD.—The City Passenger Railway Company has been granted permission to extend its trolley line in the northeastern part of this city. Walter B. Franklin is president and can be addressed for details.

NEW BRIGHTON, S. I., N. Y.—The Staten Island Railway Company has been granted franchises to build trolley lines along Richmond Terrace, Jersey street and Richmond turnpike. The secretary can be addressed.

GLOUCESTER, MASS.—The contract will be awarded in the near future for the construction of the Gloucester, Beverly & Essex Street Railway from this place to Beverly. President Ferguson can be addressed for details.

PITTSBURGH, PA.—The McKeesport, Du Quesne & Wilmerding Electric Railway Company will receive bids until April 19 for the construction of connecting links between its Versailles and Fifth avenue termini. Address the secretary of the road.

SPENCER, MASS.—An electric railway from Spencer to West Warren will probably be established. L. L. Currier, Worcester, president; John Mulcahy, Hiram Gerald, Abin Hyde and others are directors. The proposed capital stock is $200,000.

ALBION, N. Y.—Surveys are being made for the construction of an electric line from Albion to Eagle Harbor to be known as the Beecher Electric Railway Company. Address the secretary of the Waterford Electric Railway & Power Company for details.

MILLERS FALLS, MASS.—An electric power house is to be constructed across Millers river. Two water wheels will furnish power to two electric roads, one to run from Millers Falls to Turners Falls, and the other from Turners Falls to Greenfield.

MONTICELLO, N. Y.—The Monticello & Navesink Traction Company has secured the right of way for its line between Monticello and Grahamsville; also the privilege of using the water of the Navesink river to furnish power to run its dynamos. Work is to begin soon.

CHATTANOOGA, TENN.—Col. D. M. Steward is interested in the construction of an electric railway to connect Chattanooga, Rossville and Chickamauga National Military Park. The estimated cost is $30,000, and the prospects are favorable for the consummation of the scheme.

BEAVER FALLS, PA.—The Shenango Valley Electric Street Railway, run between Sharon and Sharpsville, has been purchased by a number of capitalists, who have formed a company for the operation and improvement of the road. A. M. Jolly is president and A. R. Leyda secretary.

PHILADELPHIA, PA.—The Fairmount Park & Haddington Passenger Railway Company has been granted permission to lay tracks on Lansdowne avenue by the board of district surveyors. Permission has also been granted the Union Passenger Railway Company to lay tracks on certain streets of this city.

KINGSTON, N. Y.—The Rondout & Eddyville Railway Company has been incorporated for the purpose of operating a street railway, three miles in length, from this city to Eddyville. Wm. T. Hiscox, Percival C. Smith, and others, of New York, are among the incorporators, and can be addressed for particulars.

NORRISTOWN, PA.—The court has granted a perpetual injunction against the Montgomery County Passenger Railway Company, restraining it from running cars on the branch line from Bridgeport to Sweedland, in Upper Merion township, a distance of one and one-half miles. The court held that the electric railway tracks occupy land belonging to the Pennsylvania Railway Company and pass under its bridge in Upper Merion.

GENEVA, N. Y.—The Geneva Surface Railway Company, the Geneva & Waterloo Railway Company, the Waterloo, Seneca Falls & Cayuga Lake Railway Company, and the Seneca Railway Company have consolidated under the name of the Geneva, Waterloo, Seneca Falls & Cayuga Lake Traction Company, with a capital stock of $450,000. The road will be extended from Auburn to Syracuse via Skaneateles. Clifford E. Beebe and William Nottingham are among the directors.

PERSONAL NOTES.

WILLIAM H. McKINLOCK, president of the Metropolitan Electric Company, Chicago, was called east last week on business. He was accompanied by Mrs. McKinlock, son and daughter, who left New York Wednesday, April 10, on the steamship La Touraine, for Paris, France, to be absent a year.

PROF. ALEXANDER MACFARLANE was married on April 8 at San Antonio, Tex., to Miss Helen Martha Sweringen. The numerous friends and admirers of the accomplished professor and physicist will, we feel sure, join us in wishing the happy couple their full quota of connubial happiness and material prosperity.

MR. C. N. BLACK has succeeded Mr. E. W. Phipps as superintendent of the Brush Electric Company, Cleveland, O., the latter gentleman having tendered his resignation on April 8. Mr. Black, who has been assistant superintendent, and also, in connection with Mr. Brush electrician of the company, was graduated from Princeton University in 1888 with the degree of B. A. He pursued a two years' post-graduate course in electrical engineering under Prof. Brackett, after which, in 1890, he secured a position in the shops of the Brush Electric Company, where he has had an experience in every department, and, therefore, is personally familiar with the work required of each man in the shops, and, in nearly all cases, has performed similar work himself. At one time he was at the head of the drafting room, and is an expert draftsman. Again he was in charge of the testing room, and became perfectly familiar with the various machinery manufactured by the Brush Company. Not long since Mr. Black received an offer from one of the largest manufacturers of electrical apparatus in the country, but preferred to remain with the Brush Company. His association and work with Prof. Brackett, of Princeton, and Mr. Brush, of Cleveland, together with his practical experience in the work, have more than ordinarily fitted him for the position of superintendent of the Brush Electric Company. Mr. Black's successor as assistant superintendent will probably be appointed from some of the men in the works.

MISCELLANEOUS NOTES.

THE MECHANICS' INSTITUTE, at Peterborough, Ont., is taking steps to establish a reference library of manufacturers' catalogues, for the use of its members.

THE ELECTRICAL ENGINEERING SOCIETY of Lehigh University, at its regular monthly meeting last week, was favored with a paper on the monocyclic system, by Mr. Gibson, and a talk by Prof. Powell on the coupling of dynamos.

TELEPHONE RENTALS in nearly every place in western New York except Buffalo and Rochester have been reduced 10 per cent. Michigan has made a general reduction in city rentals of from 20 to 35 per cent, and the Central Union Telephone Company, operating in Illinois, Indiana, Iowa and Ohio, has reduced rentals about 25 per cent.

THE UNIVERSITY OF WISCONSIN has arranged for the annual inspection tour of junior electrical and mechanical engineering students, which is to be taken as usual during a portion of the spring intermission. The party will leave Madison on Wednesday of examination week at 5 10 p. m. Inspections in Chicago will begin on Thursday morning, and the following works will be visited by the electrical engineers Thursday Works of the Illinois Steel Company, at South Chicago; works of Pullman Company, at Pullman Friday Works of Siemens & Halske Electric Company, at the Grant Locomotive Works; works of Western Electric Company. Saturday—Electric power plant of Metropolitan Elevated Railway, works of Fraser & Chalmers, electric plant of Auditorium Hotel and theatre. Monday—Electric plants of Chicago Edison Company, cable railway plant, electric railway plant. Tuesday—Works of Pabst Brewing Company, Milwaukee; Pabst power house, power house of Milwaukee Street Railway Company, central exchange of Wisconsin Telephone Company. On Monday, Tuesday and Wednesday electrical students may, if they desire, leave the main party and join the mechanical students in visits to the great industries of Joliet, Waukegan and Milwaukee

Trade and Industrial Notes.

THE KNAPP ELECTRIC & NOVELTY COMPANY, 47 Warren street, New York, is receiving increased orders over last year for its battery motors and outfit. Several improvements have been made which add to their popularity.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is opening the spring campaign on the Meston alternating current fan motor with considerable success. A number of improvements have been made in this season's machine.

THE KEYSTONE ELECTRIC COMPANY, of Erie, Pa, has just issued a neat catalogue of its well-known motors and dynamos. The special reversible elevator motor made by the company is described at length, with illustrations.

SPRAGUE ELEVATORS AT MINNEAPOLIS.—The contract for Sprague electric elevators for the new Minneapolis pulbic building was granted on April 14, after a lengthy contest with a combination of hydraulic elevator manufacturers.

GARRETT, MILLER & CO., of Wilmington, Del., have purchased the electrical department of the Delaware Electric & Supply Company, and will largely increase the supply and construction business. A full line of supplies for electric lighting, power and traction work will be carried, as well as a complete stock of house goods.

THE GOUBERT MANUFACTURING COMPANY, 14-16 Church street, New York, is doing quite an extensive business in large feed water heaters, one of which is described in another column. Many of these are installed in electric light and railway plants throughout the country, and are the subjects of a large amount of favorable comment.

THE GENETT AIR BRAKE COMPANY, 33 Wall street, New York, is distributing a couple of pamphlets describing the Genett brake, and containing a reprint of the paper read by Mr. E. J. Wessels at the Atlanta Street Railway Convention last October. The pamphlets are exceedingly tasteful as to both typographical work and outside finish.

E. V. BAILLARD, 106 Liberty street, New York, has removed his quarters to the third floor of the same building, in order to obtain the additional space necessary to handle his increasing business. He will put in more machinery so as to have ample facilities for turning out work promptly. Mr. Baillard's specialty is model and experimental apparatus, and his shop is fully equipped for this class of work.

THE FERRACUTE MACHINE COMPANY, Bridgeton, N. J., has published a very comprehensive illustrated catalogue of its presses, of which it makes an extensive line. There are cutting, horning and wiring presses drawing and embossing presses, presses for punching and shearing, presses for stamping, and other presses too numerous to mention. It is difficult to imagine any sort of press which is not included in the list presented by the catalogue referred to.

THE ELECTRIC CONSTRUCTION & SUPPLY COMPANY, of Wilmington, Del., has been awarded the contract for furnishing the electrical material for the electric light, power and railway station being built at Fort Delaware. The McCay-Howard Engineering Company, of Baltimore, received the contract for engines, boilers and generators, and the Westinghouse Electrical & Manufacturing Company of Pittsburgh, Pa., will build the electric locomotive for the trolley line.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., is building an iron retort house for the Collins Company, Collinsville, Conn., and has the contract for the new Capitol avenue bridge at Hartford, Conn. The bridge will consist of two span plate girders, each 82 feet long, and will have a 25-foot roadway and two sidewalks. It has also completed the new boiler house for the Hartford Gas Light Company, at Hartford, Conn. The roof is anti-condensation. The New Jersey Magnetic Concentrating Company is putting up a new dryer plant at Lyon Mountain, N. Y., which will be entirely of iron, designed and built by the Berlin Iron Bridge Company.

THE HERCULES FLOAT WORKS is the name of a new corporation just organized at Springfield, Mass., for the manufacture of seamless copper floats for use with steam and hydraulic apparatus. The officers are H. S. Anderson, president and treasurer; F. Engelhard, manager, and H. S. Anderson, H. H. Parkhurst, F. Engelhard and F. H. Engelhard, directors. The office and factory are located at 54 Taylor street. This float is manufactured under a newly patented process, is made without seams, and [illegible] metal. It is claimed to be perfectly even and homogeneous throughout and absolutely impervious to water.

THE PHŒNIX INTERIOR TELEPHONE COMPANY, 141 Liberty street, New York, is the name of a new enterprise recently established by Messrs. Geo. W. Sutton and John H. Scofield. The new concern reports the outlook very encouraging as is evidenced by the fact that orders have already been taken from the Clark Thread Company, of Newark, N. J.; Passavant & Company, New York; The Royal Baking Powder Company, New York; J. C. Hoglan, president Royal Baking Powder Company, residence; R. Hoglan, president Cream Tartar Company, residence and factory, New York; Colored Orphan Asylum, New York; House of the Good Shepherd, Brooklyn; F. G. Smith, piano factory, Brooklyn; McLaughlin Brothers, Publishers, Brooklyn, and Flint, Eddy & Co., New York.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., reports a continuation of the large amount of new business secured. The following sales were made last week: The C. Weyand Brewing Company, Buffalo, N. Y., one 40-kw direct connected generator; Robert Walker, M.D., Warnerville, Pa., one 00 light and one 250-light ring type dynamo; G. M. Angier & Company, Boston, Mass., one 3-hp Manchester type motor, and one 250-light ring type dynamo; William Oswald, New Orleans, La., three 5-hp, one 10-hp, one 15-hp and one 30 hp Manchester type motor. Through J. Holt Gates, of Chicago, Western contractor, one 60-kw 220-volt direct connected multipolar generator for the Westville Coal Company; one 60-kw and one 85-kw 220-volt multipolar generators for other electric coal mining works, of which class of work the Mather Company is making a specialty; one 30-kw and one 45-kw multipolar generator for isolated lighting. B. F. Sturtevant & Co., Chicago, two 20-hp, Manchester type motors, and Burtis & Howard, Minneapolis, Minn., one 50-light ring type dynamo, third order.

THE WALKER MANUFACTURING COMPANY, Cleveland, O., reports the following contracts closed since April 1, 1895, which serve to show the popularity its improved generators and motors are gaining: St. Charles Street Railway Company, New Orleans, La., three 200-kw direct-coupled generators; Corning & Painted Post Street Railway Company, Corning, N. Y., two 125-kw direct-coupled generators; Channon & Wheeler, Quincy, Ill., one 75-kw belted power generator; Manhattan Beach Hotel & Land Company, New York, one 60-kw belted generator; Norfolk & Ocean View Railway Company, Norfolk, Va., two 250-kw belted generators, three double car equipments, 50-hp steel motors, and two double car equipments, 30-hp steel motors; E. A. Darling, Superintendent Columbia College, New York, one 50-kw belted generator; Buffalo, Kenmore & Tonawanda Electric Railway Company, Buffalo, N. Y., two double car equipments, 25-hp steel motors; Stern & Silverman, Philadelphia, Pa., for Rapid Railway Company, Detroit, Mich., two 200-kw belted generators and eight double car equipments, 50-hp steel motors; Dunkirk & Fredonia Railway Company, Fredonia, N. Y., one double car equipment, 25-hp steel motors; Scheneley Park & Highlands Railway Company, Pittsburgh, Pa., three double car equipments 30-hp steel motors. There has also been a marked increase in the orders received for general work as well as electrical.

Business Notices

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

AN ELECTRIC ELEVATOR PATENT SUIT.—As much has been said of the patent suit which has been brought against our company by the Otis Company, we thought it might be well to let your readers know the facts in the case. The patent on which the suit is brought is No. 324,621, issued Aug. 18, 1885. The claim is made by the Otis Company that this patent gives them the sole right to run elevators by shunt wound motors, with a low resistance armature. It is not a question in this suit as to how the motor is connected to the elevator, whether by worm or spur gearing or by belting, nor does it matter how the gearing or belting is arranged that connect the motor to the elevator nor what kind of controller is employed for operating the motor. What is claimed is the application of the electric motor to an elevator. If a man now owning an elevator which is driven through a countershaft by a gas engine, a hot air engine, or a steam engine should buy any well-known make of motor of the kind described above and employ any one to remove this engine and put the motor in its place to drive the countershaft, and through the countershaft the elevator, he would infringe this patent according to the claims of the Otis Company. Our patent attorney in the case is Mr. Livingston Gifford, and the electrical expert is Mr. Franklin L. Pope.

A. B. SEE MANUFACTURING CO., 116-120 Front street, Brooklyn, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 9, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

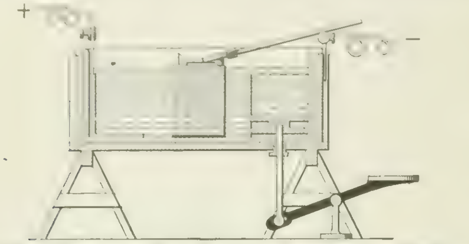
536,996. ELECTRODE; H T. Barnett, London, England. App. filed Dec. 27, 1893. In an electrode the combination of a carbonized pile fabric with a conducting support provided with guards extending beyond the ends of the pile, and with which the pile fabric is connected mechanically and electrically.

537,004. App. filed Dec. 11, 1893; 537,005. App. filed April 26, 1894; 537,006. App. filed Aug. 24. 1893; 537,007. App filed Jan. 23, 1895; Electric Heating and Welding Apparatus; G. D. Burton, Boston, Mass. These patents cover details of electric welding and heating apparatus.

537,008. App. filed Sept. 5, 1892; 537,010. App. filed Dec. 7, 1892; 537,011. App. filed Dec. 7. 1892; 537,012. App. filed March 3, 1893; 537,014. App. filed May 4, 1893; 537,402. App. filed Oct. 11, 1894, G. D. Burton, Boston, Mass., and E. E. Angell, Somerville, Mass. Electric Welding and Heating Apparatus These patents cover details of electric welding and heating apparatus.

537,0[illegible]. ELECTRIC CLOCK; F. L. Gregory, Chicago, Ill. App. filed Jan. 30, 1894. The combination of a time train and a time train actuator, also a time train stopping device carried by the actuator and adapted for engaging and stopping the time train at each end of the stroke of the actuator and for positively locking the time train against forward or backward movement.

37,058. INCANDESCENT LAMP; C. A. Merritt, Birmingham, Ala. App. filed Sept. 17, 1894. The combination of a series of conducting wires to connect the carbons, the wires connected at their upper ends to contact post embedded in the insulating filling, the contact plate having a head attached to the base by screw threads, a switch journaled to the contact plate between the head and the base, the switch adapted to make an electric connection to one or more of the contact posts as desired.



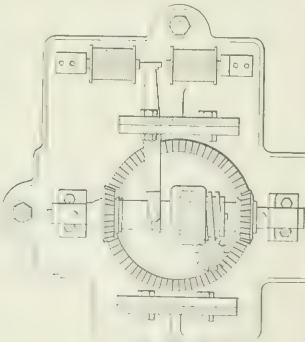
No. 537,007.—Apparatus for Electrically Heating Metal.

537,118. ELECTRICAL INDICATOR; F. H. Johnson, New York, N. Y. App. filed Oct. 1, 1891. The combination of an indicating device, electro-magnetic means for moving the indicating device, and a retarding device comprising an elongated dash pot, an elongated hollow plunger open at its inner end, and a mechanical connection from both sides of plunger to the device, so as to move the plunger in both directions.

537,124. ELECTRICAL STEERING GEAR; R. Nourvy, Nouveau Phalere, Greece. App. filed March 12, 1894. In a compass for the automatic steering of vessels the combination with the compass card controlled by terrestrial magnetism and having the toothed periphery and the alidade adjustably mounted on said compass card, of the gear wheel movable into and out of gear with the teeth on the compass card, an operating handle for said gear and means for holding the alidade against movement around its pivotal centre.

537,130. ARC RUPTURING DEVICE; E. A. Sperry, Cleveland, O. App. filed Oct. 16, 1894. An unprotected pole formed by one end of a magnet or contact constituting an electrode, also a co-operating electrode means for relative movement of the two electrodes, the final break of contact while disconnecting being in a certain line with reference to the pole, and an intercepting shield of solid insulator mounted upon the polar electrode, the face of which is in a plane practically at right angles to the said line.

537,133. ELECTRIC RAILWAY SIGNAL APPARATUS; G. L. Thomas, Brooklyn, N. Y. App. filed April 23, 1894. The combination with a rotary spindle, means for actuating the spindle and electric circuits including electromagnets for releasing the spindle at intervals, also reciprocating counterbalanced arms mounted independently and having operating wheels fixed to reciprocate with the arms, also a master wheel adapted to engage the arm-operating wheels successively and arm retaining devices having holding engagements with the master wheel at intervals.



No. 537,124.—Electrical Steering Gear.

537,149. DEMAGNETIZER; E. F. Gooding and G. W. Scovil, Elgin, Ill. App. filed Dec. 29, 1894. In a demagnetizer apparatus the inclosing case provided with a cover which has also a socket to make and break the circuit when box is opened or closed, and a magnet having the core connecting a plate with the table, and a coil wire with the ends insulated from each other, but fitting a lamp socket with the effect to connect the wires to the circuit.

537,161. POLICE SIGNALING APPARATUS; W. H. Kirran, Bayonne, N. J. App. filed Dec. 28, 1892. In a police signaling apparatus the combination with an alarm bell at the receiving station, of a relay controlling the circuit of such bell, a spring dog which drops back of the armature and holds the bell circuit closed, and a hand pull for withdrawing the spring dog.

537,194. App. filed June 18, 1894; 537,195. App. filed April 14, 1894; 537,197. App. filed Nov. 3, 1893; 537,196. App. filed June 18, 1894; 537,198. App. filed August 9, 1894; 537,199. App. filed Feb. 20, 1894; 537,200. App. filed April 10, 1894; 537,414. App. filed Feb. 17, 1893; 537,415. App. filed July 6, 1898; 587,416. App. filed Oct. 12, 1894. Supply Systems for Electric Railways; J. H. Guest, Boston, Mass. These patents cover details of construction relating to conduit railway systems.

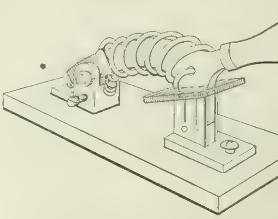
537,228. CUT-OFF OR SAFETY ATTACHMENT FOR ELECTRICAL CONDUCTORS; J. Parkinson, M. Springfield and C. Mills, Philadelphia, Pa. App. filed Oct. 10, 1894. An attachment for conductors consisting of a bridge having a section pivoted thereto, an insulated piece attached to the section, and a block pivoted to the piece, with a conductor leading from the block to the pivoted section and another conductor attached to the pivoted section which is intermediate, the latter conductor being adapted to serve as a conveyor of the current in case of accident.

537,259. NON-ARCING SWITCH; A. Wurts, Pittsburgh, Pa. App. filed April 14, 1893. A sliding contact, a stationary contact, a reciprocating switch, and a series of extinguisher bars arranged parallel to the path of the sliding contact and composed of non-arcing metal.

537,268. RAILWAY SIGNAL; H. E. Boothby, Chicago, Ill. App. filed Nov. 30, 1892. A signal having apertures in front and back to be used for signaling day and night, both signals being adapted to move independently out of the aperture and electrically connected to magnets to make a contact and so move signal.

537,271. INCANDESCENT LAMP BASE; W. C. Bryan, Bridgeport, Conn. App. filed Dec. 20, 1894. An incandescent porcelain base having a central opening and a surrounding recess on one side with a sheet metal screw-threaded terminal adapted to be flanged on to the base, and with a second flange to fit the recess.

537,282. TELEPHONY; E. F. Frost, Washington, D. C. A telephone system having a microphone, the combination therewith of an extra current or spark coil, the two being in parallel across the line circuit.



No. 537,130.—Arc Rupturing Device.

537,283. TROLLEY; Z. T. Furbish and G. A. Staples, Augusta, Ga. App. filed Sept. 25, 1894. In combination with the pole, a removable cap having ears, a socket pivoted to the ears, a trolley wheel supported by the socket and a connection between the lower end of the socket and the pole platform.

537,321. INSULATING COMPOUND; A. C. Thompson, St. Louis, Mo. App. filed July 30, 1894. A composition of different chemicals which can be used like paint for insulating connections, etc.

537,336. PROCESS OF AMALGAMATING AND SEPARATING METALS; H. M. Baker, Brooklyn, N. Y. App. filed June 22, 1894. A dry process of amalgamating and separating which consists in mingling with the material an amalgam of quicksilver and iron, and then passing the material through a magnetic field.

537,343. ELECTRICAL MEASURING INSTRUMENT; E. Hartman and W. Braun, Bockenheim, Germany. App. filed Nov. 27, 1891. A measuring device consisting of two wires held between fixed supports and arranged to have a current traverse them, in combination with a flexible connection, a transmitting connection, and an axle to which the transmitting connection is secured, and an indicator secured to the axle.

537,354. TRAVERSING APPARATUS FOR COMMUTATORS; J. Pease, Apperley Bridge, Eng. The combination with a supporting frame of a worm shaft, a crank slide wheel, a gearing connecting the worm and the wheel so as to regulate the extent of traverse desired to be imparted to the commutator or a dynamo.

537,358. ELECTRIC BATTERY SYSTEM; A. J. Powell and W. H. Hall, Brooklyn, N. Y. App. filed Nov. 13, 1894. The combination of an electric motor and suitable electrical connections to a main battery and two sets of switch bars to automatically reverse one pair of the switch bars to open the circuit when the main battery is connected to the motor, and means for reversing the other switch bars at will independently of the first pair.

537,404. APPARATUS FOR ELECTRICALLY HEATING METAL; G. D. Burton, Boston, Mass. App. filed Nov. 6, 1894. The combination of a tank containing an electrolytic bath, a carriage to hold the metal and means for regulating the flow of liquid from the receiving vessel, and suitable conductors connecting the electrolytic bath and the metal to be heated with opposite electric poles.

537,405. APPARATUS FOR ELECTRICALLY HEATING METAL; G. D. Burton, Boston, Mass. App. filed March 16, 1895. The combination of a tank containing an electrolytic bath, a carriage to hold the metal, and means for regulating the flow of liquid from the receiving vessel, and suitable conductors connecting the electrolytic bath and the metal to be heated with opposite electric poles.

537,412. RHEOSTAT; J. C. Pyfe, Chicago, Ill. App. filed Jan. 24, 1895. A rheostat having a magnetic contact adapted to engage another contact and be held thereby, together with a magnet shunt for short circuiting the magnetic field of the magnetic contact for releasing the said contact.

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CURVES FOR WINDING MAGNETS.

We print elsewhere the first of two sets of curves designed to assist in selecting the proper size of wire for winding magnets. Owing to conflicting conditions as to the resistance, number of turns and heating limit, the computations otherwise necessary for this purpose may be quite extensive and are laborious in any event. By means, however, of the tables constructed by Mr. Wood, each trial merely necessitates a glance at the table, and besides the labor being thereby reduced to a minimum, the result is apt to approach much closer to the best condition. The plan of using several different scales in constructing each chart is one that might be more often employed in similar work, as through it measurements from every point of the curve may be taken with almost equal accuracy. Another feature of value is the ease with which a temperature correction is applied, it being only necessary to change the value of the actual ampere-turns to conform to the working temperature fixed upon, and apply the new value to the curve.

GENERAL ELECTRIC AND WESTINGHOUSE.

During the past week the proposed arrangement between the General Electric and Westinghouse companies in regard to patents seems to have "struck a snag." At a meeting of the directors of the former company during the week, no action was taken in the matter, and now it is said that the joint committee charged with the details of the arrangement has been relieved of its duties for the present. As to the nature of the difficulty encountered, there are various rumors, none of which can be verified. According to one, director T. Jefferson Coolidge, of the General Electric Company, objected to the terms of the arrangement arrived at, which was equivalent to a veto. Another report is that the opposition of the executive officers of the two companies to the project finally had effect with the banking interests that favored it. A Wall street rumor cynically ascribes the interruption to the unfavorable condition of the stock market, and predicts that the same measure will soon be brought forward again for stock jobbing purposes. Finally, it is said that the cause of the difficulty was a disagreement as to the valuation of certain patents, and this appears to be the most plausible reason. All of the more valuable patents owned by either company are now questioned by one or the other, and it will naturally be no simple matter to arrive at an amicable agreement under these circumstances. Even should the validity of a patent be conceded, its valuation would be subject to the widest differences of opinion. The Tesla rotary field patents would appear, for example, to offer serious obstacles to an agreement, for it seems probable that the Westinghouse Company would insist upon the recognition of their validity, an acceptance of which condition would place the General Electric Company at a decided disadvantage.

ELECTRICAL RESONANCE.

The paper read by Messrs. Houston and Kennelly at last Wednesday's meeting of the Institute on "Resonance in Alternating Current Lines" is a valuable contribution to the *Transactions*, and admirably supplements Dr. Pupin's work on the same subject. While the mathematics are necessarily of such a character as to appeal to but few, happily the understanding of but a small portion of the paper is affected by this. The graphical method given for solving the equations, together with the clear and simple explanations, enable the general expression to be applied to specific cases without the necessity of being fully acquainted with its deduction or with the special mathematics involved. The conclusions of the authors are of particular interest in showing the relation when there is resonance between the line losses and the amount of power delivered. As the phenomenon of resonance is due to displacement of phases it was natural to suppose that when present the power factor would be decreased, and this the paper very conclusively shows, though it is pointed out that a preponderating capacity may produce a limited increase in efficiency by reducing the generator capacity. It is also stated that, theoretically, benefit might be derived from resonance were it possible to tune receptive devices, such as a transformer, in harmony with the line, but the inference to be drawn from the context is that practically this cannot be obtained. While, therefore, resonance offers no advantages for power work and possesses distinct disadvantages on account of the rise of voltage incident to it, the case appears to be different with respect to telegraphic and telephonic transmission. Here the question of line loss cuts no appreciable figure, and the rise of voltage would probably reach no serious proportions. The conclusions of the paper consequently do not seem to apply to these cases, while on the other hand the claim has been authoritatively made that resonance can be made to play an important part in this connection. We hope that the question may soon be put to a definite test on a long distance telephone line. By distributing in stations along its length the necessary apparatus to bring the line to resonance, a satisfactory experiment should be possible, and the importance of the issue at stake would seem to be sufficient to warrant the necessary outlay.

UNDERWRITERS' RULES.

The Institute paper of Prof. Anthony on "Underwriters' Rules" differed from the usual character of papers written by engineers on that subject, in that it criticised a rule for lack of stringency, and it is not creditable to the New York Board of Fire Underwriters that the necessity for such a course should have arisen. It is also significant that the blunder of this board was made in a departure from the code of rules formulated by the Underwriters' National Electric Association. We have before referred to the practice of some of the underwriters' associations in making whimsical or unwarranted changes or additions to this carefully prepared set of rules, and the present case is probably typical of the value of most of the supposed improvements thus introduced. Of all underwriters bodies, the New York Board has in the past shown itself to be the least qualified to take any step involving technical judgment, and it is not surprising, therefore, that the absurd rule criticised by Prof. Anthony should have originated with it. The discussion which followed the paper was quite at variance with the spirit of Prof. Anthony's criticism, for it consisted of little more than a denunciation of underwriters' associations, rules and inspectors in general. About the only specific criticism was directed at the rule permitting only one wire of a circuit in iron-armored conduits, which no longer exists; while one of the speakers denounced the underwriters for not keeping up to the time with their rules, another inveighed against them for the several recent revisions which were made for this very purpose. It is natural that an antagonism should exist between the underwriters and those who have to do with installing wires and apparatus; the main desire of the latter is to do work in as economical a manner as possible, while the former are inclined to lay down requirements with a view to an excess of security against fire hazard, the expense entailed being a secondary matter. Instead, however, of general denunciation, which will merely make matters worse, criticism of underwriters' rules should be specific, as in the paper referred to, which would result in making a tangible issue toward which the attention of the electrical interests could then be directed with a view to correcting the alleged evil, should it be proved to really exist. We are glad to learn that there is a movement on foot for a conference between the Underwriters' National Electric Association and the several national electrical bodies, the object being to arrive at a mutual understanding in regard to a code of insurance rules. This should serve a good purpose, for if there is not unanimity in the views of the two interests, and it is improbable there will be, the differences will be narrowed down to specific points and the battle can afterwards be waged on these alone and not against the entire code. This offers the most satisfactory solution of the difficulty, for the adoption of a rival set of rules by the electrical interests would merely accentuate the trouble. It would also be illogical for one interest to thus lay down a code of rules for the guidance of an antagonistic interest, particularly when the latter has immense sums of money at stake in the matter, and, above all, is in such a position that it can with impunity completely ignore the existence of any other rules than its own, which course would undoubtedly be adopted.

The Street Railway Gazette.

The *Street Railway Gazette*, with all its assets, has been purchased by Mr. W. J. Johnston, and will hereafter be issued each week from 253 Broadway, New York. The *Gazette*, which is the only weekly street railway journal in the world, was established in 1886, and for the first six years was published monthly. Since 1892 it has been issued every week. Mr. Clarence E. Stump, general manager of the paper, and Mr. J. W. Dickerson, the editor, will still be connected with it under the new management. As a result of the change in ownership some modifications will be made in the paper. The size of the page will be slightly reduced and the number of pages considerably increased. Careful attention will be bestowed upon the reading contents, in order to render them of the greatest every-day value to the audience addressed. The articles will be by practical men, for practical men, and while technically accurate will be written in plain and simple language. More illustrations will be used than formerly, and the effort will be to make the paper in every way a worthy representative of the activity and enterprise and progressiveness characteristic of the street railway business. The co-operation and assistance of both street railway officers and employees to this end will be highly appreciated. Items of news, articles for publication, and suggestions as to directions in which the *Gazette* can be improved will always be welcome; so will names of probable subscribers and lists of new subscriptions.

Mr. A. P. Trotter.

Mr. A. P. Trotter has recently resigned the editorship of the London *Electrician*, over whose pages he has so ably presided for several years. Electrical journalism suffers a real loss in the retirement of Mr. Trotter who, in addition to his thorough scientific and professional requirements, possesses a trenchant literary style and independent habit of thought that won favor with readers and gave a distinctive and enviable character to the editorial pages of the *Electrician*. Mr. Trotter, we learn, will hereafter devote his whole time to his mechanical and electrical consulting practice, including photometric testing. Being now able to give more attention to work in his laboratory, we may perhaps expect from Mr. Trotter's pen further valuable contributions on photometry and illumination, like his notable paper on the "Distribution and Measurement of Illumination," read several years ago before the Institute of Civil Engineers, and his more recent paper on "Dioptric Glass Shades."

Subway Explosions.

Referring to the recent subway explosions in London, the *Electrician* hazards an explanation. We have, it says, a cathode separated by a film of electrolyte from a larger supply in damp wood, connected with an extensive vat in the form of the earth. There is then a continuous flow of dilute solution of salt to the cathode. Soda is formed, and as the water is scarce, sodium. This process, going on by the month or year, can accumulate considerable quantities of soda and sodium, and, of course, carbonates are also formed. As to how the sodium can light the gas, the catastrophe can happen in many ways. If you have 100 volts or more on a circuit, which, owing to the gradual accumulation of caustic, has a fairly low resistance, you may easily have a high enough temperature to fire a piece of sodium suddenly exposed to the air by a flake of protecting hydrate or oxide falling off. That the sodium is in lumps shows it must have been hot at least once, as it would not otherwise be run together unless it aggregates in some mysterious way like flints in chalk. Again, a piece falling off into a wet culvert might easily fire. In many cases potassium was also present. Potassium fires more easily than sodium. The metals also alloy and form a liquid which will light even without being thrown into the water. This alloy being liquid, a coating cannot adhere to and protect it. When a drop is spilled on the table, if it does not catch fire at the time, it will if a duster is used to wipe it away.

The American Institute of Electrical Engineers.

The regular monthly meeting of the American Institute on April 17 was opened by President Houston with a feeling tribute to the memory of the late treasurer of the Institute, Mr. Geo. M. Phelps. Mr. A. E. Kennelly then read a paper on "Resonance in Alternating Current Lines," prepared by himself and Mr. E. J. Houston.

The objects of the paper were stated to be to present the formula expressing the variation of electric current and pressure in an alternating current circuit under the most general conditions, and in its simplest form; to present calculations for the pressure and current in any alternating current circuit, by a graphical method; to investigate the effects of static capacity in an alternating current circuit, and to investigate the effects of capacity and inductance on the delivery of energy at the distant end of a circuit. General formulæ are deduced for the E. M. F. and current strength at any point of an alternating line, expressed in terms of the resistance, inductance, capacity, leakage and the initial and terminal E. M. F. and current strength, hyperbolic functions being employed. Graphical methods of determining the vector terms of the equation are given, and a chart is included enabling the numerical value of the hyperbolic functions to be arrived at by inspection.

Examples are worked out with data favorable to the development of resonance, with a view to disproving the claim that has been made as to the economy offered by resonant lines for the transmission of power. It is shown that while a resonant line may deliver twice as much alternating current with the same $C^2 R$ loss as a continuous current line, owing to difference of phase between the E. M. F. and current, much less energy will be delivered in the former case with the same line loss. The conclusions of the authors are as follows:

(1). The combined effect of capacity and inductance is to produce a tendency to resonance. (2). The tendency to resonance is favored by high frequency, high insulation, high inductance, high capacity, and high conductance. (3). When the line is free at the distant end, the resonant effects are more pronounced at that end than at the generator. (4). The determining factor for the production of resonance is the angle of the vector geometric mean of the conductor impedance and dielectric admittance, and rapidly increases with the same. (5). The complete wave-length in a resonant line is 2π times the length, in which the reactances of the inductance and the capacity are equal, the maximum difference of pressure or current strength being exhibited in one quarter of this wave-length. (6). When resonance occurs, the current and pressure in the circuit are not in phase except at their maximum and minimum values, *i. e.*, at the crests and troughs of the waves. (7). In resonant circuits, the lag of the pressure and current is 90 degrees between any successive pair of maximum and minimum values. (8). In ordinary lines, worked sinusoidally at ordinary frequencies, resonant effects are practically negligible. (9). Prominent upper harmonics in the E. M. F. of the generator may sometimes give rise to appreciable resonant effects, although the resonance to the fundamental frequency may be inappreciable. (10). A certain amount of capacity tends to increase the plant efficiency of the generator, and is, therefore, economical, but marked resonance in a line not only ceases to be economical, but is actually wasteful. (11). Although, on a large scale, less energy can be delivered at the distant end of a powerfully resonant line, than on a nonresonant line, yet a greater current strength can in some cases be delivered over a powerfully resonant line.

In the discussion that followed Prof. Pupin said that Prof. Kirchoff in 1867 first directed attention to the subject just treated. The analogy of a stretched string to the conditions of resonance was dwelt on, it being stated that the analogy was a true and not merely illustrative one. Prof. Pupin, while accepting the conclusions of the author as to the non-applicability of resonant lines to the transmission of large amounts of energy, maintained that for telephonic and submarine cable purpose the employment of the resonant principle was of value.

Prof. A. G. Webster referred to the thorough manner in which Prof. Oliver Heaviside had treated the general question involving capacity and inductance, and paid a high tribute to his intellectual power. The chart of hyperbolic functions was criticised on the score of complexity and a substitute offered; the paper was also declared deficient through not properly considering terminal conditions. In reply Mr. Kennelly stated that the chart in the paper was constructed for the exact requirements implied in its proposed use, which condition was not satisfied by the chart suggested by Dr. Webster. He also showed that the general equation given in the paper did properly consider the necessary terminal condition.

Prof. W. A. Anthony then read his paper on "Underwriters' Rules," which severely criticised the approval by the New York Board of Fire Underwriters of a certain insulated conductor as a substitute for conductors in tubing. The conductor referred to consists of a standard insulated wire with its covering of rubber and braid, having woven upon it two additional coverings of extra heavy braid. This additional covering, which is tightly woven on, and from which the wire can no more be removed than from its original covering of rubber and braid, the maker, said Prof. Anthony, by an extraordinary stretch of language, calls a tube, and claims for it the advantages of the conduit tube prescribed in the insurance rules, which unwarranted claim has been accepted and approved by the New York Board of Fire Underwriters.

The discussion which followed was participated in by Messrs. Hammer, Leonard, Woodbury, Jenks, Holmes, Mailloux, Ayer and Hamblet. The opinions expressed principally related to the manner in which insurance rules were enforced, though some of the speakers roundly denounced insurance rules, underwriters and inspectors in general. In the course of the discussion it was announced that a movement is on foot to bring about a meeting of official representatives of the American Institute of Electrical Engineers, the Underwriters National Electric Association, the National Electric Light Association and other bodies interested in insurance inspection, the object being to arrive at an agreement as to a code of rules.

At the council meeting in the afternoon Mr. Geo. A. Hamilton was elected treasurer for the unexpired term of the late Mr. Geo. M. Phelps, and a committee was appointed to draft resolutions commemorative of the services of the latter to the Institute, which were read at the evening meeting as follows:

"The Council of the American Institute of Electrical Engineers, desiring to express its sense of the loss to the Institute in the death of George May Phelps: at its meeting held Wednesday afternoon, April 17, 1895, at the Institute headquarters, appointed a special committee of three to draft suitable resolutions which the undersigned as committee respectfully present herewith.

"Resolved: That in the death of George May Phelps, the council has suffered the loss of an energetic, faithful, and capable member, and the Institute a most efficient officer; one who was constantly striving to uphold the standard of its work, one who was ever watchful of its welfare. In his disinterested efforts to serve the Institute, he brought to bear upon its deliberations his keen perceptions, intellectual ability, and eminent force of character.

"Resolved: That a copy of this resolution be suitably engrossed and framed and presented to Mrs. George W. Graham, his daughter, and the sole surviving member of his family."

Science and Mathematics.

In a recent address delivered by Prof. H. S. Carhart on "The Educational and Industrial Value of Science," he refers to the relations between science and mathematics as follows:

"Mathematics furnishes a training in the relations of abstract number, and in the manipulation of symbols invented to facilitate operations expressing the relations between related quantities. It is not only a valuable agency in mental development, but it is a powerful instrument for the investigation of phenomena in those branches of science to which applied mathematics is indispensable. Science has more to do than either language or mathematics with objective phenomena. The student of science soon finds that he has a new set of relationships with which to deal. He may be familiar with mathematical theorems and solutions, but his first difficulty is to see the points of attachment of mathematics to the facts of physical science. He is armed with a weapon of most modern design and exquisite workmanship, and he has possibly obtained some skill in target practice, but he has no eye for game. He may be too short-sighted to see that there is any game even."

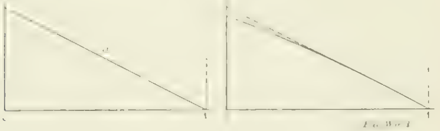
Press Telegraph Messages.

The London *Electrician* says that so heavy is telegraphic press work at night time that the most highly paid operators and the most costly appliances have to be resorted to in order to cope with it. Night work is always more expensive than day work, and it is probably a fact that press messages cost more at night than in the day time, although transmitted at a cheaper rate.

Contribution to a Theory of Synchronous Induction Motors.

BY ALEXANDER ROTHERT.

The object of the present article is not to put forth any novel ideas, but rather to explain, in a clear and general way, the properties of simple alternating and polyphase motors, and particularly to elucidate the operation of a simple alternating motor in plain terms. For this purpose, we have a very convenient method, which shows the properties of these motors remarkably well: namely, the diagram of torque as dependent upon speed and slip.



FIGS. 1 AND 2.

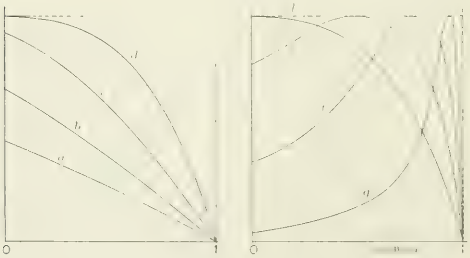
Let us turn at first to the more simple case, that of the polyphase motor. We must make the supposition, that the field system generates an approximately constant rotary field, whose intensity, within practical limits, depends only upon the working potential, the latter being taken as constant.

For the sake of simplicity, let us take the theoretical case in which the closed circuited armature has no self inductance; *i. e.*, that all the lines of force which pass through the armature also traverse the field system. The electromotive force generated in the armature will be (as in a continuous current dynamo) proportional to the relative velocity of the field and armature, that is to say, proportional to the slip. In accordance with Ohm's law, the armature current will accordingly be directly proportional to the slip. The torque is equal to the product of the armature current and the intensity of the rotary field, and, therefore, with a constant rotary field, proportional to the armature current and, consequently, to the slip also.

The result is shown graphically in Fig. 1. The abscissa eare the revolutions of the motor from 0 to the speed of synchronism, which is called 1, and the ordinates are the corresponding torques. In accordance with the above, the straight line *a* shows the dependence of the torque upon the speed, as, with synchronism (slip = 0), the torque is zero, and with the motor at rest (slip=1), the torque becomes a maximum.

A motor approaching this theoretical case would be one whose closed armature winding possesses large resistance in proportion to its self inductance; that is, a motor with very little winding space in its armature. Such a motor would naturally be worthless in practice, on account of too much slip, low efficiency and large size for a given power, but it would start very well, because when at rest the torque is a maximum.

The larger the self inductance becomes in proportion to the resistance, the more bent does the straight line become (Fig. 2), because there arises a shifting of phase between the current and E. M. F. in the armature, which on the one hand weakens the attraction between the rotary field and the armature current, while on the other hand the current itself diminishes.



FIGS. 3 AND 4.

The self inductance of the armature is limited by the scattering of the lines of force induced in it by the armature current, and is therefore greater, the greater the number of such lines which are closed upon themselves without passing through the iron of the field magnets. This leakage will, in general, increase with a larger number of ampere turns in the armature (that is, with greater winding space) and with increasing magnetic saturation of the air space.

If we start with a given number of turns in the armature, and let the resistance diminish successively, that is, have the winding space increase, the diagrams will appear as in Fig. 3. The curves will differ more and more from a straight line, while the torque as well as the power of the motor will increase considerably, but only to a certain maximum. From this point the maximum value of the torque remains constant*; but the character of the curve changes as the torque at starting diminishes again, and the more, the greater the winding space—that is, the smaller the armature resistance becomes. This relation is shown by Fig. 4.

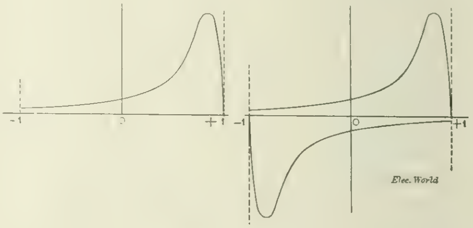
A motor corresponding to curve *g* would start badly, eventually not at all, but on the other hand has a much more constant speed, as the torque reaches its maximum before the slip has grown at all large. This amount of slip may be reduced at pleasure, but naturally, as Fig. 4 teaches, only at the cost of the starting torque.

As can be seen by these curves, the designer is entirely able to make non-synchronous rotary current and polyphase motors to suit any particular case.

A motor may be required, for instance, to drive a crane, which shall start with great power, while constancy of speed is not important; or, on the other hand, a motor with as constant a speed as possible, but which starts with no load.

Between these two extremes, all sorts of intermediate cases may naturally arise.

We possess, however, a means by which both important properties may be combined. This consists in switching non-inductive resistances into the armature circuit at starting, by which we obtain the curve *d* for the start, instead of curve *g*. After the motor is running, the resistances are gradually cut out. This method also possesses the advantage of avoiding excessive currents at starting, but unfortunately it involves the use of collecting rings and brushes. Instead of switching in resistances, certain parts of the winding can be made to oppose others and thus reduce the effective number of turns while keeping the resistance constant. The same object would be attained by switching condensers into the armature circuit and so neutralizing the self induction, but it would be difficult to employ this method in practice. All these methods presuppose that a closed circuited armature, wound with wire, is used, and not a so called "closed ring" armature consisting, as is well known, of rods which at either end of the armature are connected with each other by a conducting ring.



FIGS. 5 AND 6.

Before passing to simple alternating motors, the following case must be disposed of: Let us imagine that the armature revolves in a direction opposite to the movement of the rotary field, and let the appropriate diagram be drawn. Naturally, work must be expended to turn the armature, for, according to Fig. 5, the torque opposes the motion and is therefore negative.

The alternating current produces in the field magnets of a simple alternating motor a pulsating field, which for simplicity's sake may be taken as sinusoidal. But a sinusoidal pulsating field may be resolved into two rotary fields of equal period, which revolve in opposite directions.

We can now return to our former line of thought. Each of these two rotary fields induces in the closed circuited armature currents of different periods, which again produce two torques, one of which, considered with reference to the direction of motion, is positive, the other negative. Let us show these torques in the diagram. Fig. 6. On the right of the axis of ordinates are drawn the torques for direct (clockwise) motion and on the left those for the inverse rotation of the armature. The two curves must naturally be entirely congruent, as the armature is a system symmetrical to both rotary fields. It follows then directly, that at rest the motor produces no torque, as the two single values cancel each other, and when set in motion can turn in either direction at pleasure, in which respect it acts very nearly like a polyphase motor. It also follows from the diagram that only closed circuited armatures with large winding space can and should be used here, for if an armature were taken, whose torque curve looked like Fig. 3°, for instance, a diagram like Fig. 7 would be obtained, which, as is easily seen, gives only a negative torque.

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* Blondel has shown this analytically in his able treatise: "Notes sur la Theorie Elementaire des Appareils à Champ Tournant," in *La Lumière Electrique*, 1893, vol. 50. It also follows from the graphical representation of Heyland in the *Elektrotechnische Zeitschrift*, 1894, No. 41.

The drawbacks of the simple alternating motor as compared with the polyphase motor can also be directly derived from the diagram: The former, when running unloaded, has a greater slip than the polyphase motor, since its torque is negative when running synchronously; there is also much more loss of energy in the armature of the single phase motor, because the rotary field which is opposed to the direction of revolution works inductively and causes losses of energy in the form of currents of great frequency (equal to twice the frequency of the alternating current). Moreover, these currents influence the torque injuriously.

The motor will work more favorably, the smaller the slip is made, because the negative torque is thereby reduced. A limit to this diminution of the slip is sometimes fixed by the requirement that the motor shall start like a polyphase motor. A further important drawback of the simple alternating motor results from the fact that the pulsating field, which we have imagined resolved into two rotary fields, is twice as strong as its two components, as the following consideration easily shows:

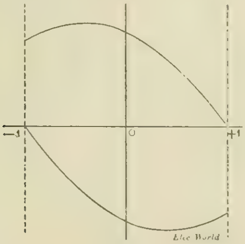


FIG. 7.

The two oppositely turning rotary fields will, at two points 180 degrees apart, combine to form the amplitude of the alternating current field, while they will cancel each other at two points distant 90 degrees from the former two; each of the two rotary fields has, therefore, only half the intensity of the alternating current field. In consequence, a motor with a single current will require twice as strong a field as with polyphase currents to produce the same torque with the same slip, the same working E. M. F. (with polyphase currents, the E. M. F. of one current) and the same power being presupposed. The iron of the simple alternating motor would, therefore, be much more strongly saturated, or, as this is not generally customary, the motor would have to be considerably larger.

Although the slip can be reduced by further enlargement of the winding space in the armature, the torque cannot be increased, and so the simple alternating motor will always be decidedly larger than a corresponding polyphase motor, and will at the same time have about double the hysteresis loss. Moreover, in consequence of the double strength of field for the same torque, the shifting of phase will be much greater, as has been fully proved by experience.

As has been seen, the operations in a simple alternating motor, which are really somewhat complicated, are here derived in an elementary and, at the same time, a very striking manner; and the method of the diagram of torques used here may be recommended in all cases where it is desirable to elucidate the properties of simple and polyphase alternating current motors in an easily understood way, without much mathematics. And to the designer it also suggests a simple method of calculating the dimensions of closed circuited armatures for simple alternating motors.

The Galvanometer in Practice.

BY LOUIS DENTON BLISS

Electrical measuring and testing instruments of all classes in their commercial form, while easily understood and intelligently handled by an expert, are usually so complicated in construction, with their numerous concealed wires and indefinable circuits, that in the hands of the student who has only acquired an elementary knowledge of the science, they appear very complex and exceedingly difficult to handle.

The essential parts of a galvanometer are three things, namely: a piece of wire, a magnetized needle, and a silk thread. All the other material so frequently used is simply for the purpose of rendering the instrument more sensitive in its operation, more nearly "dead beat," and to further improve its appearance generally, in order that a purchaser may be induced to feel that he is getting a little nearer the worth of his money. An instrument may be constructed at a cost not exceeding 20 cents, which, in connection with a slide meter Wheatstone bridge, will accurately indicate, within a half centimetre, the unknown resistance.

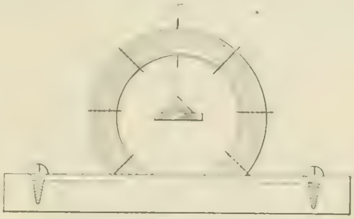


FIG. 1.

Fig. 1 illustrates the general appearance of the instrument. Fifteen cents' worth of cotton covered magnet wire, wound in a coil, as indicated, and mounted upon a block of wood, constitute the main parts of the instrument. A brass screw at each side of the block serves as a terminal for each end of the coil, and also as a binding post. Next, a piece of a watch spring, not over five-eighths of an inch in length, which can be obtained from any jeweler, should be magnetized by stroking it with one pole of a permanent or electromagnet. Heating it red hot and cooling it in mercury before magnetizing will render its retentivity greater.

This needle should now be glued to a fibre drawn from a short piece of silk thread. The other end of the fibre should be attached in a similar manner to a piece of brass wire, which has previously been carefully forced downward between the wires to about the centre of the coil. A triangular piece of very thin paper glued to the side of the needle, as shown in the cut, will render this instrument partially "dead beat."

A thin disc of mica, just small enough to fit snugly into the coil on each side, serves to keep off the air, and at the same time prevents the needle from turning all the way around, which would tend to break off the fibre by the continual twirling of the needle. The galvanometer is now complete, and will be found exceedingly useful for detecting very small currents.

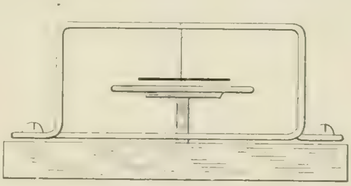


FIG. 2.

A simple detector galvanometer may be made at a cost for materials of not more than 10 cents, and is capable of indicating the presence and direction of comparatively small currents. Fig. 2 illustrates this instrument, which consists of four turns of No. 12 uninsulated magnet wire, the convolutions resting parallel to each other but not quite touching. The terminals of the wire are attached by means of two brass screws (which serve also as binding posts) to a small block of wood. A common steel sewing needle, magnetized and suspended in the same manner as described in the previous and more sensitive instrument, serves to indicate the deflection. A paper dial mounted on a little wooden table directly under the needle shows the proportionate intensity of different currents.

A tangent galvanometer can be constructed at practically no cost whatever. A piece of No. 12 scrap wire, 18 inches long, bent into a circle, as shown in Fig. 3, makes an excellent ampere meter when a needle is used of the same size as that in Fig. 1. A long pointer, consisting of a wisp of straw, when glued to the needle, serves to indicate, in amperes, the strength of the current passing, reading directly on a scale laid off in the tangent of a circle. The only objection to this instrument would be that it is not "dead beat," but as far as accuracy of indication is concerned it would compare favorably with a $25 ammeter.

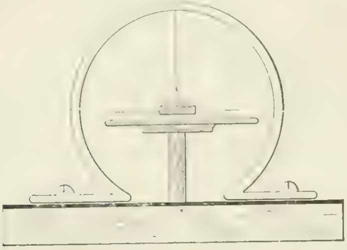


FIG. 3.

A Wheatstone bridge is very easily constructed out of a piece of board three inches wide, seven-eighths of an inch thick, and 42 inches long. A binding post at one end has fastened under its base a piece of No. 16 German silver wire, 39¼ inches long (one metre), which is also attached at the other end in a similar manner. A binding post placed in the centre of the board, a little to one side, completes our bridge, as shown in Fig. 4. The board should be marked off, under the German silver wire, into 100 equal parts, or centimetres. The galvanometer shown in Fig. 1, when used with this bridge, gives excellent results.

Let us suppose that we have an unknown resistance which we desire to measure. We will attach one terminal to the binding post *A* and the other to the top of the binding post *C*. We must then insert a known resistance between *A* and *B*, which, for convenience, we will presume to be 100 ohms. To the binding posts *B* and *C* we will also attach the terminals of a battery consisting of two or three cells of the Leclanche or other similar type. One wire will also be connected from the binding post *A* to the galvanometer, and another from the other side of the galvanometer leading down, with a bare terminal which may be touched at any desired point upon the German silver wire extending from *B* to *C*. The current leaving the battery and entering the bridge at *B* finds two paths which it may take, one through the German silver resistance wire, the other through the hundred ohm coil and unknown resistance. The proportion of current which will flow through the German silver wire will be, of course, greater than that which will take the path through the resistance coils on the other side of the bridge.

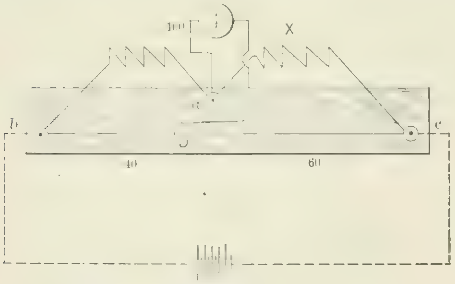


FIG. 4.

If the resistance of the portion of wire between *B* and *D* bears the same relation to the portion between *D* and *C* that the hundred ohm coil does to the unknown resistance coil, no current will flow across the bridge through the galvanometer from *A* to *D*. One important fact to be noticed in this connection is that it is not at all necessary to know the resistance of the German silver wire extending from *B* to *C*, as the unknown resistance may be determined wholly upon the ratio which one side, *B*, *D*, bears to the other, *D*, *C*.

If the galvanometer wire, when resting upon the German silver wire, be moved in either direction, so as to disturb this ratio, the balance would no longer be maintained, and the current would flow, thus deflecting the needle one way or the other, according to the direction in which the galvanometer wire was moved.

Now, if the point on the bridge necessary to bring the galvanometer needle to zero measures 40 centimetres from *B* to *D*, and 60 centimetres from *D* to *C*, we would have the simple algebraic formula to find the unknown resistance, which would be $40 : 60 :: 100 : x$, from which we find the unknown number to be 150 ohms.

Supposing we desire to find the resistance of the galvanometer itself—in other words, make it indicate its own resistance without the use of another galvanometer; it is only necessary to place it in the position formerly occupied by the unknown resistance coil, as in Fig. 5, between *A* and *C*, and connect a wire in short circuit directly from *A* to *D*.

A large amount of additional resistance of any kind must also be looped in series with the galvanometer and embraced in the circuit from *A* to *C*. If, now, the battery circuit be attached the greater portion of the current will, of course, come through the German silver wire from *B* to *C*. A slight portion will be deflected through the hundred ohm coil, galvanometer, and other resistance which now occupy the space between *B* and *C*.

The needle will, of course, be deflected somewhat. By touching the wire *D* to the German silver wire, a portion of the current having passed the hundred ohm coil, and finding in its path beyond that point the increased resistance of the galvanometer, and the other coil, will be inclined to leave the binding post *A* and take the path of the lowest resistance from *D* to *C*. This would allow a little less current to pass through the galvanometer, permitting the needle, already deflected, to partially recover itself.

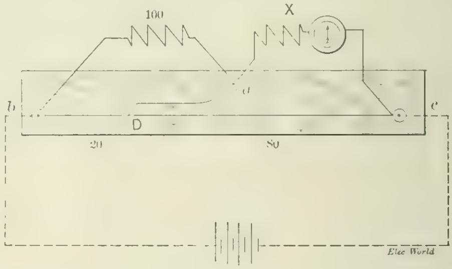


FIG. 5.

When the ratio which *B D* bears to *D C* is the same as 100 bears to the unknown resistance, no deflection of the galvanometer needle will be apparent, indicating that a balance has been attained and no current is passing from *A* to *D*, when the wire leading from *A* touches the German silver wire at the point *D*.

If, now, we find that *B D* measures 20 centimetres, and *D C* measures 80, we have the equation $20 : 80 :: 100 : x$, from which we find the galvanometer and other resistance coil to measure 400 ohms. By separately measuring the extra resistance, as in Fig. 4, and deducting it from the 400 ohms, we would be enabled to tell the true resistance of the galvanometer.

The Three-Wire System.

At the recent meeting of the English Institution of Electrical Engineers, one of the speakers, says *Lightning*, introduced an unexpected and welcome variation of the monotony of the debate by the discovery of an entirely new advantage in the three-wire system. It was so convenient, he said, to have your lights on separate circuits, so that you could extinguish half of them. This reminds *Lightning* of a three-wire installation it once heard of, in which the middle wire was put down double the cross section of either of the other two, because, said the contractor, *it had to carry the current on both sides.*

Curves for Winding Magnets—I.

BY HARRISON H. WOOD.

In determining the shunt windings of a dynamo or motor many independent and often conflicting requirements have to be met. The field coils must not become too hot; the energy lost must not be so great as to impair the efficiency of the machine; the windings frequently have to be confined to a limited space; the weight of copper must be kept as low as possible. Usually there is but one size of wire that will most nearly satisfy all these conditions, and the problem is to determine from the given data this size of wire.

The various quantities that enter into the computation are the ampere turns necessary to set up the desired magnetization, the impressed electromotive force, the length of wire or mean length of one turn, the number of turns, the current, the resistance, and the available space for winding. These are all interdependent, and from the relations that exist between them various formulæ have been derived that will give the diameter of wire that will have to be used. To satisfy all the requirements, however, may necessitate several trials, and as the formulæ are complicated, this is a laborious process.

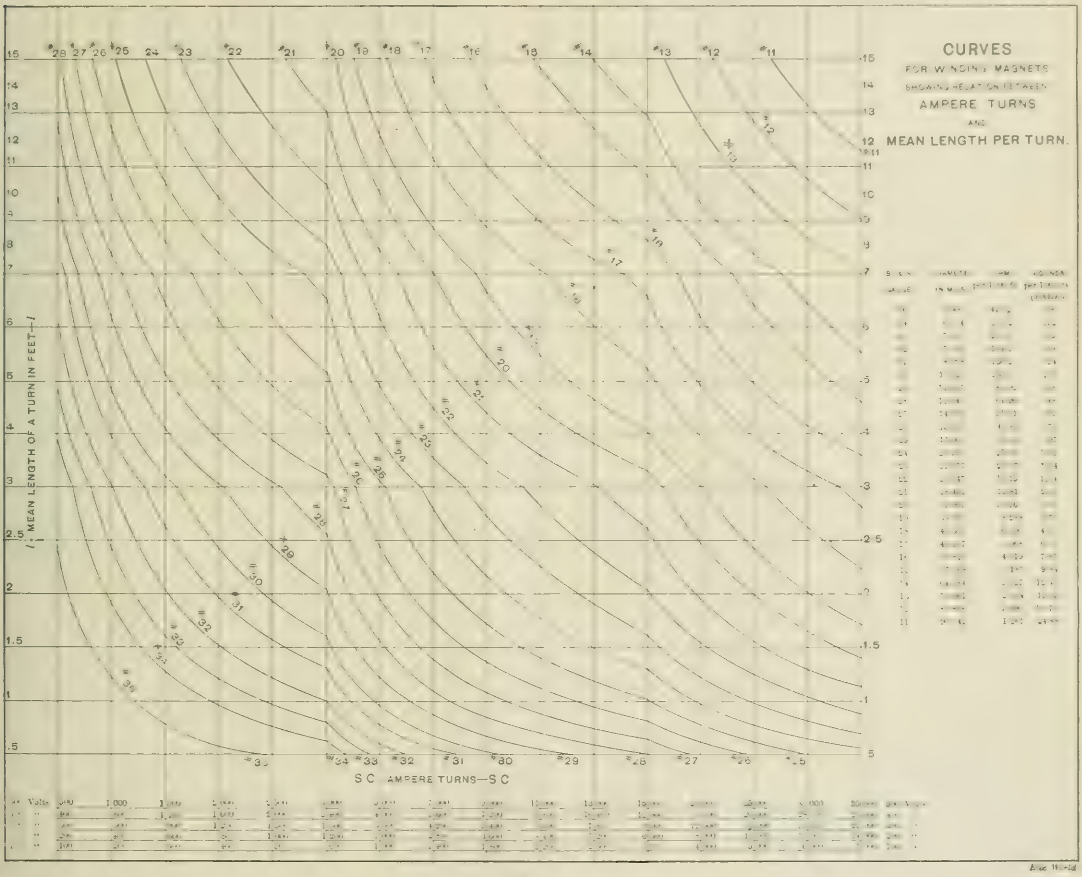


FIG. 1.

When the relation that exists between variable quantities can be expressed by means of an equation, however simple the equation may be, it is often a great help to represent the relation graphically on cross section paper. This is especially true in regard to the above quantities, and the writer has endeavored in the following curves to represent in the most useful and comprehensive manner the complicated relations that exist between them.

The curves do not supply any new methods for dynamo design, but they give almost at a glance what would otherwise take a large amount of labor to accomplish, and by means of them the designer can see just how the variation of one quantity will affect all the others; and with whatever quantities he may have given the others can be determined by simple inspection. If the assumptions are such as to make the choice of a satisfactory winding impossible, he can see at a glance just what alterations to make in the original assumptions in order to produce the desired result.

Two sets of curves have been constructed, each set consisting of a curve for each size of wire from No. 4 to No. 36. It has been found convenient to use two separate cuts for each set, Fig. 1 containing the curves for the smaller sizes of wire, and Fig. 2 those for the larger. The curves in the first set show the relation between ampere turns and mean length per turn, and those in the second set the relation between current and total length of wire. It is a familiar fact that increasing or decreasing the total length of wire on a magnet will not alter the number of ampere turns, providing the mean length per turn is not changed. The only effect will be to decrease or increase the current density. Therefore, if a certain size of wire is found from set No. I. to give the desired number of ampere turns, any current density or length of wire can be chosen from the curve for that size of wire in set No. II., depending only on the independent limitations of space, heating effects, efficiency, weight, etc.

In using the curves for determining the shunt windings of dynamo machines care must be taken to use the actual electromotive force impressed at the terminals of the coil which is to produce the required ampere turns.

Construction of Curves in Set No. I.

L = total length of wire in feet.

l = mean length of a turn in feet.
S = total turns.
R = total resistance.
r = resistance per foot at 75° F.
E = impressed electromotive force.
C = current.

Multiplying the equation

$$C = \frac{E}{R}$$

by L, we have

$$L \times C = L \times \frac{E}{R}$$

But $L = S\,l$ and $R = L\,r$; hence

$$S\,C \times l = \frac{E}{r} \qquad (1)$$

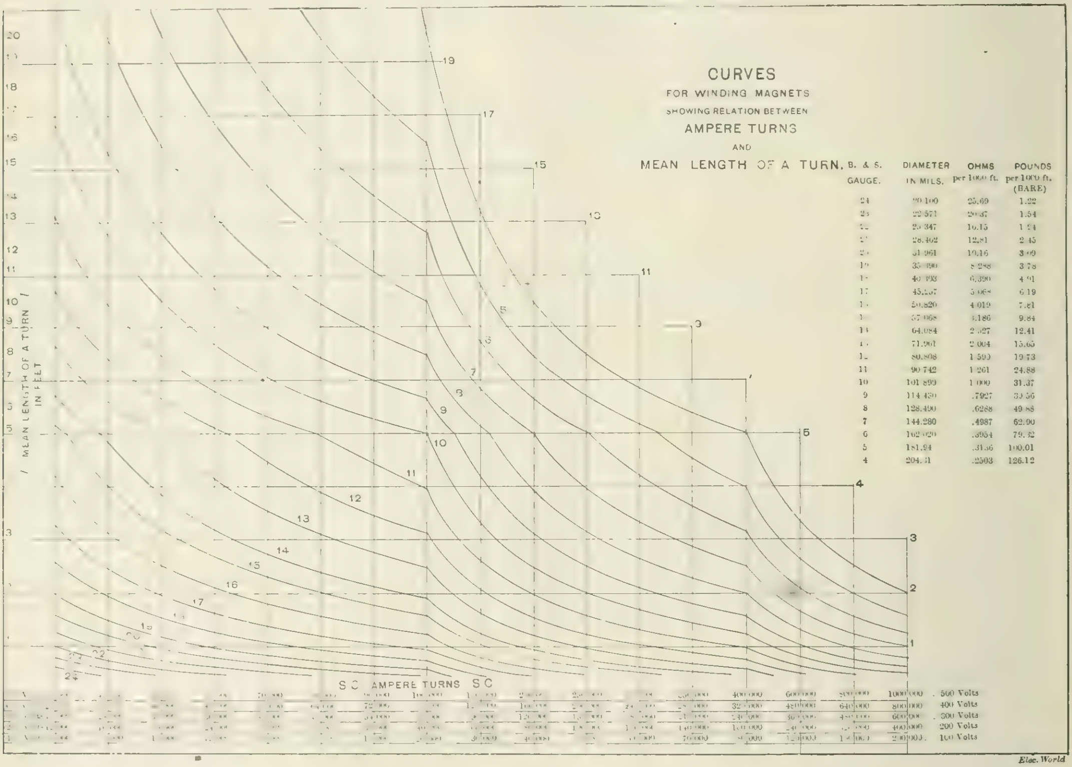
r is constant for each size of wire. Therefore if E be taken constant at, say, 500 volts, the relation between $S\,C$ (ampere turns) and l (mean length per turn) will be represented by a rectangular hyperbola. This curve for each size of wire from No. 4 to No. 36 has been plotted for the value of $E = 500$, the abscissæ being values of $S\,C$ and the ordinates values of l. the reading for 500 volts as the E. M. F. chosen is to 500 volts. Five scales have been placed on the sheets to correspond to E. M. Fs. 500, 400, 300, 200, 100; and readings for any other E. M. F. can be determined by simple arithmetical interpolation.

The limits of the curves have been chosen so as to include all values of $S\,C$ and l ordinarily met with in practice. The limits between which the values of l lie are ½ ft. and 18 ft., and those of $S\,C$ are 500 to 30,000 on sheet No. 1 and 30,000 to 1,000,000 on No. 2.

The value of r used in plotting the curves is for 75 degrees F. As field coils of a dynamo machine are almost always worked at a higher temperature than this, a temperature correction may have to be applied, and can be done as follows:

T = Temperature in degrees F. at which the coil will be worked.

r = resistance of wire per foot at T degrees F.
r_1 = resistance of wire per foot at 75 degrees F.
$S\,C$ = ampere turns at T degrees F.
$S\,C_1$ = the number to be looked for on the scale.



B. & S. GAUGE.	DIAMETER IN MILS.	OHMS per 1000 ft.	POUNDS per 1000 ft. (BARE)
24	20.100	25.69	1.22
23	22.571	20.37	1.54
22	25.347	16.15	1.94
21	28.462	12.81	2.45
20	31.961	10.16	3.09
19	35.890	8.258	3.78
18	40.303	6.390	4.91
17	45.257	5.068	6.19
16	50.820	4.019	7.81
15	57.068	3.186	9.84
14	64.084	2.527	12.41
13	71.961	2.004	15.65
12	80.808	1.590	19.73
11	90.742	1.261	24.88
10	101.890	1.000	31.37
9	114.430	.7927	39.56
8	128.490	.6288	49.88
7	144.280	.4987	62.90
6	162.020	.3954	79.32
5	181.94	.3136	100.01
4	204.31	.2503	126.12

Fig. 2.

Since readings on a curve are most accurately determined when the inclination of the curve is most nearly 45 degrees, and since the intervals between the units on the two scales may be decreased as the number of units increases without increasing the percentage of error of the readings, the horizontal and vertical scales have been shortened at suitable points. The scale of abscissæ has been shortened in Fig. 1 at the values of $S\,C$ = 3,000 and 15,000, and the scale of ordinates at l = 3 and 7; and on Fig. 2 at $S\,C$ = 100,000 and 400,000, and at l = 5.

The curves can be used not only for an impressed electromotive force of 500 but for any value of E whatever. From equation (1) it is evident that if l and r remain constant $S\,C$ will be directly proportional to E. Hence, a scale for $S\,C$ may be plotted that will correspond to any desired value of E, and its readings for any point on any of the curves will be in the same ratio to

Since the rise of resistance with temperature in copper wire is .21 per cent. per degree F. we have

$$r = r_1\left[1 + (T - 75) \times .0021\right]$$
$$= r_1\left[.0021\ T + .8425\right] \qquad (2)$$

From
$$S\,C_1 \times l = \frac{E}{r_1} \text{ (at 75° F.)} \qquad (1)$$

and
$$S\,C \times l = \frac{E}{r} \text{ (at } T\text{° F.)} \qquad (1)$$

we have
$$\frac{S\,C_1}{S\,C} = \frac{r}{r_1}$$

and
$$S\,C_1 = S\,C\,[.0021\ T + .8425] \qquad (3)$$

The value of $S\,C$ to be looked for on the scale can thus be found from the given value at T degrees F. by substituting the value of T in the above equation.

(To be continued.)

Electrodynamic Machinery.—XXXIII.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

186. An inspection of Figs. 148 150 will render it evident that the effect of superposition of the armature M. M. F. upon the M. M. F. of the field magnets, is to weaken the intensity of the field flux at the leading edges of the pole pieces, and to strengthen the intensity at the trailing edges of the pole pieces. At the same time, it is necessary to advance the brushes; *i. e.*, the diameter of commutation, so as to bring the commuted coils under the leading edges of the pole pieces, in order that they may receive a sufficiently powerful intensity of field flux to enable the armature current to be reversed in the coil under the brushes, and sparkless commutation thus to be effected. If, however, the number of ampere-turns on the armature; *i. e.*, its M. M. F. at a given load, be sufficiently great, the field flux at the leading edges of the poles will be so far weakened that the intensity left there will be insufficient to effect sparkless commutation, no matter how great the lead may be. In other words, the flux from the armature will overpower the field flux, in any position of the brushes. This will take place when the M. M. F. due to half the turns of active conductor on the armature, covered by the pole face, is equal to the drop of magnetic potential in the field flux through the entrefer.

187. The magnetic intensity under the edge of the leading pole piece will be zero, when the magnetic difference of potential between this polar edge and the armature core, immediately beneath, is zero. The magnetic difference of potential across the gap at this point due to the field flux alone, will be the magnetic drop in the entrefer, or $\mathcal{B}d$, where $\mathcal{B}$, is the field intensity in the gap with no current in the armature, and d, the length of the entrefer in cms. The total M. M. F. of the armature along the arc of one pole will be $\frac{4\pi}{10}\,w$, where w, is the number of turns covered by the pole, and this will be the total difference of potential in the magnetic circuit of the armature. Assuming that the armature is not operated near the intensity of magnetic saturation, almost the entire reluctance in the armature circuit will be in the entrefer. Fig. 152 represents diagrammatically the magnetic circuit of a Gramme-ring armature. The reluctance between *bc* and *cd*, in the field pole, also between *ef* and *fa*, in the armature, will be comparatively small, so that the total magnetic difference of potential developed by the armature will be expended in the two air gaps *ab* and *de*, half the M. M. F. of the turns beneath the pole face being expended in each air gap. Strictly speaking, the magnetic flux produced by the armature will not be confined to the paths indicated by the dotted arrows, but will pass across the air gap at all points not situated on the neutral line *cf*. The above principles may be relied upon, however, to a first approximation.

188. In order, therefore, that a smooth-core armature should be capable of sparkless commutation, the M. M. F. of the turns on its surface, covered by each pole, should be somewhat less than the drop of magnetic potential in each air gap. For example, if each air gap or entrefer has a length of 2 cms, and the intensity in the air is 3,000 gausses, the drop of potential in the air will be 6,000 gilberts. If the Gramme-ring armature turns, covered by one pole-piece, are 200, then a current of 80 amperes from the armature will represent 40 amperes on each side, and the M. M. F., produced by this current, will be $\frac{4\pi}{10} \times 40 \times 200 = 10{,}056$ gilberts, and half of this amount, or 5,028, being less than the drop of field flux in the gap, should leave a margin for sparkless commutation.

189. Although the preceding rule enables the limit of current for sparkless commutation, on a smooth-core armature, to be predicted under the conditions described, yet it by no means follows that sparkless commutation must necessarily be obtained if the M. M. F. of the armature lies within this limit. If, for example, the number of commutator segments is very small, the inductance of each segment may be very considerable, and a powerful flux intensity may be required to reverse the current under the brush in the presence of such inductance. No exact rules have yet been formulated for the determination of the inductance in a coil with which a given current strength, speed of rotation, and field intensity, shall render sparkless commutation possible.

190. The methods in general use for the suppression of sparking may be classified as follows.

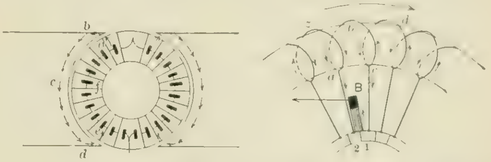
(1). Those which aim at the reduction of inductance in the commuted coils.

(2). Those which aim at the reduction of the current strength passing through the coil during its short circuit by the brush, and, therefore, at the reduction of the current strength which must be reversed before the short circuit is over.

(3). Those which aim at the reduction of the armature reaction, or its influence in weakening the field intensity in which the coil is commuted.

191. There are two methods for reducing the inductance of the armature coils. The first is to employ a great number of commutator segments, thus decreasing the number of turns in each coil under commutation. It is evident that an indefinitely great number of commutator segments would absolutely prevent sparking. A great number of commutator segments is, however, both troublesome and expensive, so that in practice a reasonable maximum cannot be exceeded. The second method for lessening the inductance of the armature coils differs from the preceding only in the method of connection. It consists in providing two separate windings or sets of coils, or, as it is sometimes called, in double-winding the armature. The two separate windings are insulated from each other, but are connected to the commutator at alternate segments, so that the brush rests coincidently upon segments that are connected with each winding. Each winding, therefore, furnishes half the current strength and the effect of the inductance in each coil is reduced.

192. When the brushes are not so shifted as to bring the diameter of commutation into coincidence, or even in advance of the neutral point, the coil under commutation will be situated in a magnetic flux in the wrong direction; *i. e.*, a magnetic flux which tends to increase and not to reverse the current strength in the coil, so that when the coil is short circuited by the brush, the current strength becomes increased in the wrong direction. When, for any reason, it is impossible to alter the lead of the brushes during variations of load, as, for example, when the generator has to run without attendance, the sparking, which may be produced at the brushes owing to the resultant flux in which the commuted coils lie, may be greater than that due to the mere reversal of armature current in the coil under the influence of its inductance. In such cases, considerable improvement is effected by the insertion of a resistance between the coils and the commutator segments with which they are connected. Thus in Fig. 153, the connecting wires *a*2 and *c*1, are sometimes made of German silver. It is evident that under these circumstances, the coil undergoing commutation will not only have the resistance of the coil, but also the resistance of the German silver wires in its local circuit through the brush, and the current, which can be set up in this circuit by the E. M. F. induced in the coil, owing to its motion through the distorted field, is prevented from assuming considerable strength. The value of the German silver resistances, although great by comparison with the resistance of a single coil, is small when compared with the resistance of the entire armature, and, consequently, does not greatly add to the armature's effective resistance. It is clear that this method does not obviate the sparking due to the inductance of the armature coils, but tends rather to obviate that due to the establishment of unduly powerful currents in the short circuited coil in the wrong direction, and which current has suddenly to be reversed when the short circuit is broken. The method is, therefore, generally employed with armatures for which the brushes cannot be shifted.



Elec World

FIGS. 152 AND 153.—CURRENT FLOW IN ARMATURE WINDING.

193. The most generally adopted plan for reducing sparking is to employ a comparatively high resistance in the brush itself. An examination of Fig. 153, will show that if the resistance in the tip of the brush B, can be made sufficiently great, the current which enters the commutator from the wires will be so far reduced, before contact with the brush tip ceases, that when the rupture does take place, practically all the current from the armature will be passing through the coil in the right direction; *i. e.*, in the same direction as that it will have when the brush has passed to the next coil, and,

consequently, the current strength which has suddenly to be reversed when the brush leaves the bar is very small.

194. Thus in Fig. 153, suppose the armature is rotating in the direction of the large curved arrow, the commutator segment 1 is about to move from beneath the brush *B*. The coil 2 *a b c* 1, is about to change position, from the left hand to the right hand side of the armature, and the current in the coil is about to change in direction, as indicated by the small curved arrows, from the direction *a b c*, to the direction *c b a*. The current leaving the armature having recently been flowing to the brush *B*, from section 1, and the wire *c* 1, is now flowing from sections 2 and 1, and from wires *a* 2 and *c* 1. If the resistance in the tip of the brush is considerable relatively to that in the whole breadth of the brush, the current through *c* 1 *B*, will be relatively reduced, and that through *a* 2 *B*, relatively increased. This will require, however, that the current from the right hand side of the armature shall be forced through the coil *b*, in the direction *c b a*, and the more nearly this can be accomplished before contact is broken between 1 and *B*, the less opportunity there is offered for the inductance of the coil *a b c*, to produce a spark at rupture. With this purpose in view, brushes are made up of strips of German silver interleaved with copper or of woven gauze; or they may be made of carbon with a specially high resistivity. This plan tends to reverse the current in the armature, during the period of short circuiting, and also aids in checking any undue current in the wrong direction, caused by distortion of the field flux, owing to armature reaction.

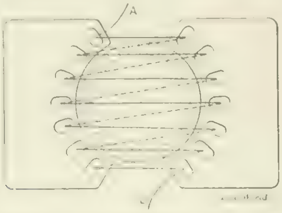


FIG. 154.—DEVICE FOR PREVENTING ARMATURE REACTION.

195. Referring now to the third method, a variety of plans have been attempted at different times for bringing about a reversal of the current in a commuted coil, during the period of short circuiting, by the action of a specially directed magnetic flux upon this coil, as, for example, by winding a special magnet placed with its pole immediately over the short circuited coil, in such a manner that the flux from this magnet, penetrating the commuted, revolving coil may induce in it an E. M. F. sufficiently powerful to set up, in the short circuit, a current strength equal to that which the coil must sustain after commutation is over. In other words, to produce automatically that which the lead of the brushes would be capable of effecting under the most favorable conditions. When, however, the current through the armature and its M. M. F. are powerful, the M. M. F. needed on such controlling magnets may require to be very considerable, and, for this reason, the plan in this form has never come into general use.

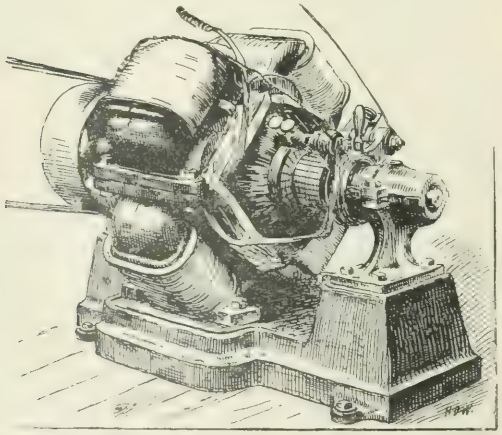
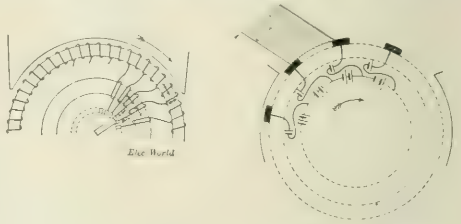


FIG. 155.—QUADRIPOLAR GENERATOR WITH BALANCING COILS.

196. In this direction a method has recently been proposed for obtaining sparkless commutation by introducing into the magnetic circuit of the machine, a M. M. F. equal in amount, but opposite in direction, to that of the armature. This has the effect of practically preventing all armature reaction and distortion of the field flux. It is carried out by winding around the armature and through the field poles, as shown in Fig. 154, a number of turns, between *A* and *B*, equal to that of the armature winding, and in series with the armature, so that the ampere turns in the balancing coil *A B*, are equal and opposed to the ampere turns on the armature. The two M. M. Fs. thus counterbalance and neutralize each other, leaving the field flux practically unchanged at all loads of the machine. By this means all sparking due to distortion of the field is prevented, and only the sparking due to the inductance of the commuted coil and the current reversal in the same is left. In order to check this, an additional winding or magnet over the commuted coil is introduced for the purpose of reversing the E. M. F. in this coil as above described, a process which is more usual of application when no armature reaction exists than when armature reaction is unchecked. A quadripolar machine wound in this manner with a quadruple set of balancing coils is shown in Fig. 155.

197. While it is claimed for this method that it entirely overcomes armature reaction, yet it possesses the disadvantage that it requires the use of what is practically an extra armature winding upon a part of the machine which does not revolve, thus introducing an additional cost and complexity. It, therefore, remains to be determined how far the advantage of sparkless operation is offset by extra resistance, weight, material, and cost.



FIGS. 156 AND 157.—DEVICE FOR PREVENTING SPARKING.

Another method which has been tried in England for the purpose of suppressing sparking, adds extra coils on the armature, one between each commutator segment and the armature connection. These coils are arranged in such a manner that the E. M. F. induced in them by their revolution through the field shall reverse the direction of the current in the coil under commutation. Fig. 156 represents the method of winding, and Fig. 157 the action of the various E. M. Fs. In Fig. 156 the inner ring with the additional coils actually forms part of the armature core and receives the flux from the field. Fig. 157 shows the coil *x*, being short circuited by the brush, and the direction of the current in this coil is being reversed by the action of the auxiliary coil *c*, which is still under the trailing pole edge, so that when the bar *B*, leaves the brush no serious spark shall follow.

198. In one dynamo-electric machine having but three commutator segments, the spark is prevented from forming by an air blast directed against the commutator in such a manner as to extinguish the incipient spark at the breaking of the short circuit. This air blast is supplied by a small centrifugal pump rotating with the armature.

199. Thus far we have mainly considered smooth-cored armatures. The great majority of dynamos, in construction at the present time are, however, toothed-cored armatures. In the first production of these machines, the sparking which they exhibited was more troublesome and violent than in smooth-cored armatures of equal size, and apparently for the reason that the inductance of each armature coil was increased, owing to its being surrounded, or nearly surrounded, by iron, instead of having an iron base only, as in the smooth cored type. This difficulty has since been overcome by careful designing, and toothed-cored armatures are now constructed which give less trouble from sparking than smooth-cored armatures of equal size and output. This is accomplished by giving such a cross section to the teeth in the armature that, at no load, the iron in the teeth is

nearly saturated, and has, therefore, a high reluctivity. The presence of armature reaction tends to increase the intensity in the teeth beneath the trailing pole edges, and to diminish it in the teeth beneath the leading pole edges, as already observed. This tendency is opposed by the increasing reluctivity of the saturated teeth at the trailing pole edges, and, consequently, the teeth tend to restore an equal distribution of magnetic flux over the surface of the armature; or, in other words, tend to check the effect of armature reaction. At the same time, the high reluctivity of the teeth tends to diminish the inductance of each coil undergoing commutation, so that, by careful adjustment, the existence of the teeth is not merely a mechanical but also a considerable electrical advantage.

In practice, the output of a generator is not really limited by excessive sparking. As usually designed, the temperature elevation of the armature, even when thoroughly ventilated, fixes the limit to the output before the sparking becomes troublesome. And, in fact, many generators are to-day in use which never require to have any lead given to their brushes and need only occasional attention to their commutators.

200. In the preceding discussion, we have considered armature reaction from the standpoint of the Gramme-ring armature only, but the same principles are equally applicable to disc or drum armatures.

Laboratory of Houston and Kennelly, Philadelphia.

(To be continued.)

Self Inductances.

MM. Roosen, Colard and Close in the current number of the *Bulletin* de la Socéité Belge d'Electriciens give the result of some measurements of self-inductances, from which the following table has been compiled:

	Resistance ohms.	Current milliamperes.	Self-Inductance.	
			Armature up.	Armature down.
Magnets of Morse apparatus—				
One coil	890	10	15	18 6
Two coils in series	—	10	47.3	54 5
Two coils in parallel	—	10	11	14.2
Vibrating bell	776	10	18.6	45 5

The writers ascribe the difference in the value of the self-inductance of the Morse magnet with the armature up and the armature down to a difference in saturation. While the value of a self inductance depends upon the leakage and saturation, it also depends upon a varying reluctance, which in the present case is the principal factor.

The Edinburgh, Scotland, Municipal Station.

The Edinburgh municipal electric suply station, which has been recently opened, is desiged for both continuous and alternating current supply; the former working on the three-wire system for the nearer districts, and the latter working at high pressure with transformers, for the districts which are more remote. The plant capacity of the station is 40,000 glow lamps and 175 street arc lamps. A battery of the newest type of Crompon-Howell storage cells has been erected. The alternating current is supplied at a frequency of 60 periods, from two Ferranti alternators direct coupled to Willans engines. Besides supplying the outlying districts, these alternators also drive the street arc lamps through Ferranti rectifiers. The feeders consist of armored cables for the alternating currents, and bare copper in conduits for the continuous currents. The distributors consist of covered cables in earthenware conduits. The charge for supply will be 12 cents per kw in the night, and seven cents during the daytime; and a system of discounts will be adopted.

Perhaps the Truth, But—

In its reports of the meetings of the English Institution of Electrical Engineers, one of our English contemporaries indulges in rather pointed personal criticism, of which the following is an example: "After Mr. —— arose the irrepressible Dr. ——, whose penetrating voice and exasperating drawl the long-suffering audience endured until his allusion to some experiments on mice, guinea pigs, etc., gave Mr. Preece a chance for a joke to the effect that the guinea pigs were, perhaps, directors. The pent-up feelings of the members were relieved by a burst of laughter, and the learned doctor subsided, wondering what they could find to laugh at."

Electrical Terminology.

To the Editor of The Electrical World:

SIR: In the London *Electrician* of about a month ago, a letter of mine was published, in which it was urged that as "kation" was the name originally given to the ion separating at the kathode, and as it is undoubtedly a word etymologically correct, whereas "kathion" is incorrect, a return should be made to the older terminology. Unfortunately the aspirated form of the word has crept into some modern books, and into many articles in electrical journals, but I think it is a pity for the error to be perpetuated.

From one point of view, it is a small matter, but if we are to use words derived from the Greek at all there is no reason why they should not be derived properly, and really show their origin. The word "ion" is the neuter participle of the verb *ειμι* and means *the thing going*. The compound *κάτειμι* gives the participle *κάτιογ the thing going down* (with the current). There is no participle *κάθιογ* and therefore no ground for introducing the aspirate into English. A correspondent to the *Electrician* criticising my letter suggested *καθίημι*, *to send down*, as the origin of "kathion," but there is not much difficulty in showing the incorrectness of this view and that his argument is untenable.

As THE ELECTRICAL WORLD is so widely circulated, I think that if you were to insist that all articles published in your paper should adopt the correct spelling, your readers who may not have considered the question of origin and may have become accustomed to "kathion" would soon quite naturally use "kation," and thus one etymological barbarism would be removed from electrical literature.

Royal Military College of Canada. JOHN WADDELL.

Electrical Power Transmission at High Voltages.

To the Editor of The Electrical World:

SIR: In your issue of March 16, Dr. Louis Bell states that there is at present no plant operated at more than 10,000 volts. I wish, however, to inform your readers that the power plant of the Oerlikon Works, which has been in steady and successful operation for nearly three years, works actually at an effective pressure of 13,000 volts. No serious trouble has been experienced with the insulation of the line, which is of bare copper supported on large porcelain insulators of a special type. EMIL KOLBEN.

OERLIKON, Switzerland.

To the Editor of The Electrical World:

SIR: I am pleased to be corrected by Mr. Kolben regarding the voltage of the three-phase power transmission plant at the Oerlekon Works. My information was derived from publications in the technical papers shortly after the plant was installed, and the voltage was given at about half that mentioned by Mr. Kolben. It is not unlikely, as in the case of the San Antonio transmission plant in California, that the voltage originally tried was half the final voltage. At all events, the present conditions of operation bear out in a very gratifying manner the statements in my article concerning the feasibility of operating transmission lines at and above 10,000 volts without extraordinary precautions for insulation. I am much obliged to Mr. Kolben for the information and correction.

Chicago, Ill. LOUIS BELL.

The Bonta Telephone Patents.

To the Editor of The Electrical World:

SIR: In your issue of April 13th, in connection with your article on the Standard Telephone Company of New York, in closing you state that you have learned that, amongst other patents, the Standard Telephone Company control the Bonta patents. We will consider it a favor if you will correct this error in your next issue, as all of the Bonta patents are owned absolutely by us.

M. & B. TELEPHONE CO.

PHILADELPHIA, PA.

[The officers of the Standard Telephone Company state that they do not control the Bonta patents, and never asserted that they did so. Our information was obtained from the presumably official public statement announcing the formation and plans of the Standard Telephone Company.—ED.]

Electric Traction in Oporto.

A contract has recently been secured, in competition with several German firms, by the French Thomson-Houston Company for the construction of an electric tramway, about two miles long, on the overhead-conductor system in the city of Oporto.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors, or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 927 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French, or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Induction Motor.—In a short article by Mr. Kennedy in the Lond. "Elec. Rev.," April 5, on "The Early History of the Polyphase Motor" he expresses his belief that the Bailey motor was the first true polyphase induction motor yet discovered. He criticises very unfavorably the recent American Institute paper of Lieut. Reber, the results of whose "bewildering mathematical formula" he claims are useless to an engineer; he reprints Mr. Steinmetz's simple theory of the induction motor. (See also THE ELECTRICAL WORLD, April 20, p. 474.)

Alternating Current Motors.—The Lond. "Elec. Rev.," March 29, begins an article by Mr. Rhodes of a general nature; in the present portion he discusses synchronous motors and their theory.

Dynamo with Single Bearing.—A translation in abstract from the French, of the dynamo mentioned in the Digest, March 9, designed by Mr. Helmer of the Cail Company is given with illustrations in the Lond. "Elec. Eng.," April 5.

Motor Alternator—The "West. Elec.," April 13, reprints the description with the illustration of the laboratory machine mentioned in the Digest, March 23.

LIGHTS AND LIGHTING.

Comparative Measurements of Different Incandescent Gas Lights.—An article by Dr. Wedding is reprinted in the "Elek. Zeit.," April 4; it contains the results of measurements in the form of tables and curves.

Effective Electric Lighting.—Mr. Maycock in Lond "Elec. Eng.," April 5, describes and illustrates some incandescent lamp shades, an inverted arc lamp, and a horizontal one.

Specifications for Street Lighting by Arc Lamps.—The "Eng. News," April 11, reprints the specifications prepared by Mr. Judson for the street lights now furnished to the city of Oswego.

POWER AND HEAT.

Electricity in Factories and Workshops.—The Lond. "Elec. Rev.," April 5, abstracts from "L'Elec.," the recent descriptive article on the plant at a ribbon and silk manufactory in St. Etienne.

Distribution of Power from Niagara.—An illustrated descriptive article by Mr. Perkins is published in the "West. Elec.," April 20; it concludes a good illustration of the transformer room showing the rotary and the stationary transformers.

TRACTION.

Electrolysis of Pipes.—The "Elek. Zeit.," April 4, contains an article by Dr. Rasch in which he discusses a number of points involved in the return circuit for electric railways, in order to prevent electrolysis of underground pipes. Regarding the use of earth plates he states that in endeavoring to reduce the voltage one should be careful that in doing so the resistance of the earth circuit is not reduced to a greater extent than the voltage or else the results will be worse than before; if the resistance between the conductors and the earth is relatively small, then the effect of earth plates on the total resistance of the earth circuit will be very small and the loss of voltage, as also the current strength, will be affected only slightly but in the same direction as in the first case; the earth plates will in this case at least be of no advantage; in both cases the earth plates will tend to distribute the current in the neighborhood of the central station and thereby will diminish the current density, but he argues that if it is not possible to avoid the damage which the current does, it is certainly preferable to localize it on a few pipes even if these must be changed more frequently. He discusses mathematically the question of a return copper circuit parallel with the rails, and finds that to reduce the current flowing through the earth from 6 to 5 per cent. of the total current, it will be necessary to have a copper return circuit containing 3.5 times as much copper as the feeders; this is based on very effective bonding but if this does not exist the return circuit would have to be still larger; he concludes that good bonding is much better than an extra return circuit.

Breakdown Tests with Railway Line Material.—In "Elec. Power" for April, Mr. Sever publishes the tabulated results of breakdown tests on various kinds of insulators and fixtures for railway lines. The tests seem to indicate that with 1,200 volts there is very little danger from breakdowns, the leakage over wet surfaces being much more serious; there appears to be no necessity for improving the quality of the insulating materials to guard against higher potentials, but some change seems necessary to protect the system from a considerable loss through leakage. The apparatus used for testing is briefly described; it consists of a separately excited alternator and step-down transformer with a ratio of 10 to 1, and a step-up transformer with a ratio of 1 to 500, the voltage in the latter circuit, which may be raised to 50,000, being that which is used.

The Electric Railway for Interurban Traffic.—In a short article by Mr. Pope in "Elec. Power" for April, he compares the relative merits of electric and steam roads for interurban traffic.

Lenox Avenue Conduit System.—A well illustrated description is published in "St. Ry. Gaz.," April 13; the "Elec. Rev.," April 17, also contains a description with some of the illustrations.

Fenders.—The "St. Ry. Gaz.," April 13, abstracts the portion of the Massachusetts Street Railway Statistics on the requisites of an efficient fender.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

The Varying Cost of Electricity Supply.—In an article under this heading by Mr. Wright in the Lond. "Elec.," April 5, he discusses the cost of supplying electricity showing how it varies in practice according to the number of hours per day during which the consumers use the current; he refers more particularly to the experiences at Brighton where his system of charging has been in use for two years. He shows by means of two curves the improvement in the load factor due to the adoption of his system. The annual sale of electricity per maximum kw taken from the mains, has increased nearly 25 per cent., the figures being arrived at by dividing the kw hours sold, by the greatest demand in kw experienced at any moment; they show that the average demand and the maximum demand have been brought more nearly to coincidence; the revenue derived from the maximum kw has increased about 10 per cent. although the average price obtained fell more than 12 per cent.; the sale of current has nearly quadrupled since the adoption of the system while the maximum load at the generating station increased only three-fold; another advantage obtained is in the introduction of the light into basements, kitchens and other places where it would not be introduced so readily under the uniform system; the average number of kw hours consumed per lamp installed has increased 15 per cent., while generally the reverse is the case. He compares the table of figures in Mr. Leonard's recent American Institute paper, for the estimated power charges on a sliding scale, with one prepared by himself, applied to the Brighton station; the latter figures average less than half and do not vary nearly as much. He discusses the subject of standing charges and the running cost per unit; for the Brighton station for this year they work at 12 cents per day per kw demanded for the former and two cents for running costs. The costs in the Brighton station will be about met if the consumers use their demand on the average one hour per day and paying during the first hour 14 cents per kw hour, after this it may be assumed that the cost of supplying each kw hour will not exceed two cents. As there are really only two divisions in the items constituting the cost of supply, namely, standing and running cost, it is therefore only necessary to have two rates of charges in order to obtain a perfectly equitable sliding scale and this without involving hardly any more clerical work than a uniform price system. That station he believes holds the record for the lowest cost of production and the greatest sale per inhabitant, which he believes is attributable largely to the sliding scale used. He attaches importance to the superiority of a system giving rebates based on a consumer's actual use of the generating plant and mains, over one based on the more or less prolonged use of the lamps installed; the former encourages the general use of the light in a house while the latter has the reverse effect. In a table he gives the following figures showing the percentage of consumers who use their demand on the average as follows: less than one hour per day 13.6 per cent., more than one and less than two hours 38.6 per cent., more than two and less than three hours 32.1 per cent., more than three hours 15.8 per cent.

Best Combination for Electric Light Undertakings.—A long paper by Mr. Dawbarn is reprinted in the Lond. "Elec. Rev.," March 29, and

April 5, and is to be continued. He discusses the best mechanical and electrical equipment for an electric light station under the normal conditions of an English provincial town. Regarding the system, he states that the great duel between alternating and direct currents has been "fought to the bitter end and one of them is dead" (referring apparently to the continuous current system); he gives two comparative maintenance estimates for a town of about 55,000 inhabitants to provide service during the whole day; these are given in detail and show that the cost per kw hour for the continuous current system with accumulators is about 1 per cent. higher than that for the high tension alternating current system; in making future extensions by putting down feeders double the length of those serving the first area, it can be done for double the cost of the first feeders for the alternating current system, while for the direct current system it would involve four times the cost of its first feeders; as the area of supply grows the difference between the annual cost in the two systems will therefore become more and more marked, increasing in favor of the alternating current system. Regarding the load diagrams he gives the following data: the average load factor is 10 per cent.; given the energy sold in December, that sold per year will amount to about 60 per cent. of this multiplied by 12; that sold on the lightest summer day represents only about $\frac{1}{6}$ of that sold on the average December day; the maximum current in June or July is between $\frac{1}{4}$ and $\frac{1}{5}$ of that in December; the minimum current in direct current stations may be only $\frac{1}{50}$ of the maximum winter load and with alternate current stations about $\frac{1}{25}$ or with separate house transformers 6 to 7 per cent.; the midday current on a fine winter day is less than $\frac{1}{4}$ of the maximum evening current. Regarding generating units he states that the day load unit should have a capacity not less than 14 per cent. of the total plant capacity, and to allow for extensions say 20 to 25 per cent.; he does not believe in starting with too many units notwithstanding that for the time being the fuel consumption may suffer; the cost of fuel is much less important than that of labor; the capital outlay is also greatly reduced by adopting the larger units; he suggests having the units not all of one size. The subject of boilers is briefly discussed. Regarding direct coupling he states that although more expensive, the difference is much more than covered by the saving in floor space, buildings, rope renewals and fuel consumption; the loss due to rope driving he gives as 6 per cent. on full load or 10 per cent. on the average load. Regarding engines he considers the vertical marine type the best with sufficiently high speed to make the extra cost of the direct coupled combination negligibly small. In discussing high vs. low speeds he admits that slow speed engines save fuel but shows that it would have to save 70 per cent. of the fuel to justify its adoption, considering the capital outlay only. Regarding the day load unit he advises adopting a slow running day load set in order to reduce the amount of attendance. Concerning condensing he states that one should go considerable distance for water rather than sacrifice condensing; where condensing water is not attainable an evaporator condenser should be used which requires even less water than would be used for boiler feeding; where there is plenty of condensing water there is room for debate as to the best way of using it. He recommends avoiding the use of donkey engines; electric motors may be used for the automatic stokers but he objects to electric boiler feed pumps. He claims that each alternator should have its own direct coupled exciter.

Load Factors.—See abstract above.

Central Station Statistics for Germany.—The "Elek. Zeit.," April 4, publishes a large table containing a list of all the central stations in Germany with some brief tabular data concerning each one; it is doubtless the most complete table of its kind published for that country. Eighty-one per cent. of the number of stations use the continuous current and represent 78 per cent. of the total power; 54 per cent. of the stations use steam power, representing 81 per cent. of the total power; only a few use water power exclusively, and still less use gas; over one half of them have a capacity of less than 100 kw; there are 43 medium large stations and 20 very large ones; only 15 per cent. of the energy is used for motors. There are altogether 148 stations representing 33,896 hp of machinery besides 4,589 hp in accumulators; of the 148 stations 80 use the continuous current with accumulators, 40 the same without accumulators, 15 use alternating currents and the other five, mixed systems; the number of 50-watt incandescent lamps connected is 493,081, the number of 10-ampere arc lamps is 12,357, the horse power of motors connected is 5,635. It seems that these statistics are for the present date, April, 1895.

Electric Lights for Railway Purposes.—Mr. Langdon's paper is reprinted in full with illustrations in the Lond. "Elec.," April 5. A reprint is begun in the Lond. "Elec. Rev.," April 5, and the discussion, which contains nothing of particular interest, is given briefly in the Lond. "Elec. Eng.," April 5; the paper was abstracted in the Digest last week; it contains nothing regarding the lighting of trains.

Coupling Dynamos for Arc Lighting.—In a short article by Mr. Lea in the Lond. "Elec., Eng.," April 5, he suggests a method by which arc lighting dynamos for series lighting can be connected in series on the same circuit in order to supply increasing amounts of energy as lights are put in circuit. It consists essentially of properly designed switches for putting additional machines in and out of circuit; it appears that the armature of an additional machine is first switched into circuit, which may be done whether the machine is running or not; the field is short-circuited and has a resistance across its terminals, which resistance may be adjusted and acts as the usual shunt for such series machines; the shunt is first short-circuited and is then gradually increased until the machine supplies the proper voltage. With ordinary switches it would be possible to short-circuit a working machine, and to prevent this his switch cuts out the field coils first before the armature is short-circuited; the switch is illustrated.

Electric Circuits in Streets.—The "Elek. Zeit.," April 4, reprints a long paper by Dr. Kallmann, chiefly of local interest, on the rules and regulations for electric circuits in the streets of Berlin; a diagram is given showing the location of all the underground wires and pipes in a cross section of a street; he discusses the effects of different circuits on each other, their protection, explosion in conduits, etc.

Municipalization of the Berlin Stations.—A long report forming part of the argument concerning this proposed change, is reprinted in full in the "Elek. Zeit.," April 4.

Salzungen.—An illustrated description of the installation in this town, in which accumulators are used, is given in the "Elek. Zeit," April 4; the accumulators are placed at substations.

Day Load for Central Stations.—"Elec. Power" for April contains an article by Mr. Perry entitled "Working out its Own Salvation" in which he calls attention to the great disadvantages in not having a constant load and suggests two remedies, one consisting in equalizing the load by storage and the other in supplying a productive load to which the machinery may be shifted when not fully occupied for the purpose for which it was installed; the latter method he considers far preferable, as it increases the gross income $2\frac{1}{2}$ times and the net income probably still more; he suggests a number of methods by which this may be accomplished; what is required is some load which may be entirely under the control of the central station. Among the industries already well established in which electricity has supplanted other methods he mentions the following, discussing each in detail: the bleaching of textile fabrics, the electrical refining of metals and the products of the electric furnace. The article is to be continued.

Classification and Selection of Lighting System.—Prof. Crocker's article is concluded in the "Elec. Eng.," April 17. He discusses briefly the selection of a system, the size of plant, and alternating vs. direct currents.

Electrical Distribution in Office Buildings.—A brief abstract of an address by Mr. Pierce, giving a few general hints on the selection of machinery, is published in "Elec. Eng'ing" for April.

Brooklyn.—The new station of The Citizens' Electric Illuminating Company is described and illustrated in the "Elec. Eng.," and "Elec. Rev.," April 17.

Los Angeles.——An illustrated description of the electric light station in this city, by Mr. Guy, is contained in the "Elec. Eng.," April 17.

WIRES, WIRING AND CONDUITS.

Explosions.—The "Lond. Elec. Rev," March 29, discusses editorially the St. Pancras and the Southwark bridge explosions; according to the report of Major Cardew regarding the latter, the cause was not due to electricity, but it was due to the electric conduits that the explosion was allowed to travel along them; as it may not be possible to prevent leaks from gas pipes, it suggests that conduits may have to be abandoned and the mains imbedded in such a way that there shall be no space surrounding them for the accumulation of explosive mixtures.

Electric Mains in Paris.—The Lond. "Elec. Eng.," April 5, publishes a translation with illustrations of the recent article by Mr. Monmerque mentioned in the Digest Jan. 26, Feb. 23, March 23.

Paper as an Insulator for Electrical Conductors.—The third and last article by Mr. Bishop on this subject is contained in "Elec. Power" for April. He states that like everything else paper has its place and limits; for underground work or even for overhead work it is superior to anything else known as long as the integrity of the lead sheating remains; but for submarine or exposed overhead work, for leading-in wires and other similar work subject to exposure to damp and atmospheric changes, it is practically useless. He shows that the discovery of paper as an insulator for a conducting wire is old, but its application for producing a low capacity is comparatively recent. He refers to the gradually increasing size or sectional area of conductors used for light and power purposes and shows that in this the employment of rubber or any of the asphalted compounds is very unadvisable while the use of the so-called fibre compound, is impossible; a very wide margin must also be allowed for the mechanical strains which the insulation must bear; for these large conductors paper seems not only to be the best possible insulator, but the only one available.

Underground Conduits and Cables.—An article on this subject is begun by Mr. Maver in "Elec. Power" for April. He calls attention to the rapid increase in amount of underground conduits and cables, stating that in 1882 there were perhaps not more than 10 miles of underground conduits in the United States, while now the aggregate length of underground conductors in this country alone may be placed at 175,000 to 200,000 miles, of which perhaps 2,500 to 3,000 miles are used for electric light and power service exclusive of railway feeders, and the remainder for telegraph, telephone, and like purposes; he quotes a few extracts from the opinions of scientific authorities, superintendents and others who expressed adverse views in 1888. In the present article he intends to give a description of a number of electrical subways in operation in this country and Europe, and of the conductors and cables which they contain, with comments concerning the advantages and disadvantages of existing systems. He discusses the nomenclature and begins the illustrated description of some subways and tunnels.

[illegible]—In a short article on "How to Join Wires" in the "Teleg. Age," April 16, a table is given containing the results of tests of the breaking strain of a number of different joints, the tests having been made by Mr. Davis, of the Postal Telegraph Company. Most of them are the mean results of about 10 samples and all were made with No. 10 B. & S. copper wire. For the ordinary twist joint, with solder poured over the joint and wire, the average breaking strain of the joint, in per cent. of strength of the wire, was 83, the joint having 7 turns on each side of the centre; when the solder was poured on the thick part of the joint only, and not allowed to touch the wire elsewhere, the per cent. of breaking strain was 100, the joint having 5 twists on each side; the three-wire or Western joint with 7 turns, soldered in the same way, gave the same results; without solder the ordinary twist joint with 7 turns fell to 53 per cent.; for the McIntire joint with a 5-inch stem and no solder the value was 93 per cent. and 82 per cent. for 4 and 3 twists respectively.

Kelvin's Law of Economy in Conductors.—Mr. Perrine's article is continued in "Elec. Eng'ing" for April; it does not admit of being abstracted. From one of his equations he draws the following conclusions: "The maximum value of the net income in any transmission when the values of the resistance of the line and the electromotive force delivered are fixed, is at such a value of the current that the gross income, less the cost of the energy generated and delivered, equals twice the value of the energy used in the transmission; or that transmission is the most economical in which one-half the difference between the selling price and cost of the energy is equal to the value of the energy used over the line."

ELECTRO-PHYSICS AND MAGNETISM.

Approximate Calculation of the Effects of the Capacity of Coils.—In a highly mathematical article by Mr. Cauro in the "L'Eclairage Elec.," March 23, he developes mathematical expressions for calculating the electrostatic capacity of bifilar coils, such as are used in resistance boxes; he states that the capacity of such coils can have an appreciable effect, giving them an apparent negative self-induction; he discusses the ordinary winding, the Chaperon winding and a new system in which the wires are wound from left to right in one direction, then brought back straight, to the beginning of that layer, and parallel to the axis, then wound in another layer in the opposite direction to the first, and so on throughout the whole winding; the capacity of the Chaperon winding as compared with this one appears to be as 4 to 3.

Optical Rotation of Ions.—The Lond. "Elec. Rev.," April 5, notices briefly a paper by Mr. Walden in the "Zeit. f. Phys. Chem.," Vol. 15, p. 196, on this subject. From observations with certain organic acids, he concludes that the undissociated molecule possess a somewhat greater rotatory power than the dissociated molecule. In experiments with various metallic salts, he was led to conclude that the rotation of their solutions is dependent on the number of active ions, and at complete dissociation in equimolecular solutions, the rotations of different salts containing the same active acid ion, are equal. The molecular rotation of an electrolyte of two active ions appears to be equal to their molecular rotations.

Diselectrification of Air.—A short Royal Society paper by Lord Kelvin and Messrs. MacLean and Galt is reprinted with illustrations in the "Lond. Elec. Rev.," April 5. They describe some more or less successful attempts to filter electrified air through fine wire gauze.

New Researches Regarding the Phenomenon of Kerr.—An article by Mr. Wind from the "Wied. Ann.," February, regarding the phenomenon of the rotation of the plane of polarization by reflection from the surface of a magnet, is abstracted in "L'Eclairage Elec.," March 23.

Division of the Science of Electricity.—Mr. Maycock in a short article in the Lond. "Elec. Rev.," April 5, discusses briefly the divisions and subdivisions of electricity and suggests the following four general divisions: (1) Electricity at rest, or static electricity, or electrostatics; (2) electricity in locomotion, or current electricity, or electrokinetics; (3) electricity in rotation, or magnetism; (4) electricity in vibration, or radiation, or light.

Waves.—The third and fourth lectures of Lord Rayleigh are abstracted briefly in the Lond. "Elec. Rev.," March 29.

Absolute Units.—A system of absolute units for physical quantities is described by Mr. Clavenad in "L'Eclairage Elec.," March 23.

Electrostatic and Magnetic Circuit Analogy.—In an article by Mr. Taylor in the Lond. "Elec. Rev.," March 29, he discusses a number of points regarding the magnetic circuit and in a few cases gives electrostatic analogies. In studying magnetic circuits a most important step is to recognize that the iron is of quite subsidiary importance and that it is the magnetized air in the air gap that is effective; the energy required to produce a given flux is almost wholly expended in magnetizing the air gap, which is therefore the seat of the greater portion of the magnetic energy of the system. In drawing away an armature the energy is supplied by the extension of the lines of force and not by generating more of them; he points out the great similarity between electrostatic lines of strain and magnetic lines of force. He discusses self-demagnetizing force; like a spring in a state of tension, magnetized air tends to resume its normal unmagnetized state, which tendency is called the self-demagnetizing force of a magnetic circuit; when there is no air gap in a magnetic circuit, this force is very feeble; he makes an analogy with lines of conduction in fluids and the self-demagnetizing force of a bar magnet. Regarding the nature of magnetism he believes it highly improbable that the state of being magnetized consists merely of a sort of spinning or rotational movement in or of the ether, and that the energy is therefore wholly kinetic, for if this were the case it would be difficult to see how a self-demagnetizing force could exist.

Magnetic Rotation of Hydrocarbons.—A recent paper by Dr. Perkins read before the Chemical Society of London, is noticed briefly in the Lond. "Elec. Rev.," April 5. He shows that the magnetic rotations of the olefines do not differ from those of the paraffins to quite such a large extent as do other substances correspondingly unsaturated; there are some exceptions, however, which he duly calls attention to; the molecular rotations, speaking generally, which involve both density and specific rotation, exhibit great regularity.

Secular Variation of the Earth's Magnetism.—A recent German publication by Dr. Bauer is noticed briefly in "Elec. Eng.," April 17. He constructed the curve described in the course of centuries by the north end of a free magnetic needle from data of 24 stations distributed over the globe and from the result he established a law governing the direction of the curve; this law is briefly that the north end of a needle moves in the direction of the hands of a watch in consequence of the secular variation. He believes that it has not yet been proved that the earth actually possesses a common secular variation period.

Capacity of Conductors Carrying Currents—A translation in abstract, giving some of the formulas, of the paper of Mr. Vaschy, which was abstracted in the Digest, Feb. 9, is published in the "Elec. Rev.," April 17.

ELECTRO-CHEMISTRY AND BATTERIES.

Secondary Batteries.—The Lond. "Elec.," April 5, givs a translation of a paper by Mr. Poincare from the "Comptes Rendus" Vol. 120, No. 11. He suggests overcoming the defects of the ordinary lead accumulator by using as electrodes metals in a liquid state, as mercury for instance; an acid electrolyte cannot be used as the hydrogen would be wasted, but with a salt of an acid there will be formed at the cathode an amalgam, the mercury being the anode; the most interesting results were obtained with the alkaline salts of the haloids; perfectly reversible batteries mostly of about two volts were obtained but the chlorine or bromine which combines with the positive mercury forms a layer of high resistance and the efficiency is therefore not good; with iodide of sodium the results were quite different; the solution should be sufficiently concentrated, the density of the current not too great, and the positive electrode larger than the negative, in which case no deposit is formed on the anode; the two electrodes of such a battery remain entirely metallic after the charge; the only loss is a small amount of sodium deposited by the current; the ampere-hour efficiency may not exceed 90 per cent. but the watt-hour efficiency is nearly the same, the rate of discharge being a matter of indifference; the E. M. F. is 1.85 volts and the capacity per pound is about the same as that in lead accumulators, which he gives as 4.5 ampere-hours per pound; he shows that all the chemical energy given to the cell is given out again as electrical energy. This battery is only of theoretical interest, and he admits that it could not be used commercially in that form owing to the high price of the materials, the difficulties in using liquid electrodes, and keeping the amalgam from contact with the liquid; the latter can be accomplished "by a device similar to that employed in the batteries with rolled up electrodes."

Purification of Water by Electrical Processes.—A brief article in the Lond. "Elec. Rev.," March 29, divides the processes into two classes, those in which water is electrolyzed, liberating oxygen, and those in which solutions of salt are electrolyzed, producing certain germicidal substances; in each, substances are produced which act chemically on the impurities; it is not likely that the first of these could ever be realized in the water supply of a great city; regarding the second process it questions the desirability of treating a city's water supply with a powerful and soluble disinfectant unless it is possible by precipitation to eliminate every trace of the hypochlorite after it has done its work; the second process, however, is extremely useful in the disinfection of sewage. The lines upon which electrical engineers have hitherto sought the solution of the problem of the purification of water may not give promise of much result.

Theory of Electrolysis.—The Lond. "Elec. Rev.," March 29, in calling attention to the recent article of Prof. Bucherer in THE ELECTRICAL WORLD, Feb. 2, p. 138, states that he does not agree with the modern view of electrolysis as represented by Nernst's theory of a solution tension, when he states that the potential difference between a metal and its solution is due directly to the relation of the partial pressure of the metallic vapor with which it participates in the equilibrium and the sublimation pressure of the immersed metal.

Electrochemical Equivalents.—Mr. Fitzgerald in the Lond. "Elec. Rev.," April 5, criticises the table of equivalents given in Dr. Keith's recent paper (see Digest April 6 and 13) intimating that there is an error; he gives a table of the electrochemical equivalents of hydrogen and silver based on each of four different fundamental values.

Electrolysis of Gold.—The discussion of Dr. Keith's paper is published apparently in full in the Lond. "Elec. Rev.," April 5.

In a communication to that journal, March 29, Dr. Keith claims that electrolysis, from its two Greek derivatives, means the dissolving, loosing or setting free of a substance by means of electricity, and refers to Webster who speaks of the electrolysis of silver. In the issue of April 5, Mr. Andreoli criticises the title of the paper, saying that gold cannot be electrolized, as an electrolyte must be a body which can be decomposed. He also states that Dr. Keith cannot claim to be the original discoverer of the electronegative property of mercury to gold, which he shows by quoting from a publication by Skey dated 1875.

Plating Aluminium.—The Lond. "Elec. Rev.," April 5, notices briefly a paper by Mr. Goettig in the "Ber. d. Deut. Chem. Gesellsh." Vol 27, p. 1824, in which he states that he can obtain a good deposit of several different metals by immersing aluminium in such a solution of the metal as will not deposit by simple immersion and then rubbing the surface with a brush made of wire of some electropositive metal; the deposit is more rapid when the aluminium is relatively most electronegative; copper is deposited from copper sulphate by rubbing the aluminium with tin foil; tin, from aluminium stannic chloride by rubbing with brass wire; he intends to apply the process to other metals besides aluminium.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Apparatus for the Analysis of Alternating Currents.— In the Lond. "Elec.," April 5, Mr. Hicks describes and illustrates an apparatus somewhat similar to that recently described by Dr. Fleming (see Digest March 9 and 16) which he constructed and used some time ago. The synchronizing motor resembles the Mordey alternator; after some trouble he overcame difficulties by fixing the instrument vertically with the lower end of the shaft pivoted; the dimension are given; it will analyze simultaneously both primary and secondary amperes and volts in a transformer, the currents being measured by the volts at the ends of a non-inductive resistance; the motor revolves a commutator in the form of a large disc around which different sets of brushes may be adjusted to any different positions; a condenser is charged repeatedly and is then discharged, by the action of the brushes, through a galvanometer as a direct current; by means of different sets of brushes on different parts of the commutator, the volts and amperes of the primary and secondary circuits are measured simultaneously; to start the motor, a connection is made with the brushes by means of which the current is commutated and it therefore starts as a continuous current motor; when the desired speed has been reached the alternating current is switched on and if it then falls out of step the switch is turned on again for a moment. By running the machine on end he believes there is no doubt that permanent magnets will suffice. A number of curves taken with his instrument are given.

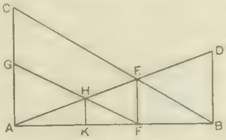
Specific Resistance of Some New Alloys.—"L'Eclairage Elec.," March 23, publishes some extracts from an article by Mr. Van Aubel from the "Jour. de Phys.," Vol. 4, p. 72. The following are some of the results for the alloy kruppin: a wire was heated during several hours to 150 degrees C. then during two hours to 200 degrees C.; the specific gravity was 8.107; the specific resistance at 18 degrees C. in microhms per cm and square cm cross section, was 84.7 or only about 10 per cent. less than that of mercury; the temperature co-efficient is given for a number of different ranges averaging somewhat over 0.0007 which is nearly twice that of German silver; it is said that this material will stand a temperature of 600 degrees C. without suffering any change in structure. The results are also given for a number of patented nickel alloys made by Fleitmann, Witte & Co.; the specific resistance varies between 40 to 53; the temperature co-efficient of some is negative and in all is exceedingly small, averaging less than a tenth of that of German silver; one of these alloys has a higher resistance than manganine and a lower co-efficient of temperature.

Researches with the Induction in Cables.—Dr. Breisig's article (see Digest last week) is continued in the "Elek. Zeit.," April 4; the present portion refers to telephone cables; among his conclusions he states that encircling the wires of a telegraph cable with a shield of tin foil or lead, will not protect them in a measureable degree against induction from neighboring circuits used for Hughes or Morse instrument; one of his experiments shows the very large dimensions which the metallic shield must have in order to protect the wires appreciably against induction; on the other hand the measurements have shown that the metallic shield in telephone cables answers its purpose; the protecting action begins at a relatively small number of impulses and for those occurring during a conversation there is a reduction of the co-efficient, and with it approximately also of the induced current, of about 25 per cent. of the value which it would have if there were no metallic shield.

Calibrating Large Ammeters at Stations.—Owing to the variations of the current sent out in regular service the calibration of large ammeters in stations is difficult or impossible when a Thomson balance or a Siemens dynamometer is used as a standard. A method used in the Louisville electric light station with complete success, by means of which the difficulties are overcome, is described by Mr. Speed in the "Rose Technic" for April. The ammeter and the standard are connected in series with the large dynamo at a time when the dynamo is not carrying a load; the bus bars are short-circuited by twisting heavy wire around them; the shunt field winding circuit is opened near the rheostat and a small water resistance is put into that circuit; the series coils of the compound generator are short-circuited by a heavy jumper which, however, must not be too heavy, as a small amount of compounding is necessary; the current may then be run up as high as desired by diminishing the water resistance; a machine thus arranged usually gives 10 to 20 per cent. of its current with the shunt field open. He gives an example of this method in which a 550-volt 700-ampere generator was used, the calibration requiring one hour and fifteen minutes including the adjustment of the ammeter, which was found to read incorrectly.

Combined Ammeter and Voltmeter.—An instrument is briefly described and illustrated by Mr. Parker in "Elec. Power" for April; it consists simply of a D'Arsonval galvanometer with two coils placed at an angle with each other, both rigidly fixed to the same axle; one is placed in series with a high resistance, and the other shunts a low resistance; it can therefore measure both volts and amperes; the coils may be placed in parallel or in series "so it may be possible to have the instrument also indicate watts and ohms."

Graphic Calculation of Resistance.—The following simple method for finding graphically the combined resistance of two or more circuits in parallel, is described by Mr. Wines in the "Elec. Eng.," April 17; he also gives the proof. In the adjoining figure AB is any convenient length, AC is laid off equal to one of the two resistances and BD is made equal to the other; draw CB and DA and from their intersection draw EF; then the length of EF is equal to the combined resistance of these two. If there is a third resistance, as AG for instance, then as EF is the combined resistance of the other two, carry out the same construction, which will give the distance HK, the length of which will be the combined resistance of all three. The same process may be carried out for any number of resistances.



Apparatus for Measuring Difference of Phase.—The article of Mr. Derr, abstracted in the Digest, April 6, is reprinted with the illustrations in the "West. Elec.," April 13.

Measuring the Variation of Internal Resistance of a Cell with Current.—Prof. Carhart's recent article, abstracted in the Digest, March 30, is reprinted in the "West. Elec.," April 13.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Microphone.—A new form in which plastic carbon is used, is described and illustrated in the "Elek. Zeit.," April 4.

Annunciators.—A new form is well illustrated and described in the "Elek. Zeit.," April 4; it is intended to indicate the number of times the signal bell has been rung; in a number of hotels one, two or three rings indicate each a different signal and the object of the present annunciator is to indicate which of these signals has been given; the annunciator contains a disc pivoted at its centre and rotated a quarter of a revolution for each ringing of the bell thereby uncovering the number corresponding to the signal.

Government Telegraphy.—In a brief article in "Elec. Power" for April by Mr. Delany, he states that he can see no good reason why the government should not own the telegraphs. He goes further and asks why the government should carry our letters by train at 30 miles an hour instead of by telegraph; there are about 30,000 letters exchanged between New York and Chicago daily, and assuming that they average 50 words each, all could be telegraphed over two copper wires the size of a lead pencil; with the automatic chemical method 1,000 words per minute can be recorded perfectly between New York and Chicago over a one-ohm-per-mile wire; messages can be perforated at the rate of 25 word per minute and typewriters can print from the receiving tape at the same speed; at this basis letters of 50 words could be perforated, transmitted, printed, and delivered through the mails at a cost of about 5 cents; with the present hand transmission, companies cannot telegraph for less than existing rates; he believes that hand working and great numbers of cheap iron wires will soon pass, and that automatic systems and a few big copper wires reaching out to the principal cities will carry all the correspondence.

Machine Telegraphy.—In a short article by Mr. Delany in the "Teleg. Age," April 16, he expresses his opinion quite decidedly to the effect that machine telegraphy is the coming method of transmitting telegraph dispatches; "cheap iron wires, overloaded poles, with an enormous repair expense, should and will disappear quicker than the horse car when the movement once begins."

Submarine Telegraph of the World.—The "West. Elec.," April 20, reprints the statistics recently compiled by the International Bureau at Berne.

How Cables are Repaired.—A profusely illustrated article of a semi-popular nature referring to submarine cables, is begun in the "Teleg. Age," April 16.

Telephony.—"Elec. Eng'ing" for April, begins the publication of a serial on telephony by Dr. Wietlisbach. It is claimed that every feature in the telephone exchange and in the science of telephony will be covered in this illustrated serial. The present portion discusses sound vibrations and gives a general description of the telephone.

Railroad Signalling.—A recent paper by Mr. Gibbs on the "Modern Practice in Signalling" is abstracted in the "Eng. News," March 14; the discussion is abstracted in the issue of April 11.

MISCELLANEOUS.

Carbide of Calcium.—The "Elec. Age," April 13, contains an abstract of a recent article by Mr. Wood from the "American Gas Light Journal." According to the Electric Gas Light Company, who controls the manufacture of this material, an electric horse power in the form of incandescent lights compared with the same amount of energy in the form of calcium carbide gas would be about as 7 to 11 in light, but he adds that these deductions should be received with caution until they have been verified; this difference is not sufficient to enable steam generated carbide and acetylene to compete with the electric incandescent light; when the latter have an efficiency of 3.5 watts per candle the lights will be equal. The lowest prime cost of an electric horse power from a central station is four cents hence, the cost of power for a ton of carbide will be nearly ten times that estimated by the company, which is 50 cents per horse power per year; the statements of the company he says have never been verified by any one not working in their interest. He gives an estimate in which he states that one electric horse power produces 10 pounds of carbide in a ten-hour day; he believes it is doubtful if the useful effect can be increased to much over 50 per cent. of the materials charged, and the waste in the furnace must necessarily be large. He makes an estimate for a 2,000-hp steam plant producing 20 tons daily; with coal at one dollar per ton the cost of the carbide will be $19.70 per short ton; with a water power plant on a basis of five dollars per horse power per year it will cost $16.10 per ton; with contemplated improvements it may be possible to produce the carbide for a commercial price of $24 per ton F. O. B. but only under extremely favorable conditions. He gives the numbers and dates of the three Wilson patents. The same journal reprints the portion of Mr. Perry's paper from the "Eng. Mag.," for April, regarding the manufacture of this material in central lighting stations.

Hardening of Steel.—A translation, in abstract, of the recent paper of Mr. Charpy abstracted in the Digest last week under "Temperature of Transformation of Iron and Steel," is published in the "Eng. & Min. Jour.," April 13.

Patents.—"Elec. Eng'ing" for April contains an article by Mr. Smith, reprinted in the "Elec. Rev.," April 17, on "Patent laws; the Inventor; the Public"; another by Mr. Hill on "The Mechanical Expert Witness in Patent Causes"; another by Mr. Smith on "Expert Witnesses in Patent Causes."

Municipal Industrial School.—"Elec. Eng'ing" for April contains an article by Mr. McMynn; also an editorial by Mr. DeLand on "Character Forming Schools."

New Book.

THE PRACTICAL APPLICATION OF DYNAMO ELECTRICAL MACHINERY. By Carl K. MacFadden and William D. Ray. Second edition, revised. Chicago: Date & Ruggles. 167 pages, 38 illustrations. Price, $1.00.

This is one of the numerous books written with the design to teach technical subjects in a juvenile style to "practical" men, and is perhaps somewhat better than most of its kind. The writers labor most conscientiously to render clear to the reader the mysteries of Ohm's law which is declared to be "without doubt the foundation of all electrical knowledge," and from which are obtained "all of the more complex formulas known to the Electrical Engineers." The various chapters contain, along with cuts and descriptions of series, multiple and multiple-series circuits and other time-honored subjects, much useful information, particularly in those portions where the authors relax their pedagogical attitude and deal with everyday matters of practical interest.

While the book is dated last year, portions of the chapter on street railways are apparently some years in arrears; the "Sprague-Edison" method of street car motor control, for instance, is illustrated and described at length, and its simplicity stated to be such that "this plan is used by the Thomson-Houston Company on most of its equipments." The writers define inductance as "the magnetism-producing effect of the circuit," and the reason why copper is used for conductors is said to be owing to "its 'conductivity,' that is, its small resistance to the flow of the current"—the implied definition of conductivity being rather unique.

To the reader in search of simple practical information this work will be found useful, though he should bear in mind that some of the subjects treated are much less difficult than might be supposed from the amount of space devoted to them.

Electric Flash Light.

An interesting application of photography was recently made at the Metropolitan Opera House in New York, a photograph of the vast audience assembled to hear Alvary's 100th performance of the title role of Siegfried being taken by flash light. This was the largest photograph ever taken by flash light and proved to be a complete success. Electricity played an all-important part on this occasion, for by its means 35 piles of magnesium powder were simultaneously exploded, making one gigantic flash lasting less than one-fortieth of a second.

Many attempts have been made to obtain photographs of large interiors and groups of people. Very little success has attended these efforts, owing to the difficulty of obtaining an intensely brilliant light in the shortest possible space of time. So well were the many obstacles overcome in the photograph of the Metropolitan Opera House that not the slightest movement can be noticed in the audience of 3,500 people.

Heretofore it has been customary to use a quantity of magnesium powder stretched out in a long pile. This was ignited with a fuse, or by blowing the flames of an alcohol lamp directly against the powder. These methods have answered for groups or interiors. The task of photographing a large, constantly moving audience in a brilliantly lighted auditorium was never accomplished until the aid of electricity was invoked. The apparatus for producing the flash was constructed by Mr. T. D. Bunce, of the Storage Battery Supply Company, 239 East 27th street. The photographic work was done by Mr. E. Marx.

Many experiments have been made by Mr. Bunce and many smaller pictures successfully taken. But in a photograph of this kind many things had to be considered, such as quantity, speed, projection and distribution of the light. A small pan of powder may be exploded with sufficient speed to produce an instantaneous exposure. For an interior the size of the Metropolitan Opera House such a quantity of powder was required that if it had been ignited in one mass the exposure would have been too long, as well as having the great objection of the light coming from one point. Electricity solved the problem. It produced a simultaneous discharge of the powder, allowed of proper distribution, and the safe and unseen operation of the flash.

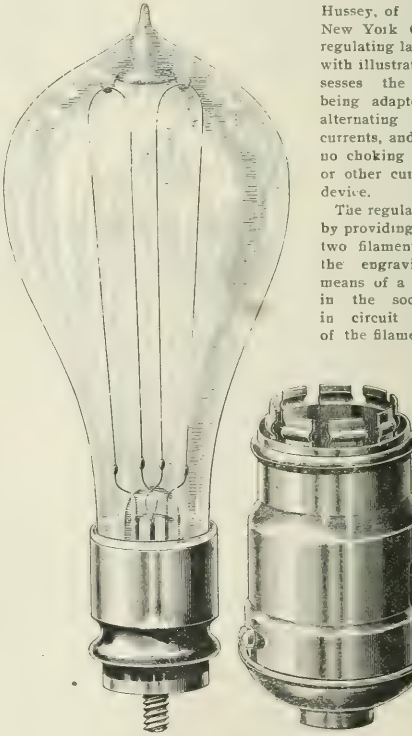
The apparatus consisted of an iron frame, supporting seven pans upon the sides and top. In each pan were placed five specially constructed fuses that were in connection with a storage battery behind the scenes. The camera, holding a plate 18 by 20 inches, was placed in the centre of the frame. Behind this were white cardboard screens. Around each fuse was placed a pile of magnesium composition especially prepared by Mr. Marx.

At the close of the first act of the opera the apparatus was quickly placed on the stage. The curtain rose, a hurried focus was taken, the switch closed and the intense light flashed out. The curtain descended and the photograph of 3,500 people was taken before they knew it. The picture was perfectly successful, as may be seen from its reproduction in *Harper's Weekly* of April 3.

A Combined Regulating Socket and Lamp.

Patents have recently been granted in this country, Canada and England to Mr. C. A. Hussey, of 680 Broadway, New York City, upon the regulating lamp socket herewith illustrated, which possesses the advantages of being adapted for either alternating or continuous currents, and of containing no choking coil, resistance, or other current-consuming device.

The regulation is obtained by providing the lamp with two filaments as shown in the engraving, and, by means of a suitable switch in the socket, throwing in circuit one or both of the filaments, as may be desired. In a lamp rated at 16 cp each filament gives 8 cp, the full capacity of the lamp being obtained by switching both filaments in parallel. For night service, the filaments are connected in series.



NEW REGULATING SOCKET AND LAMP.

New Panel Board and Box.

The accompanying engravings illustrate some new forms of cut-out boxes and distributing board recently perfected by T. J. Murphy & Company, of 136 Liberty street, New York.

The improvement in the tablet board consists in so arranging the cross connections as to locate the two connection lugs for any given branch circuit, side by side, as shown by Fig. 1, instead of placing all the positive connections on one side of the board and the negative lugs on the opposite side.

The feature of the cut-out boxes is the method of leading in the wires. A small iron nipple bushed with insulating material, shown at the top of Fig. 2, is secured by lock-nuts in a hole in the side of the box, and the wire is brought through the nipple. The end of the conduit is brought up to the end of the nipple, and the two joined by a coupling, forming a continuous covering for the wire without recourse to special devices or troublesome fitting. On the right of Fig. 2 is shown a plain cut-out box equipped with leading-in nipples, and on the left a compound box with tablet board and nipples complete. This latter form of box is designed to meet the views of those engineers who prefer plenty of "lee-way" between the entering holes and the connection lugs for the purpose of making changes in connections if desired, or leaving slack in the ends of the wires to provide for the possible shortening by accidental breakage, etc. If desired, the chamber formed between the inner and outer walls of the box may be filled up flush with an insulating compound.

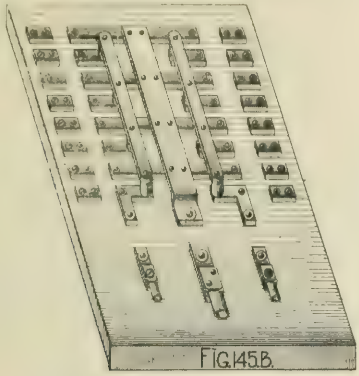
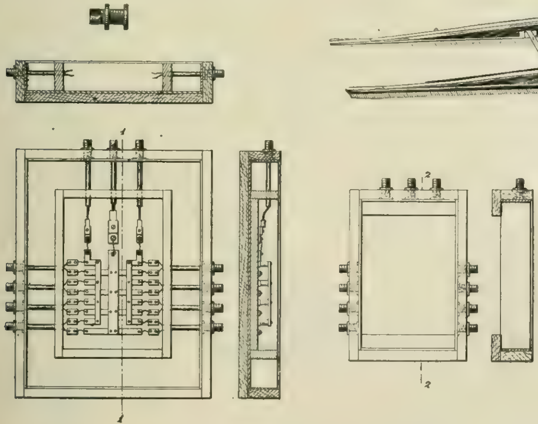


FIG. 1.—NEW PANEL BOARD.

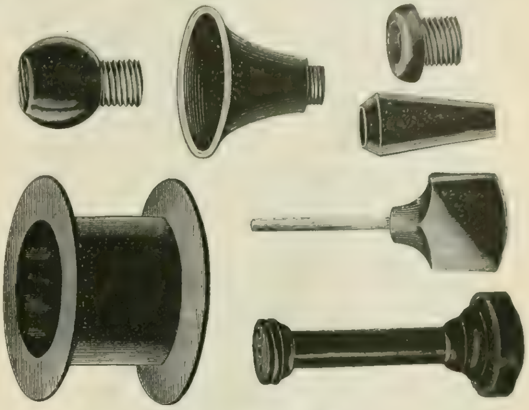


IG. 2.—IMPROVED DISTRIBUTING BOXES.

A Substitute for Hard Rubber.

Among the substitutes for hard rubber which has passed largely into use for electrical purposes is electrose, which material is manufactured in many forms, several of which we illustrate, by the Electrose Manufacturing Company, 216 William street, New York. Of the many advantages of this material for electrical work one is that it will not tarnish metal with which it is contact, no sulphur being used in its vulcanization. Though much cheaper than hard rubber, it possesses the highest insulation properties; it can be readily moulded into any shape and when colored does not fade. Possessing a high polish and great strength electrose is particularly adapted for telephone receivers and other fittings, for lamp socket nipples and handles and other purposes where these qualities are desirable.

A valuable property of this material is that changes of temperature do not affect it, so that when used for telephone cases the adjustment of the diaphragm and magnet are not affected. It will also resist the action of the weaker acids and alkalines and withstand an elevated temperature.

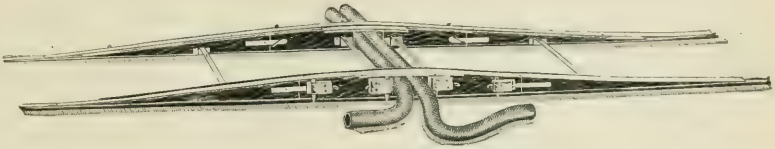


ELECTROSE SPECIALTIES.

Portable Hose Bridge.

A most useful piece of apparatus for street railway purposes has recently been placed on the market by the Metropolitan Electric Company, Chicago, in the form of a portable hose bridge, whose employment will obviate annoying delays to the public, with accompanying inconveniences and losses of fares to street railway companies.

The bridge is sixteen feet in length, each side being in three sections. These sections are quickly connected by means of a clasp, which holds the parts firmly and rigidly together. Braces hold the two sides securely in place, while ratchet spikes, held by strong springs, hold the parts to the ground and rail. The parts are all made of such strength and materials that the heaviest motors and trailers can be easily carried. The bridges will fit any kind of rail and are made for any gauge. They can be placed in position by one man inside of three minutes, and can be carried to the scene of a fire either in a car or a "hurry-up wagon." Two lines of the largest fire hose made can be used through the bridge. The connection at each end with the rail is close and the rise of a car in going over the bridge is so gradual and slight as to be hardly perceptible. The bridges are so sturdy that the makers guarantee them for a minimum life of ten years.



A PORTABLE HOSE BRIDGE.

Accumulator Traction in France.

An electric tramway on the accumulator system has recently been completed between Nice and Cimiez. The generating plant comprises two 50-hp steam engines, driving two dynamos giving 200 amperes at 200 volts. The accumulators employed are of the Laurent-Cély type, supplied by the Société du Travail Electrique des Metaux. Each car is provided with 90 cells, and two motors connected to the axles by gear wheels.

An Electric Mountain Railway.

A company is being formed to construct an electric rack railway up the Sonnenberg at Lucerne, under an 80-years concession granted in June, 1893. The line will be 3.8 kilometres long, the terminal station being at an altitude of 2,555 feet. The necessary electric energy will be supplied from the Rathhausen central station, the current being conveyed along an underground conduit. The line will be of the metre gauge, the speed ranging between 9 and 12 kilometres per hour.

The Phœnix Transformer.

In placing upon the market their new Phœnix transformer, which we illustrate herewith, the Louisville Electrical Works, of Louisville, Ky., claim to be exploiting an apparatus which will be well worth a thorough examination and test upon the part of the central station manager.

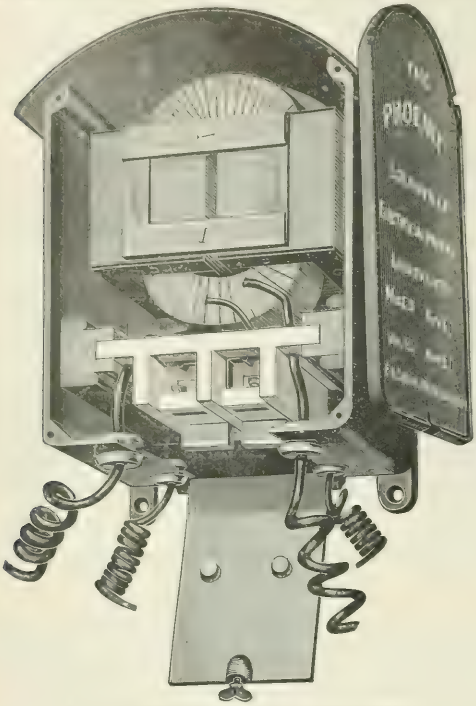


FIG. 1.—INTERIOR VIEW OF TRANSFORMER.

In Fig 1 the Phœnix transformer is shown, with the cover removed and the door lowered, which view shows the coil, core and terminal block and fuse device in their positions. Fig. 2 gives a clear idea of the very simple method of forming the core about the coil, while Fig. 3 shows the construction of the terminal block and fuse plug. The cases are strong, durable and well ventilated, besides being thoroughly waterproof. At the bottom of the case is a small hinged door, secured by only one thumb screw, through which the fuse plugs are readily and safely reached; adjoining the door are four slots, in which are freely and loosely placed the porcelain insulators, through which the leading-in wires are run. The use of a porcelain insulator in this position and for this purpose is a new departure, and an improvement upon the usual rubber insulators, which are so readily broken.

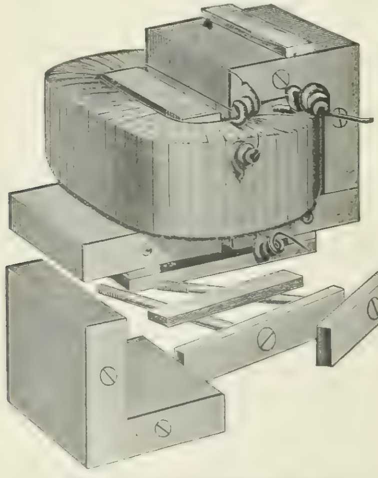


FIG. 2.—CORE PARTIALLY BUILT UP.

The core is formed of L-shaped laminations, tightly bolted together in four interchangeable blocks or sections. The core sections, after having been assembled about the coil, are rigidly and securely bolted together by means of two long screws running through wrought iron clamps, which latter are thoroughly insulated from the core. Through special means of punching and treating these laminations and pressing the core together the best magnetic joints obtainable are secured. The core and coil are secured in position in the case in a very simple and effective manner, and to remove the same requires the removal of simply two cap screws.

The porcelain terminal block and fuse device are secured in the case between blocks of treated wood, held between projections on the inside of the case. The fuse plugs are all alike and interchangeable, and are fitted with blades, which slide under contact pieces upon the lower surface of the terminal block, the plug sliding between the walls formed on the block. The fuse is secured under two thumb nuts and passes through a slot in a bridge of porcelain formed on the upper surface of the plug, and which effects the destruction of the most serious arc.

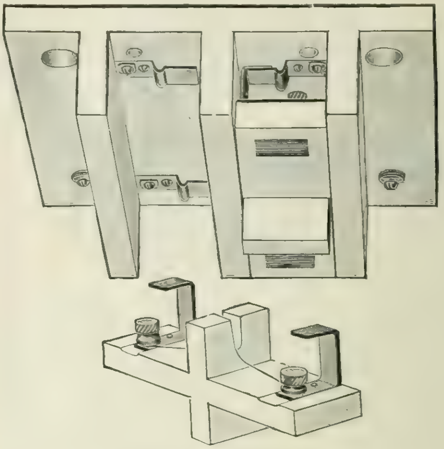
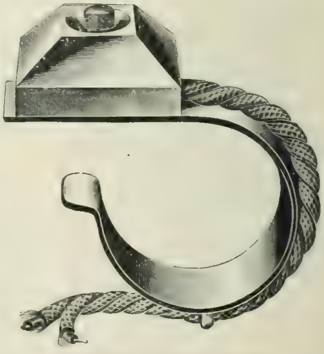


FIG. 3.—FUSING DEVICE.

The construction of the fuse plug makes it as effective as a jack-knife switch as a circuit breaker, and not only causes it to be absolutely safe for the lineman to handle, but through the blowing of a fuse it cannot possibly be broken, having an open space at each end for the escape of the gases formed. When the door of the case is closed, the two lugs upon its inside surface move into position in front of the thumb pieces on the fuse plugs, making it impossible for them to become loosened.

Through the use of the highest grade of material, the proper proportioning thereof and the peculiar method employed in forming and securing together the core, the Louisville Electrical Works claim that they are enabled to guarantee for their transformers the very closest regulation, the highest efficiency, and the least leakage, and are willing to have any one put them to a thorough and complete test for the determining of the correctness of their statements upon these points.

Combination Clip and Push Button.



COMBINED CLIP AND PUSH.

Among the new electrical devices recently placed on the market by Huebel & Manger, 286 Graham street, Brooklyn, is a combined clip and push button, illustrated herewith. As will be seen by a glance at the cut, the device is complete in itself, and adaptable for many purposes where a temporary connection to a call bell is desired. It can be easily and quickly attached to any piece of movable furniture, such as card and chess tables, an easy chair, invalid's couch, etc.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK April 20, 1895.

THE ELECTRICAL STOCK MARKET continued uneventful again this week, not even the mildest sort of enthusiasm being aroused in any quarter. Close students of American Bell say that the decline in that stock is due to the reports of reductions in rates throughout the country, and claim that there has not been so much reduction in rates as a change in the system of charges from the flat rental system to a so-called "measure" basis. Be that as it may, the fact remains that the stock has been flat and unsteady for some time past, a sudden but slight advance yesterday and to-day being the sole approach to anything like a rally.

GENERAL ELECTRIC displayed a rather unusual degree of activity and firmness this week, over 12,000 shares being dealt in within 15 minutes after the opening on Wednesday. Though these transactions were made at less than 33, the stock has otherwise remained pretty steady between 33 and 34 during the week.

ELECTRIC STORAGE has maintained a very steady aspect for quite a while, and appears to be steadily gaining in favor on both New York and Philadelphia floors.

ELECTRICAL STOCKS.	Par.	Bid.	Asked
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	97¼	98⅛
" " " Brooklyn	100	..	108
" " " Boston	100	124	125
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	29	30
General Electric	100	33½	33¾
General Electric, pref	100	63¾	64¼
Westinghouse Consolidated, com.	50	33½	34½
" " pref	50	..	52
BONDS.			
Edison Electric Ill., New York	100	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co. deb. 5s	100	..	90¼
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	180	181
American District Telegraph	100	30	40
American Telegraph & Cable	100	91	..
Central & South American Telegraph	100	117	120
Commercial Cables	100	141	..
Erie Telephone	100	50	51
Gold & Stock Telegraph	100	105	..
New England Telephone	100	66	66½
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63½	..
Western Union Telegraph	100	88⅝	88¾
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	17	17⅛
Binghamton RR. com	100	100	..
Brooklyn Traction	100	9	11
" " pref.	100	..	53
Buffalo St. Ry	100	66	69
Cleveland City Ry.	100	68	70
Cleveland Electric Ry.	100	59	60
Chicago City Ry	100	305	315
Columbus St. Ry	100	46	49
Consolidated Traction of N. J	..	30	33
Electric Traction, Philadelphia	50	75½	76½
Long Island Traction	100	9	9¼
Louisville St. Ry. com.	100	37	39
" " " pref.	100	87	88
Metropolitan Traction, Philadelphia	100	89⅝	90
New Orleans Traction	100	15	18
" " pref.	100	56	60
North Shore Traction	100	..	..
" " pref.	100	74	83
People's Traction $30 pd	25	59	59½
‡Philadelphia Traction	50	82¼	82⅜
Rochester St. Ry	..	38	..
Union Ry. (Huckleberry)	100	112	115
West End, Boston	100	64¾	65
" " pref	100	88	..
Worcester Traction	100	..	13
" " pref	100	77	80
BONDS.			
Buffalo St. Ry. 1st con. 5s	100	101	..
*Binghamton Railroad Co. 5s	100	99	100
*Columbus St. Ry. 1st 5s	100	9	..
Rochester St. Ry. 1st. 5s	100	95	97
*Union Ry. 1st. mtge 6s	100	105	108
*Westchester Electric 1st. mtge. 5s	100	98	101

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* With accrued interest.

‡ Ex-rights.

BALTIMORE, METROPOLITAN & PEOPLE'S TRACTIONS are all three showing somewhat bullish tendencies, probably due, in a measure, to the increase in traffic along with the approach of spring weather, and partly owing to a general improvement in the business over last April. Since April 1, Baltimore's Traction's earnings have increased over $300 a day; for the first nine days of the month Metropolitan's earnings were over $18,000 in excess of last year's business for the same period, and it is understood that the increase in the earnings of People's Traction, as compared with this season last year, is averaging about $3,000 a day.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD.
253 BROADWAY, NEW YORK, April 22, 1895.

MR. J. C. HOBART, of the Triumph Electric Company, Cincinnati, was in New York during the week, and reports that he finds everywhere an improvement in business. His own company finds it necessary to run day and night to fill orders.

CANADIAN NOTES.

OTTAWA, April 20.

HALIFAX, N. S.—The legislature has thrown out the "Bondholders' Electric Street Railway bill."

QUEBEC.—The Quebec Street Railway Company is asking permission to introduce the storage battery system.

TORONTO.—The city's share of the electric street railway receipts for March was $5,609, and $16,266 for the quarter.

ST. JOHN, N. B.—Tenders are called for from persons willing to undertake the lighting of the streets of this city with electric light.

MATTAWA, ONT.—The Mattawa Electric Light & Power Company, with a capital of $80,000, has just secured a charter from the Ontario Government.

ST. MARTIN, QUE.—Negotiations are pending between the Mountain Park and Island Electric Railway to run a line through the towns of St. Martin and St. Rose.

OTTAWA, ONT.—The Posclean & Carleon Company, capital $100,000, have started the construction of their new works in this city. The factory will be 135 by 150 feet.

HULL, QUE.—The Deschenes Electric Company, with a capital of $60,000, is applying to the Dominion Government for a charter to manufacture electricity for light, heat and power.

HAMILTON, ONT.—The Hamilton Lake Erie Power Company are applying to the Dominion Parliament for power to build electrical works for generating electricity on a large scale.

OTTAWA, ONT.—A number of capitalists of this city have been in Jamaica, W. I., where they are negotiating for franchises to construct electric railways in Kingston and at other points on the island.

OTTAWA, ONT.—It is probable that a conference of the representatives from the Australian colonies and Canada will shortly be held to consider the tenders recently received for laying the proposed Canadian-Australian Pacific cable.

TORONTO, ONT.—The Ontario legislature has passed a bill fixing ten hours a day as the time an employee on electric railways shall work. A strong protest was entered against the section of the bill prohibiting the sale of stock below par. Hon. Mr. Bronson, in reply, said that stock worth 150 per cent. had been transferred at par, enabling certain people to pocket that which should have gone to the benefit of the shareholders at large.

OTTAWA, ONT.—The figures of the tenders received by the Canadian Government for the construction of a cable from Canada to Australia are as follows: Route No. 1, from Vancouver, via Fanning Island and Fiji to Norfolk Island, there to divide, one cable going to New Zealand and the other to Australia, £1,517,000. Route No. 2, from Vancouver to Necker Island and Fiji to Norfolk Island, there to divide, one cable going to New Zealand and the other to Australia, £1,416,000. Route No. 3, from Vancouver via Necker Island to an island in the Gilbert group, there to divide, one cable going by way of Fiji to New Zealand and the other by way of the Solomon Islands to Queensland, £1,303,000. Route No. 4, from Vancouver via Necker Island and the Gilbert and Solomon islands to Queensland only, £1,068,000. Route No. 5, from Vancouver via Necker Island, and Fiji to New Zealand only, £1,291,000. Route No. 6, from Vancouver to Honolulu and there divide, one cable going to New Zealand, the other to Australia, £1,891,000. Route No. 7, from Vancouver via Honolulu, the Gilbert and Solomon islands, to Queensland only, £1,081,000. Route No. 8, from Vancouver via Honolulu and Fiji to New Zealand only, £1,248,000.

General News.

NEW INCORPORATIONS.

THE BENTON TELEPHONE COMPANY, stock $20,000 has been incorporated by N. K. Smith, Charles Smith and others.

THE MONTICELLO MUTUAL TELEPHONE COMPANY, Monticello, Ill., has been incorporated by W. H. Plank, H. N. Knight and N. W. Hart.

THE UNIVERSAL TELEPHONE COMPANY, Indianapolis, Ind., capital stock $[illegible] has been incorporated by F. B. Charles, Robert Martindale and others.

THE GREENVILLE ELECTRIC LIGHT HEAT AND POWER COMPANY, Greenville, Mo., capital stock $25,000, has been incorporated by E. and Samuel D. Bruckman.

THE PEOPLE'S TELEPHONE COMPANY, New Haven, Conn., has been incorporated by ex-Gov. T. M. Walle, J. E. Bowles, J. Irving and J. J. Lawton. The capital stock is $500,000.

THE INTERSTATE TELEPHONE AND TELEGRAPH COMPANY, Durham, N. C., capital stock $100,000, has been organized with L. A. Carr, president, to manufacture telephones.

THE CLINTON TELEPHONE COMPANY, Clinton, Tenn., has been organized with Dr. R. K. Medaris, president and general manager; J. C. Strader, vice-president, and W. W. Medaris, secretary and treasurer.

THE CUERO TELEPHONE COMPANY, Cuero, Tex., capital stock $4,000, has been incorporated by William Probese, C. L. Stadtler, William Wagner, Lee Joseph, W. R. Rathbone, D. Hunter and Samuel C. Lackey.

THE DELAWARE COUNTY ELECTRIC COMPANY, Chester, Pa., capital stock $1,000, has been organized to supply light, heat and power. The promoters are S. T. Wellman, Upland; W. C. Gray, and O. B. Dickinson.

THE KELLY WATCH COMPANY, Chicago, Ill., capital stock $20,000, has been incorporated to make and sell time pieces, electric devices, etc. The interested parties are Thos. F. Kelly, J. O'Hare and Robt. J. Bieg.

THE WHITE BEAR TELEPHONE COMPANY, St. Paul, Minn., capital stock $10,000, has been incorporated by John L. Pratt, Chicago, Ill.; Jas. L. Brass, James Berlingett, Tracy Lyon and Robert C. Wright, of St. Paul.

THE MUNCY VALLEY STREET RAILWAY COMPANY, Mahanoy City, Pa., capital stock $50,000, has been incorporated. The promoters are Jno. J. Coyle and C. C. Smith, of Mahanoy City, and Chas. U. Brumm, of Minersville.

THE MILWAUKEE INCANDESCENT LAMP COMPANY, Milwaukee, Wis., capital stock $25,000, has been formed to manufacture and deal in incandescent lamps. John J. Reilly, M. J. Reilly and Barney Davis, Milwaukee, Wis., are interested.

THE CHICAGO SUBWAY, ARCADE AND TRACTION COMPANY has been incorporated with a capital stock of $15,000,000, for the purpose of constructing subways in that city and operating a line of cars. The secretary of the company can be addressed.

THE WACO ELECTRICAL SUPPLY AND CONSTRUCTION COMPANY, Waco Tex., capital stock $10,000, has been formed to buy and sell goods, wares and merchandise by wholesale. W. W. Seley, S. A. Hobson, and A. P. Moore, Waco, are the interested parties.

THE E. S. KAWLY ELECTRICAL CONSTRUCTION COMPANY, Chicago, Ill., capital stock $12,000, has been formed to go into the construction business, install electrical apparatus in buildings and elsewhere, etc. E. S. Kawly, V. Merriam and J. H. Weber.

THE ADAMS-BAGNALL ELECTRIC COMPANY, Cleveland, O., capital stock $150,000, has been formed to manufacture and deal in electric lamps, railway motors, electrical machinery, etc. Thos. E. Adams, E. J. Bagnall and Chas C. Hickok are interested parties.

THE HARTFORD LIGHT AND POWER COMPANY, Hartford City, Ind., capital stock $30,000, has been organized. The incorporators are Wm. N. Forbis, Monticello, Ind.; Milton H. Forbis, Cincinnati, O.; Albert Reynolds and Guy E. Reynolds, Hartford City, Ind.

THE BELLE VERNON ELECTRIC LIGHT AND POWER COMPANY, Belle Vernon, Pa., capital stock $1,000, has been incorporated to generate light and power by electricity. Samuel M. Graham, Adolph C. Hamm, and C. F. Eggers, all of Belle Vernon, are interested.

THE TAYLOR ELECTRIC LIGHT COMPANY, Taylor, Tex., capital stock $20,000, has been formed to generate and supply electricity for light, heat and power, and to manufacture and supply gas. Hugh Burns, F. L. Welch and Bernard Garry, of Taylor, are the promoters.

THE ASBURY PARK ELECTRIC COMPANY, Asbury Park, N. J., capital stock $200,000, has been formed to supply electricity for light, heat and power, etc. The promoters are Geo. A. Smook, Jas. M. Ralston, John W. Rockafeller and Harry J. Rockafeller, Asbury Park, N. J.

THE IOWA FALLS ELECTRIC LIGHT AND POWER COMPANY, Iowa Falls, Ia., capital stock $15,000, has been formed to erect, maintain and operate an electric light and power plant. L. B. Bradley, H. C. Miller, J. D. McKay and Z. K. Hoag, Iowa Falls, Ia., are the promoters.

THE AUTOMATIC TELEPHONE COMPANY of Wisconsin, Chicago, Ill., capital stock $500,000, has been formed to maintain and operate telephone service, to supply electric light and power, do wiring, etc. The promoters are J. Harry Theobald, Wm. T. Whipple and Maurice Rosenfeld.

THE ROTH MULTICYLINDER MOTOR COMPANY, Cincinnati, O., capital stock $100,000, has been formed to manufacture and sell gas and gasoline and electromotors, engines and locomotives. The promoters are Gilson W. Roth, H. L. Roth, J. M. Blair, Jos. T. Blair and R. C. Bliss.

THE AMERICAN ELECTRIC WORKS COMPANY, Denver, Col., capital stock $10,000, has been formed to buy, sell, rent, manufacture and repair all kinds of electrical, steam and other machinery. Wm. Thorne, Thomp. G. Walton and Chas. E. Hawkins, all of Denver, Col., are interested.

THE MIDDLEBROOK TELEPHONE COMPANY, Staunton, Va., capital stock $5,000, has been incorporated with John H. Bowman, president; J. Frank Clemmer, vice-president; H. A. Shepherd, secretary; W. W. Sproul, treasurer, to construct a telephone line from Staunton to Lexington.

THE NEW YORK ELECTRIC MOTOR AND VENTILATOR COMPANY, New York, capital stock $30,000, has been formed to manufacture and sell electric motors, appliances, etc. Sidney Green, New York; C. A. Sherman and Lincoln Van Cott, Brooklyn, N. Y., are interested parties

THE OSBURN ELECTRIC SUPPLY COMPANY, Chicago, Ill., capital stock $12,000, has been formed to manufacture and deal in electrical goods, machinery, supplies, etc., of all kinds, and to carry on a general electrical business. Harry G. Osburn, M. Roy Osburn and Asa W. Waters are interested.

THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Richmond, Va., capital stock $50,000, has been formed by Edward P. Meany, Newark, N. J., president, and Melville Egleston, Elizabeth, N. J., secretary, to construct and operate telephone and telegraph lines throughout Virginia.

THE STANDARD TELEPHONE AND ELECTRIC COMPANY, Minneapolis, Minn., capital stock $50,000, has been formed to manufacture telephones and other electrical instruments. S. S. Kilvington, E. W. Batchelder, H. C. Dodge and Geo. L. Scott, of Minneapolis, Minn., are the incorporators.

THE W. H. ELLIOTT ELECTRIC COMPANY, Cleveland, O., capital stock $10,000, has been formed to manufacture, buy and sell all kinds of electrical devices and machinery, etc. Robert M. Fuller, Theodore C. Vollman, Wm. H. Elliott, Alvin A. Piper and Chas. O. Cartright are the incorporators.

THE STANDARD TELEPHONE COMPANY, New York, capital stock $360,000,000, has been organized, with Thurlow Weed Barnes, of New York, president, Gen. Jas. S. Clarkson, John D. Laitre, Chas. R. Pillsbury, Judge Poindexter Dun, E. S. Johnson, Gen. Felix Agnus and others as directors.

THE MUTUAL AUTOMATIC TELEPHONE COMPANY, New York, has been incorporated with J. Wesley Allison, president, and Silas B. Dutcher, Smith M. Weed, W. Seward Webb, David A. Boody, Henry N. Whitney, John Jacob Astor, John C. McGuire and Chas. F. Cox, directors. The capital stock is $6,000,000.

THE GLOBE ELECTRIC CONSTRUCTION COMPANY, New York, capital stock $20,000, has been formed to sell and install electric equipment, apparatus and appliances, etc. J. J. Clark, T. F. Coon, of New York; H. C. Mackenzie, of Roseville, and P. M. Mowrey, of Upper Montclair, N. J., are the promoters.

THE DENISON STREET AND ELECTRIC RAILWAY COMPANY, Denison, Tex., capital stock $50,000, has been incorporated to construct and operate street railways or belt lines of railway in or near Denison, etc. The promoters are A. F. Platter, G. McLoger, P. H. Robin, T. Murphy, and E. H. Lingo, of Denison, Tex.

THE ATLANTIC COAST ELECTRIC RAILWAY, Asbury Park, N. J., capital stock $1,000,000, has been formed to construct and operate a street railway or traction company. Wm. H. Hurst, 238 Central Park, West; John J. Walsh, 6 East 93d street, and Henry Haggerty, 137 East 71st street, all of New York, are the interested parties.

THE MANHATTAN INCANDESCENT LIGHT COMPANY, Gloucester City N. J., capital stock $500,000, has been formed to manufacture, buy and sell Welsbach and other incandescent lights and burning devices. Waldron Shapleigh, Camden, N. J., Thos. Dolan, Randal Morgan and C. R. Collins, Philadelphia, are interested.

THE SEATTLE & ALASKA MINING AND MILLING COMPANY, Seattle, Wash., capital stock $250,000, has been formed to mine and market ores of precious metals, do logging, lumbering, etc., and to erect and maintain water and electric power. Wm. M. Ebner, W. E. Crews, J. E. Fox, W. D. O'Toole and P. F. Smith are the incorporators.

THE EMPIRE STATE ELECTRIC FORGING COMPANY has been formed at Syracuse, N.Y., with a capital stock of $300,000, for the purpose of manufacturing, selling and operating electric welding, forging and smelting apparatus. L. H. Groesbeck, C. M. Varner, of Syracuse; J. O. Adsit, Hornellsville, and D. E. Mosely, Rochester, N. Y., are interested.

THE TACOMA GAS AND ELECTRIC LIGHT COMPANY, Tacoma, Wash., capital stock $350,000, has been formed to supply gas and electricity for light and other purposes, and to operate water works, railways, vessels, etc. Edmund Seymour, Chas. B. Hurley, C. P. Masterson, Alfred E. Buell, Frederick Watson, W. C. Hellar and Jno. F. Dillon.

THE FELTS PRIMARY BATTERY COMPANY, Sacramento, Cal., capital stock $1,000,000, has been formed to purchase, lease, operate or dispose of all kinds of electrical rights, patents, licenses, batteries, machinery, apparatus, and other property pertaining to electric lighting. W. W. Felts, R. Watkins, Thos. E. Fogalsang and G. W. Merrell, Sacramento, Cal., are the interested parties.

TELEGRAPH AND TELEPHONE.

NEWPORT, KY.—The Anthony Electric Company will establish a telephone system.

KANSAS CITY, KY.—B. F. Jones is organizing a company to construct a telephone system

UTICA, N. Y.—The Central New York Telephone Company will put in new telephone apparatus.

BURLINGTON, N. C.—Steps are being taken looking to the establishment of a telephone exchange.

MEMPHIS, TENN.—L. E. Drake, of Anderson, Ind., is endeavoring to form a telephone exchange.

SPRINGFIELD, MO.—The telephone line from Ozark to Springfield is expected to be in operation May 1.

LE FEVER FALLS, N. Y.—The West Shore Telephone Company is erecting poles for the main line to Kingston.

ABILENE, TEX.—The Abilene Telephone Company will commence the construction of its telephone system at once.

SALISBURY, N C—C. N McAddo, of Greenboro has purchased the telephone system, and will improve the service.

ALBIA, IA.—The Harrison Telephone Company has been granted a franchise and work is to be commenced in a few days

OWENSBURG, KY.—Steps are being taken to establish a company to operate a telephone system R Monarch is interested.

SPRINGFIELD, MO—The Christian County Telephone Company will construct a telephone line from Ozark to Springfield

ORANGE, C H, VA.—The Interstate Telephone & Telegraph Company, of Durham, N. C., will erect a telephone exchange.

GORDONSVILLE, VA.—The Interstate Telephone & Telegraph Company of Durham, N. C, will erect an exchange for a telephone system.

PARIS, KY—The Paris Telephone Company desires bids on telephone, switchboard and line supplies. Address H. H Roberts, secretary

MOBILE, ALA—The Home Telephone Company is putting in a telephone exchange, and has 450 subscribers booked, with three-year contracts.

TUNKHANNOCK, PA.—A telephone line will probably be constructed between Tunkhannock and Meshpoen, by way of Eatonville and Mehoopany.

MOBILE ALA.—The Home Telephone Company, recently organized, has elected H. Piser president, Jas. K. Glennon vice-president, and W. H. Fitzpatrick secretary.

CHATTANOOGA, TENN.—The Citizens' Telephone Company is to be organized by F. I. Stone, W D Carswell, T. R Preston and others, to construct a telephone system.

SHREVEPORT, LA.—The Citizens' Co-Operative Telephone Company, of which John W. Taber is manager, is successfully pushing forward the completion of this new company.

TALLAHASSEE, FLA.—Address the Capital City Telephone Company, M. B. Rice, superintendent, concerning bids on 40 telephones and apparatus for an exchange of 50 subscribers.

THE ERIE TELEGRAPH & TELEPHONE COMPANY made a net gain of 291 subscribers for the three months ending March 31. Total number connected March 31, 1895, 16,465.

SALISBURY, MD.—The Wicomico Telephone Company has been granted a charter to erect a telephone line from Salisbury, Quantico, White Haven, Naticoke, Tyaskin, Bivalve and other villages.

ALEXANDRIA, VA.—The Ocoquan Woodbridge Telephone Company, K. S. Wyckoff, vice-president, has secured a building in which the office of the company will be located, and will soon commence the construction of the line.

ST. LOUIS, MO.—The Central Standard Telephone Company, of St. Louis, Kansas City and Lincoln, is being organized by Griffith Colt, president of the Union Trust Company, of St. Louis, and others. The capital stock is $5,000,000.

TAMPA, FLA.—The Citizens' Telephone Company, with a capital stock of $12,000, which was recently organized, with S. J. Drawdy, president; A. C. Clewis, vice-president; C. H. Keller, secretary and manager, expects to have its line in operation within 90 days.

MYERSTOWN, PA—The Daniel Drawbaugh Telephone & Electric Company has secured a building for the location of a telephone instrument factory, which will have a capacity of 50 instruments daily, and give employment to 50 workmen. Subscriptions amounting to $10,000 have already been raised.

MANASQUAN, N. J.—The Manasquan Telephone Company has installed a small exchange, using Gerson telephones and switchboard. The exchange is to be connected with one in Point Pleasant, N. J., by toll line, and later will connect with Spring Lake, Asbury Park and Freehold, and probably with Lakewood

LOUISVILLE, KY.—The Southern Standard Telephone Company is to be organized to operate in Kentucky, Tennessee, North Carolina, and South Carolina. It is to be a branch of the new Standard Telephone Company, of New York, of which Thurlow Weed Barnes is president, and is to have a capital stock of $4,000,000.

NEW ORLEANS, LA.—The New Orleans branch of the new Standard Telephone Company of which Thurlow Weed Barnes, of New York, is president, has organized as the Gulf States Standard Telephone Company, with A. Maginnis as president, W. J. Behan, vice-president, and Harry Allen, general manager. This company will control Louisiana, Mississippi, Alabama, Georgia and Florida.

ELECTRIC LIGHT AND POWER.

BARTON, VT.—An electric light plant is being placed in position.

ALEXANDRIA, LA.—An electric light plant has been established.

STATESBORO, GA.—W. D. Davis will erect an electric light plant here.

GEORGETOWN, S. C.—Steps are being taken to establish an electric ligh plant.

BOWIE, TEX.—John Graves, of Henrietta, is putting in an electric lighting plant.

LA GRANGE, TEX.—Baylor & Bradshaw have purchased the city's electric light plant.

READSBORO, VT.—Steps are being taken to establish an electric light and power plant.

NEW YORK CITY.—An electric lighting system is to be installed in the custom house.

SARATOGA, N. Y.—The Saratoga Gas & Electric Light Company's plant is to be sold May 28.

BIRMINGHAM, ALA.—An electric plant will be built to supply power to manufacturing concerns.

TAYLOR, TEX.—The Taylor electric light plant has been purchased at a foreclosure sale by B Garry for [illegible]

WESTERLY R. I.—The establishment of an electric plant here is contemplated. Address the clerk of the Council.

GOFFSTOWN, N. Y.—A bill has been introduced authorizing the village to build and maintain an electric lighting plant.

NORWICH CONN—The establishment of a municipal electric light plant is contemplated. Address the clerk of the Council

CANANDAIGUA N. Y—The Canandaigua Electric Light Company has been granted the right to operate in Wayne and Ontario counties

POELOUSAS, LA.—It is reported that bonds are to be issued for the erection of an electric lighting plant. The Mayor can furnish details.

IPSWICH, MASS.—The street lighting system is to be extended in the near future. The town clerk can be addressed for further information.

CLYDE, N. Y.—Franchises have been applied for by the Clyde Electric Light Company to build, operate and maintain an electric light plant.

ELDORADO SPRINGS, MO.—W. B. Lewis and others have been granted a franchise to erect an electric light plant to be operated within two years.

READSBORO, VT.—The Hoosac Electrical Power Company is being organized, with a capital stock of $100,000, for the purpose of developing water power.

ENTERPRISE, MISS.—A franchise has been granted L. B. Bradley, of this place, and S H. Gelbanan, of Springfield, Ill., for an electric lighting plant.

MARIETTA, GA.—The entire plant and franchise of the Marietta Electric Light Company is to be sold May 7 to satisfy a mortgage indebtedness of $3,000.

SOUTH FRAMINGHAM, MASS.—It is reported that Messrs. Gregory, Shaw & Co are contemplating the erection of an electric lighting plant in their factory.

HASBROUCK HEIGHTS, N. J.—An appropriation has been requested for the lighting of the streets. The clerk of the borough Council can furnish particulars.

BELLEFONTAINE, O.—$15,000 in bonds are to be issued for the purpose of lighting the city with electricity. Address the clerk of the Council for further particulars.

HAMILTON, ILL.—It is reported that a municipal electric lighting plant is to be established here in the near future. J. A. Borden, city clerk, can be addressed for details.

WANNESBORO, VA.—It is reported that an electric lighting plant is to be established here in the near future. P. H. Antrim and W. N. Fishburn are among those interested.

AUBURN, N. Y.—It is reported that an electric lighting plant is to be established here in the near future. The clerk of the Council or Mayor Lewis can be addressed for detailed information.

ATHENS, GA.—The Tallahassee Shoals Electric Company will be chartered, with a capital stock of $50,000, for the purpose of developing the water power of the Tallahassee shoals and transmitting the same electrically.

WEBB CITY, MO—A complete municipal electric light plant is to be established in this city in the near future. The most modern electrical machinery will be introduced, and the clerk of the Council can be addressed.

BUFFALO, N. Y.—The new office building to be erected on Franklin, near Chippewa street, is to be lighted by electricity. The structure will be fireproof, and all modern improvements will be introduced. Address J. L. Kuller.

PHILADELHPIA, PA.—The installation of an electric light plant in the city hall court yard is contemplated for the purpose of lighting the streets and publi buildings with electricity. Address the clerk of the Council for details.

GEO. F. WOOLSTON, 40 Wall street, N. Y., will receive offers for the supply of a 450 arc lighting plant for Hudson County, N. J., and for a 150-arc and 2,000 incandescent lighting plant for Kearney Township, Hudson County, N. J.

MANHATTAN BEACH, L. I., N. Y.—An electric lighting system is to be installed in the music amphitheatre owned by the Manhattan Beach Hotel & Land Company, 11 John street, New York City, at this place. The secretary of the company can be addressed for particulars

WILLIMANTIC, CONN.—Work will be commenced as soon as the plans have been prepared on the erection of the proposed city hall, which is to cost $60,000. W. R. Briggs, 238 Main street, Bridgeport prepared the plans, which call for all modern improvements, including electric lighting.

THE ELECTRIC RAILWAY.

BURLINGTON, VT.—An electric road is being built from Winooski to Essex Junction.

ROSSVILLE, TENN.—An electric railway line is to be built from Rossville to Chickamauga Park.

DENISON.—Steps are being taken to establish an electric railway. P. H. Tobin and A. F. Platter are interested.

KANSAS CITY, MO.—The steam road from this city to Independence is to be equipped with the electric trolley system.

NEW HAVEN, CONN.—A line is to be built from this place to Hamden Plains Church. Address the clerk of the Council for details.

MORRISTOWN, N. J.—Permission has been granted the Morristown Electric Company to erect poles and string wires on Hill street.

COLUMBIA, PA.—Work will be commenced in the near future on the construction of the Columbia, Mt. Joy & Ironville Railway.

PASS CHRISTIAN, MISS—A 50-year franchise has been granted Maurice Kaufman, of New Orleans, for an electric lighting plant.

HAGERSTOWN, MD.—The construction of an electric street railway in this city is contemplated. Address Mayor Keedy for further information.

CHATTANOOGA, TENN.—The construction of a railway from this city to Augusta, Ga., is projected. C. W. Howard is among those interested.

ST. LOUIS, MO.—The King's Highway Railway Company has secured a [illegible] electric line along the thoroughfare of that name.

NEW YORK.—It is reported that the New York & Greenwood Lake Railway is to be operated by electricity. Abram S. Hewitt can be addressed for details.

WILLIAMSTOWN, MASS.—Right of way has been applied for by the Hoosick Valley Street Railway Company to extend its line from North Adams to this place.

BROWNSVILLE, N. Y.—A franchise has been granted by the village authorities for the proposed extension of the electric railway. Address the village clerk.

HOUSTON, TEX.—O. M. Carter may be addressed regarding the extension of the Houston Rapid Transit Company's trolley system to the race course in the suburbs.

EASTLAKE, LA.—It is reported that the new electric street car line will be extended to connect with the Bradley-Ramsay tram road several miles north of the city.

ATHENS, GA.—The Athens Street Railway Company has purchased the Mitchell's bridge property, and will convert its magnificent water power into electricity.

GREENBUSH, N. Y.—The Electric Railway Company has applied for a franchise to construct an electric railway. A. Barnes is at the head of the enterprise.

PITTSBURGH, PA.—The Oliver Iron & Steel Company will build an electric railway on Bingham street. For further particulars address the secretary of the company.

ALBANY, N. Y.—Plans have been prepared for the enlargement of the power house of the Albany Railway, to cost $50,0000. A 1,000-hp boiler and generator will be installed.

SANFORD, FLA.—J. M. Saunders and others have been granted a franchise to build and maintain an electric street railway; it also allows the privilege of lighting by electricity.

LOCKPORT, N. Y.—Charles A. Johnson, of New York City, has been granted a franchise to extend the Lock City Electric Railway. The secretary can be addressed for particulars.

POINT PLEASANT, N. J.—The South Jersey Street Railway Company intends building to Bay Head from Point Pleasant, and will have its extension ready for operation by June 1.

MT. MORRIS, N.Y.—Surveys have been made by the B.R. & P. Railway for the extension of the Silver Lake Railway to this place. The secretary of the road can be addressed for detailed information.

POTTSVILLE, PA.—The Town Council has granted the Schuylkill Electric Railway Company an extension of time in which to complete its road. R. H. Verner, town clerk, can be addressed for detailed information.

AUBURN, N. Y.—The Auburn City Railway Company has applied for permission to construct, operate and maintain an electric street railway on certain streets of this city. Orlando Lewis is interested, and can be addressed.

FORT WORTH, TEX.—It is reported the Dallas & Oak Cliff Electric Railway Company, will extend its road from Dallas to this place as soon as right of way can be secured. Henry C. Scott is president and A. P. West, secretary.

DEVON, PA.—The Devon & Berwyn Railway Company has been incorporated with a capital stock of $8,000. The purpose of the company is to build an electric railway between the points named. Address the secretary of the company.

CHICAGO, ILL.—The Chicago & Worth Electric Railway Company, capital stock $2,000,000 is soliciting a franchise covering 28 miles of streets on the west side. It is said that the enterprise is being backed by Mrs. Hetty Green.

DANVILLE, PA.—The construction of an electric railway at this place is contemplated by the North Susquehanna Transit Company. A franchise has been applied for, and the secretary of the company can be addressed for detailed information.

MUNCY, PA.—A company has been organized for the purpose of building a trolley line, nine miles in length, between this place, Hughesville and Picture Rocks. Senator John J. Coyle and Congressman Charles M. Drummare are among the incorporators.

HARTFORD, CONN.—Judge Hall has decided that "public convenience and necessity require the construction of the proposed extension" of the trolley line between this city and Berlin, and the street railway company is, therefore, free to proceed with the work.

TERRE HAUTE, IND.—It is reported that the Crawford Coal Company of this place will prepare plans for the construction of a railway, 60 miles in length, in Fentress County, Tenn., to connect with the Cincinnati Southern system. The estimated cost is $1,000,000.

LAKE CHARLES, LA.—The Lake Charles Railway Company has been organized with a capital stock of $100,000, for the purpose of building a road at this place. The work of construction will be commenced within six months. G. A. Jahn, of New York, is president, R. H. Mason, of Lake Charles, vice-president, and H. B. Milligan, secretary.

JACKSONVILLE, FLA.—A bill has been introduced providing for the incorporation of the Jacksonville & Tampa Bay Railway Company, capital stock $2,000,000. It is proposed to build an electric railway between the points named via Sanford and Kissimmee City. C. C. Thompson, M. Dodge and T. J. Appleyard are among the incorporators.

MISCELLANEOUS NOTES.

MR. EDWARD R. GRIER, of the firm of Grier Bros., Western representative of the Bryant Electric Company, was married to Miss Lucy Parthenia Bosworths [illegible], Mass., on April 16, 1895. After a short trip Mr. and Mrs. Grier will return to Chicago.

PHILADELPHIA ELECTRICAL CLUB.—An electrical club is being formed in Philadelphia, Mr. Frank H. Stewart and Mr. Geo. Vallee being leaders in the movement. It will be composed of representative members of the supply business electrical engineers, and others identified with central stations and isolated plants. In addition to the purely social purpose of the club, it is proposed to have lectures and formal discussions of current electrical topics of importance.

THE BROOKLYN ELECTRICAL SOCIETY will give its first anniversary dinner and "Trolley-Ho" party on Thursday evening, April 25, at the Albemarle Hotel, Coney Island. The large "Trolley-Ho" car of the Coney Island & Brooklyn Railway has been chartered for the occasion, and will leave the power house at Smith and Ninth streets, Brooklyn, at 7.45 p. m. The society has recently opened a reading room at 370 Pearl street, and is in a very satisfactory condition.

THE TELEGRAPHIC HISTORICAL SOCIETY OF NORTH AMERICA will hold its first regular annual meeting May 1, 1895, in the Board of Trade rooms, 1,410 G street, N. W., Washington, D. C. The first session will open at 10 a. m., when the routine business will be transacted. At a later session, in the afternoon or evening, formal papers will be read and discussed. An address will be delivered by President Cornell and papers on interesting subjects will be presented by members of the Society. An exhibit of telegraphic relics, rare books, portraits, etc., will be made.

ELECTRICAL ENGINEERING AT THE UNIVERSITY OF WISCONSIN.—The announcement of the course of electrical engineering for 1895-96 at the University of Wisconsin, with respect to its purely technical features, is as follows, the course being in charge of Prof. D. C. Jackson, Asst. Prof. S. B. Fortenbaugh, and Instructor J. G. D. Mack.

1. Electromagnets and Dynamos.—A discussion of the simple forms of electromagnets; the development of the laws of magnetization by electric currents; the laws of simple magnetic circuits and the windings of electromagnets; the practical design, construction and testing of dynamos. 2. Applied Electrochemistry.—(a) Primary and Secondary Batteries. Batteries as a source of electricity; construction and working of primary and secondary batteries, and their commercial use. Comparative and efficiency tests of various commercial types of batteries are made by the students in the laboratory. (b) Electrolysis and Electrometallurgy. The theory and application of electrolysis and electrometallurgy. The treatment of ores, electrolytic separation and refining of metals, electrotyping and electroplating are treated from the practical side. 3. Electrical Testing.—Treats of the construction, testing, maintenance, and operation of lines and appliances used in telephony, telegraphy and electric signalling. 4. Theory and Application of Alternating Currents.—The theory of the generation and utilization of alternating electric currents; the design and construction of alternating current dynamos, transformers and motors, and methods for testing alternating current machinery. 5. Electric Light and Transmission of Power.—A study of the manufacture and use of arc and incandescent lamps; selection and arrangement of electrical machinery for generating plants; location, erection and cost of distributing lines, and application of electric motors to the general purpose of power distribution. 6. Electricity in Engineering Operations.—(a) Electric Railways. The roadbed, rolling-stock, electric circuits and power plants for city, town and suburban railways; the location and construction of street railways in cities and towns; track foundation and types of rail; selection of cars and motors to be used under different conditions; methods of conveying the electric current from the generator to the motors, and the best methods for meeting the severe conditions imposed on electric railway power plants. (b) Electricity in Mining and Quarrying. A discussion of the practice in mining and quarrying where electricity can be satisfactorily applied and the advantages and limiting conditions of long-distance transmissions of power by electricity from water power to mines. (c) Station Management and Estimates. The effect on operating expenses of the arrangement of power and generating plants and circuits, and the use of meters. Estimating costs of power and generating plants, and the cost of lines and weights of copper. 7. Graduate Work.—Advanced work as assigned after consultation. Laboratory work.—All laboratory instruction is made to conform with, and illustrate, the class room instruction. Of the total number of hours given to instruction in the electrical engineering courses, about one-half is devoted to work in the laboratories. Students are advised to use their extra time in additional work in the shops and laboratories. An opportunity will be afforded students to take surveying as an elective study.

Trade and Industrial Notes.

I. S. SPENCER'S SONS, of Guilford, Conn., are sending out copies of their 1895 catalogue, which embraces bronze push-buttons of every practical size, shape and finish, bronze name plates, gas attachments, etc.

THE LUDLOW VALVE MANUFACTURING COMPANY Troy, N. Y., has published a new catalogue, which is unusually well gotten up. The typographical work and quality of paper are greatly superior to what is ordinarily found in trade catalogues.

THE ELSON & BREWSTER ENGINEERING COMPANY, electrical and mechanical engineers and contractors, have removed their offices from 143 Liberty street, Central Building, to Room 510, Thames Building, corner Greenwich and Thames streets, two blocks below Liberty street.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is again out after the lightning arrester business with the swinging ball lightning arrester, which has made such an excellent record during the past five years. Prices have been very much reduced, and a large business is looked for during the present season.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., is furnishing the iron roof trusses and purlins for the new electric light station at Marblehead, Mass., and has received an order from the Clyde Steamship Company for its new pier shed. The building is 344 feet long and 124 feet wide, entirely of iron.

THE ELECTROSE MANUFACTURING COMPANY, 216 William street, New York, is meeting with much success in the introduction of "Electrose," whose use for telephones and electrical fittings is rapidly extending. Mr. Louis Steinberger, president of the company, is the inventor of this new substitute for rubber.

THE HALL SIGNAL COMPANY, 80 Broadway, New York, has published an elaborate and beautifully executed catalogue describing the Hall automatic electric block system. Every detail of the system is fully explained and illustrated, down to the most minute particulars, and the whole make-up of the book is thoroughly tasteful and attractive.

THE INDEPENDENT ELECTRIC COMPANY, Chicago, reports a marked effect from its recent reduction in the price of its well-known brand of fuse wire and links. The convenient and attractive manner in which the wire is packed is an indication of the thought bestowed on every detail, and which has resulted in placing the brand at the head.

J. H. McFARLAN & COMPANY, Flint, Mich., are meeting with much success with their new telephone. A report in a local paper states that in a recent exhibition, conversation could readily be carried on with the person speaking 12 feet distant from the transmitter, while a prominent member of the city government vouches for the fact that he carried on a conversation standing 18 feet away from both receiver and transmitter.

THE B. F. STURTEVANT COMPANY, Boston, in catalogue No. 81, describes the Sturtevant automatic upright engine for electric lighting and other high grade work The numerous cuts thoroughly illustrate the engine, and in a manner that will enable the engineer to readily understand all of its technical features. Nine of the cuts show the engine direct-connected to various types of dynamos, from which its good points for this use can be readily appreciated.

A CORRECTION.—The item which appeared in last week's issue under New England Notes, to the effect that Bibber, White & Co., of Boston, were agents for the Columbia incandescent lamp and the Wagner Electric Manufacturing Company was an error. These companies have jointly opened offices and storerooms at 620 Atlantic avenue, Boston, and have appointed Mr. Chas. E. Bibber New England manager, who will devote his time looking after the interests of these two progressive enterprises.

THE FUEL ECONOMIZER COMPANY, of Matteawan, N. Y., reports business improving, and the works at present very busy. Orders have been obtained for economizers of 2,500 hp for the New Jersey Consolidated Traction Company; 750 hp for the St. Charles Street Railway Company, New Orleans; 2,000 hp for the Detroit Street Railway Company; 800 hp for the Holyoke Street Railway Company; 1,000-hp for Howland Crofts & Son, Camden, N. J., and 2,400 hp for the Crystal Plate Glass Company, St. Louis.

THE HAYDEN & DERBY MANUFACTURING COMPANY, 111 Liberty street, New York, in a 32-page pamphlet entitled "Practical Information about Injectors," give some plain facts in connection with various forms of injectors sold by it, which will be of interest to all steam users. The information gives the range of the Metropolitan injector under the various conditions found in practice, including extensive tables of capacities. Full directions for connecting, operating, etc., are given, with other information that will be appreciated by users

A. KLIPSTEIN & COMPANY, 122 Pearl street, New York, whose "Electric" brand of sal ammoniac has been so favorably known to the telephone and battery trades for two or three years, report a better demand than ever before. The importance of having pure materials specially adapted for their respective uses is becoming more and more generally realized in electrical industries and the efficiency and durability of batteries being very largely dependent upon the purity of the sal ammoniac used in them, the necessity of using a good grade is apparent.

THE MORTON MANUFACTURING COMPANY, Muskegon, Heights, Mich., in a 40-page catalogue describes its extensive line of portable and stationary key seating and key making machinery, portable planers and universal draw-cut shapers. The many illustrations of machines are accompanied by unusually complete technical descriptions, a valuable feature, unfortunately too often missing from trade catalogues. The award made to this firm at the Chicago Exposition is signed by Prof. W. C. Unwin, which puts the technical merit of the machines beyond question.

THE NEW JERSEY ASBESTOS COMPANY, 117 Front street, Camden, N. J., has issued a handsome large page catalogue with an illuminated front cover, devoted to its many manufactures of asbestos. Among these are included high pressure steam packings, boiler and flange gaskets, pipe coverings, asbestos cloth, tubing, roofing, etc. Among the novelties are "Salamander" asbestos decorations in relief for the interior decoration of buildings, "Gladiator" asbestos aprons and gloves, and "Asbestolio," a cleaning and polishing powder particularly recommended for use about machinery.

ELMER G. WILLYOUNG & COMPANY 1,210 Betz Building, Philadelphia, Pa., have made an arrangement with the Anchor Electric Company, of Boston, by which the latter becomes the New England agents for the sale of "Iron Clad" ammeters and voltmeters. Large numbers of these instruments are being sold all over the country, and there has been some difficulty in supplying orders, so great has been the demand. For alternating currents in particular, the instrument is much in demand, as it is practically the only instrument there is at such a reasonable price.

THE HOPPES MANUFACTURING COMPANY, Springfield, O., has recently opened a branch office at 512 Security Building, St. Louis, Mo., in order to better handle the rapidly increasing business in that territory for its well-known live steam feed-water purifiers and exhaust steam feed-water heaters. Mr. A. W. Remnitz, long known to the steam users of St. Louis, will have charge of this office. The company reports as among some of its recent shipments of feed-water purifiers the following: Nordyke & Marmon Company, Indianapolis, Ind., one 300-hp. and one 150-hp; Indianapolis (Ind.) Abattoir Company, 300-hp; Butters & Peters Salt & Lumber Company, Ludington, Mich., 1,000-hp; for the new shape mill of the Johnson Company, at Lorain, O., 3,350 hp; Rosengarten & Sons, Philadelphia, Pa., 200-hp; New York Tartar Company, New York City, 1,000-hp; The Hudnut Company, Terre Haute, Ind., 250 hp; Detroit (Mich.) Citizens' Street Railway Company, 2,000-hp; Hamilton (Ohio) Electric Light Plant, 400-hp; Crystal Ice & Cold Storage Company, Anderson, Ind., 300-hp; Ætna Ind.) Powder Company, 100-hp.

Business Notice.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED March 26, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

537,464. PRINTING TELEGRAPH; O. L. Kleber, Pittsburgh, Pa. App. filed June 5, 1894. A printing telegraph machine, consisting of a type wheel, a toothed spacing wheel, a number of tooth selecting discs, and means for simultaneously rotating the wheels and discs in the same direction, in combination with an electromagnet, an armature bar, and pivoted finger for controlling the rotation of the spacing wheel, said finger being adapted to release the selecting discs by a downward pull of the armature bar, and resume its former position.

537,474. App. filed Jan. 7, 1893; 537,475, app. filed Aug. 2, 1894. SECONDARY BATTERY. William M. McDougall, East Orange, N. J. A storage battery with a perforated box containing an electrode and provided with vertical spacing ribs on the exterior on one wall.

537,480. COMMUTATOR; G. E. Painter, Baltimore, Md. App. filed Feb. 28, 1895. A commutator with a series of base bars suitably mounted and insulated from each other, and a series of contact shoes or bars, seated upon the said base bars being insulated from each other and a clamping device common to all of the contact bars or shoes for confining them in their proper place and maintaining them in electric connection with the base bars.

537,498. INCANDESCENT ELECTRIC LAMP; E. Thompson, Swampscott, Mass. App. filed May 23, 1892. An incandescent lamp having a screw-thread formed on the material of the exhausted chamber of the lamp and insulated terminals combined with a socket having enclosed insulated terminals adapted to make spring contact with the other terminals, with an outside covering insulated from all of the terminals, and 537,500, filed same date, and 537,501, filed same date.

537,499. ELECTRIC MEASURING INSTRUMENT; E. Thompson, Swampscott Mass. App. filed Oct 26, 1894. An electric measuring device having a pair of magnets whose poles are of unlike signs opposed to one another, also a compound coil composed of other similar coils which are hollow, laid side by side or in the same plane rotating in the field of the magnets against an opposing force.

537,513. COMBINED CUT-OUT AND LIGHTNING ARRESTER; M. J. Wightman, Scranton Pa. App. filed Jan. 9, 1895. A lightning arrester having a line circuit, cut-out terminals, lightning arrester terminals and an electromagnet in the line circuit having a pole of the same sign under each of the sets of terminals, and the two poles provided with a common armature.

537,515. ELECTRIC SWITCH; J. J. Wood, Fort Wayne, Ind. App. filed Nov. 12, 1894. An electric switch having a rotating bridge, a rotative axial spindle, an operating handle, a spring interposed between the bridge and spindle, a stationary ratchet, and a two armed pawl connected to the bridge, with its arms projecting to opposite sides of the spindle with an operating arm projecting from the spindle between said arms of the pawl and adapted to bear against either.

537,533. ELECTRIC SWITCH; E. M. Hewlett, Schenectady, N. Y. App. filed Dec. 22, 1894. A reversing switch with a set of contacts, switch blades normally held in contact therewith by means of a spring, and a second set of contacts adapted to engage the switch blades when the feeder switch is thrown.

587,538. ELECTRIC SWITCH; A. Metzger, Schenectady, N. Y. App. filed Oct. 6, 1892. A switch for electrical currents consisting of a terminal clip formed of a single piece of metal having an extension folded upon itself and provided with screw-threaded holes and projecting beyond the insulated base, one of the circuit terminals having pivoted thereto a switch blade and the other formed with a vertical projection integral therewith and serving as a stop for the switch blade when in contact with the circuit terminal.

537,539. ELECTRIC SWITCH; A. Metzger, Schenectady, N. Y. App. filed April 15, 1893. The description of this is the same as the preceding one.

537,541. REGULATOR FOR DYNAMO ELECTRIC MACHINES; W. S. Moody, Boston, Mass. App. filed Aug. 30, 1893. The combination with a switch, a system of exciter dynamo machines, a lever adapted to operate the switch, a coil in shunt to the main circuit adapted to repel the lever and move it in the desired direction when the line potential becomes too great, an adjustable restoring device for the lever, a coil in series with the main circuit and a core for the series coil whereby the effect of said coil on the lever may be varied.

537,555. FILAMENT AND CARBON FOR ELECTRIC LAMPS; P. Stiens, London, England. App., filed Feb. 14, 1895. A process of treating filaments or carbons in the course of manufacture, which consists in boiling them in burned boric acid, and then heating them by the electric current in the presence of carbonaceous vapor or gas.

[illegible] GLASS VESSEL FOR SECONDARY BATTERIES, etc. H. Kroeker, Berlin, Germany. App. filed April 22, 1893. A vessel having two internal walls provided with parallel grooves extending to the bottom of the vessel and formed with projections or shoulders on their tops.

[illegible] ELECTRICAL INTERRUPTER; G. J. Anderson. App. filed Feb. 18, [illegible] An interrupter mounted on a shaft run by power, the combination of a number of insulated segments with a brush through which the current is introduced, metal rings in such a number as allows division of the segments, metal screws connecting electrically the metal rings with the segments, and a number of brushes, each of which presses against one metal ring.

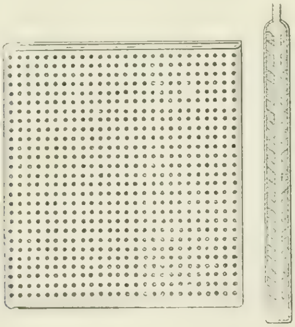
537,603. AUTOMATIC TELEPHONE EXCHANGE SYSTEM; W. Decker, Owego, N. Y. App. filed May 14, 1894. The combination consisting of parallel conducting rods and radial arms, ratchet wheels carrying each one of the radial arms which are long enough to come in contact with the conducting rods, the ratchet wheels being independently rotary upon an insulated rod, and electromechanical devices for operating the respective ratchet wheels, for the purpose of bringing two or more of the radial arms in connection with one rod.

537,617. ELECTRIC ARC LAMP; C. A. Pflunger, Chicago, Ill. App. filed July 2, 1894. The combination of a carbon holder with a carbon free to move therein, a lever pivoted to a standard and adapted to engage pins projecting from the carbon holder, a shunt magnet, and a series magnet each having its core attached to one end of lever and a lower carbon attached to a movable frame and provided with detaining points.

537,626. ELECTRIC RAILWAY CONDUIT SYSTEM; H. A. Belden, Washington, D. C. App. filed Jan. 26, 1895. The combination of a conductor support comprising a screw-threaded support, a bracket formed with a seat in its end face to hold the conductor, and having both vertical and lateral adjustments on the screw-threaded support, adjusting nuts above and below the bracket to adjust it vertically, and a conductor having a flange bolted to the projecting portion of the bracket.

537,630. ELECTRIC RAILWAY CONDUIT SYSTEM; A. N. Connett, Washington, D. C. App. filed Jan. 26, 1895. The combination of a slotted rail frame adjacent to it formed with a chamber, a conductor holding device, comprising an outer shell detachably seated in the chamber, and having its lower edge formed with an upward incline, a holder of non-conducting material in the casing and a stem insulator, adapted to sustain a conductor in the conduit.

537,638. ELECTRIC ARC LAMP; E. H. Crosby, Boston, Mass. App. filed Aug. 13, 1894. An arc lamp having two diagonally arranged fixed supports of conducting material with carbons fitted to slide and move laterally in the supports, the free ends of the carbons outside of the supports being normally spring-pushed into engagement with each other; an electromagnet in the circuit of which said supports are interposed, a non-conductive material actuated by the armature of the magnet into engagement with the free ends of the carbons and arranged to consecutively spread the same in opposition to their springs; lock the carbons against gravity movement and feed the carbons toward each other at determined points in the variation of current.



No. 537,475.—Secondary Battery.

537,644. TELEGRAPHY; R. H. Morris, Roselle, N. J. App. filed Aug. 10, 1894. The combination of a neutral relay and a current reversing key at the same station, the neutral relay being provided with oppositely wound coils which are joined, one to the positive and the other with a negative generator.

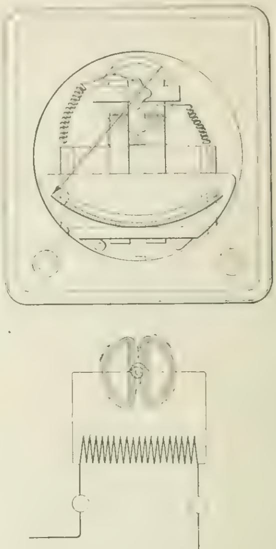
537,665. ELECTRIC SWITCH; H. P. Ball, Bridgeport, Conn. App. filed Oct. 19, 1894. An electric switch having terminals to be connected or disconnected, hinged blades connected by a spring, a pivot bearing in each blade in the form of a circle or sector, a sector of a groove in each blade concentric with the pivotal point, a conducting ring located in the sectors of the circular groove, and means for retaining the ring in position and the adjacent edges of the blades in contact.

537,672. ELECTRIC RAILWAY; J. Claret & O. Wuilleumier, Lyons, France. App. filed Sept. 19, 1894. An electric railway system having sectional conductors with the intermediate insulating parts of insulating blocks arranged transversely upon a beam, such blocks being connected by suitable insulating molten substance which is poured while hot into the joints and forming when cool a compact and rigid body connected with the contacts for the purpose of forming the central rail of the line.

537,673. ELECTRICALLY ACTUATED VEHICLE; J. B. Clark, St Paul, Minn. App. filed March 3, 1894. A vehicle with the framework mounted to run upon tracks, an axle journaled to it having pulleys upon its ends, rim surrounding the pulleys and running upon tracks, reversely inclined friction rollers supported in a framework and interposed between the rim and the pulleys and means for adjusting the friction rollers, and an electric motor so connected as to be adapted to actuate one of the friction rollers.

537,693. PROCESS OF EVACUATING INCANDESCENT LAMPS; A. Malignani, Udine, Italy. App. filed Aug. 15, 1894. The process for producing a vacuum in the bulbs of incandescent lamps is in first introducing into the tubular elongation of the bulb after the air has been exhausted, various chemicals which form a cement when heated and so seal the bulb.

537,696. ELECTRIC ARC LAMP; L. C. H. Mensing, London, England. App. filed Oct. 29, 1894. The combination in an arc lamp of an upper carbon carrier, a swing frame having pivotally supported therein a double or divided wheel composed of a grooved cord pulley and a brake wheel connected by pawl and ratchet mechanism, differential solenoid cells having their cores supported from arms of the swing frame and connected to a band on the brake wheel, and a cord connecting a pulley with a fixed carbon carrier, and a coiled band enclosed in the pulley and having one end attached thereto, and the other end secured to a fixed arbor.



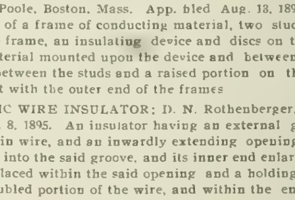
No. 537,500.—Electric Measuring Instrument.

537,706. SECTIONAL CONDUCTOR FOR ELECTRIC RAILWAYS; J. F. McLaughlin, Philadelphia, Pa. App. filed Feb. 5, 1895. The combination with a main or supply conductor and a sectional working conductor, of rotary switches for coupling the same, pivoted armatures for actuating the switches, and traveling magnets passing over the armatures in inductive relation thereto.

537,715. SAFETY SUPPORT FOR OVERHEAD ELECTRICAL CONDUCTORS; A. D Poole, Boston, Mass. App. filed Aug. 13, 1894. A safety support consisting of a frame of conducting material, two studs mounted upon the ends of the frame, an insulating device and discs on the studs, arms of conducting material mounted upon the device and between the discs, insulating blocks between the studs and a raised portion on the arms arranged to form contact with the outer end of the frames.

537,718. ELECTRIC WIRE INSULATOR; D. N. Rothenberger, Lancaster, Pa. App. filed Jan. 8, 1895. An insulator having an external groove adapted to receive the main wire, and an inwardly extending opening having its outer end extending into the said groove, and its inner end enlarged, so a doubled wire may be placed within the said opening and a holding material placed around the doubled portion of the wire, and within the enlarged portion of the opening.

537,757. RAILWAY BLOCK SIGNAL LOCK AND REGISTER; J. Dean, New York, N. Y. App. filed Oct. 26, 1894. A railway block signal lock, comprising a lock bar for the signal lever and provided with teeth, a shaft mounted to turn and under the control of the operator, a toothed wheel on the shaft adapted to engage the teeth of the lock bar, and a disc held on the shaft turning with the same, the disc being provided with targets for indicating the position of the mechanism during each revolution of the shaft.



No. 537,665.—Electric Switch.

537,769. ELECTRIC METER; H. T. Harrison, London, England. App. filed June 14, 1892. An electric meter comprising a pendulum having a constant rate of vibration, a series coil adapted to increase the amplitude of vibration of the pendulum, and a registering device to record the said increase of amplitude.

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ROPE DRIVING.

In this issue we commence the publication of the concluding sections of Prof. Flather's valuable serial on rope driving. Owing to the long interval between the present and preceding sections, a synopis of these latter is given in order that the reader may intelligently follow the remaining portion. The subject of rope driving is one to which much attention has been given in Europe, but this is the first time it has been adequately treated by an American writer. In many cases the use of ropes over belts has an advantage, and the thorough manner in which Prof. Flather brings out all of the points connected with the subject will enable the engineer to easily determine if in a specific case it will be best to adopt that method of driving.

ELECTRIC RAILWAYS AND STEAM TRACTION.

The opening of the Chicago Metropolitan Elevated Railway was an event of unusual importance from an electrical standpoint, as electricity is here given the first opportunity on an extensive scale in this country to demonstrate its superiority over steam traction. The result of the first year's operation will be looked forward to with the greatest of interest, as a favorable outcome will undoubtedly cause steam power to be displaced by electricity on the New York elevated roads. The trial may indeed be considered one between electric and steam traction in general, for here direct comparison as to these two rivals may be made for the first time on a sufficiently extensive scale. Railroads are notoriously conservative, but if it can be shown, as we believe will be in this case, that the electric motor offers economic advantages over the steam locomotive, the comparison will be so obvious as to have the necessary force to disarm prejudice in favor of the latter. Whether it will ever pay to run trunk lines of railroads by electricity is a question as yet far in the future, but there can be no doubt at the present time as to the financial practicability of electric traction for moderate distances, or to its applicability on many lines now using steam. The recent decision of the New York Central Road to run trolley cars on its steam line between Buffalo and Niagara shows that this fact is beginning to be recognized. With the data that will be derived from the comparison between cost of operation on the Chicago and New York elevated lines, and the result of even more direct experience on the Buffalo-Niagara line, the advocate of electric traction will soon be in possession of facts that will be more efficacious than volumes of à priori considerations, and which will, we believe, have a great influence on the extension of the use of electricity for traction purposes.

A CONTROVERSY ON SUBWAY EXPLOSIONS.

Two of our English contemporaries have been having a battle royal as to the cause of explosions in conduits, and though the position of one has been sustained in part by the report of a committee appointed by the Royal Society and the Institution of Electrical Engineers, the other returns to the fray. It appears that one of the journals ascribed the explosions to the ignition of an explosive mixture of air and illuminating gas from the action of water on metallic sodium, and ascribed the existence of the sodium to electrolytic decomposition of the glazing of porcelain insulators. The report of the committee is in favor of this theory, except that it considers the ignition agent to be metallic sodium or potassium formed by the electrolytic action of leakage currents on saline deposits from the soil on the insulator supports or in the neighborhood of these supports. The recommendations of the committee are that the insulating surface between the conductor and insulator bearer should be larger, and that the bearers should not be made of wood. We are accustomed on this side of the water to consider our European brethren as holding all authority in awe, but the followin remarks on the report above referred to show that one of them has been emancipated, at least with regard to scientific authority :

''Disappointment is but a mild expression wherewith to connote the state of our feelings in particular, and doubtless of the electrical industry in general, upon reading the report of the committee that was constituted to confer with the electrical adviser to the Board of Trade with regard to the explosions in St. Pancras. The formidable array of signatories to this report suggests the propriety of making any criticism which we might be disposed to offer with, as it were, bated breath. The spirit of that old statute of Richard II. concerning what was wont to be called *scandalum magnatum* still survives, and one must needs refrain from disburdening the soul too freely. We will mince matters, then, and simply observe that we are grievously disappointed. * * * What do we find? A single sheet of printed matter, and that a very small one, one side being occupied by the 'report,' and the other by the 'evidence.' The terms are doubtless used euphemistically: we will use them out of courtesy, though it is in our minds to designate this production as a mere *tabula rasa*. What wisdom lies in the ancient classics! How truly the effusions of the worthy Horace may be applied to a thing of to-day! *Parturiunt montes, nascetur ridiculus mus.*''

ELECTRICAL DIMENSIONS AND NAMES.

In another column will be found an interesting article by Prof. Fessenden in which a number of imperfections in our present system of dimensions and names for electrical units are pointed out. That force, for example, should have different dimensions in the mechanical, electrostatic and electromagnetic systems of units, and that electromotive force is not a force at all in the proper sense of the word, are disparities in glaring contradiction to the much boasted scientific character of electrical units and terminology. While the points referred to have little or no direct effect aside from questions of theory or higher science, yet their indirect effect is of importance through the difficulty the inconsistencies offer to students in the understanding of principles, and their tendency to cause him to consider the entire system dealing with units as artificial and lacking a logical physical basis. Prof. Fessenden also refers to the usefulness of the terminations—*age*,—*ance*, and—*ivity*, though the general adoption of the former seems to be much less desirable than that of the latter. Resistivity for specific resistance is already passing largely into use, and the same is true of the term reluctivity, while permeability was established from the beginning. The remarks in regard to inductance are in line with the arguments offered for the application of that word to $L\omega$ instead of to L, but as its use in the latter sense has already become extensive, it would now be difficult to displace it by the proposed term, inductivity. There is yet time, however, to clear up the inconsistencies which exist in regard to dimensions and nomenclature if the matter were placed with an authoritative body like the Committee of the British Association which devised our present system of electrical units, as its recommendations would carry the great weight necessary. As the English are most jealous in regard to measures not originating with themselves, it would for that reason be desirable for the body to be of that nationality, and if it numbered among its members, as it probably would, such scientists as Kelvin, Rayleigh, J. J. Thomson and several others that could be mentioned, their verdict would probably be received in a liberal spirit in other countries, while the work would in the end be carried to a more logical conclusion than if performed by an international body hampered by national jealousies. As it is, however, the number of inconsistencies are relatively small in nomenclature, notwithstanding the independent nature of the growth of the large list, and the several additions recently suggested, like *admittance* and *susceptance*, are logical in their formation. It may here be remarked that the large additions to electrical nomenclature recently adopted, or suggested for adoption, are not evidence of a craze in word-coining, but are the natural result of a need following from the rapid development of alternating currents. Alternating current phenomena introduce a host of new ideas, to the more important of which it is but natural to assign specific names. In most cases the criticism directed at this increase is born of ignorance, those indulging in it not appreciating the desirability of the additions made, through a lack of knowledge of the necessities arising from the modern developments of electrical science. It is true that the class of savants look askance at the tendency toward the extension of electrical nomenclature, but this is because their habits of abstract thought do not require the assistance of concrete names in order to render ideas more definite.

The Invention of the Carbon Telephone.

In a recent address Prof. Hughes renews his claims for the invention of the carbon telephone. Having experimented with the Reis telephone in 1865, the report of Bell's invention in 1876 caused him to again turn his attention to the subject, and he finally discovered the principle of the microphonic contact. All of the results of the lengthy investigation were given, he says, in a paper read before the Royal Society in May, 1878. Mr. Edison was, during the same months, engaged upon a similar research, that is, endeavoring to adapt Prof. Reis's method of transmission by a diaphragm and separate battery, and as a result, patented his carbon telephone. Prof. Hughes contends that the true principle involved in the Edison telephone is that of his microphonic contact, and that its action does not depend upon a varying resistance obtained by variable pressure of the diaphragm, as claimed by Edison. Besides, the principle of varying the resistance of carbon by pressure was not Edison's discovery, as it was well known for many years previous through Du Moncel's publication and its application by Clerac in his carbon resistance tube.

Prof. Hughes concludes as follows: ''Unfortunately, Mr. Edison and myself had a painful discussion as to priority of invention, in which we have both sustained our individual views up to the present time. Mr. Edison's views have been sustained by all the companies owning his patent; mine have been sustained by nearly the whole scientific world. The companies, however, whose interest it was to sustain and possess for themselves an entire monopoly, have spared neither wealth nor power to obtain this coveted monopoly, and by the means of the ablest legal counsel and expert witnesses they obtained a legal decision giving them the sole right to the use of a diaphragm pressing upon a variable resistance, notwithstanding that the diaphragm was the discovery of Prof. Reis and microphonic contact by myself.''

An Ineffective Patent Decision.

The United States Circuit Court at Chicago recently entered decrees in several suits of the Western Electric Company against J. H. Bunnell & Company for infringement of certain patents on magneto call-bells. Among these were patents on switches automatically cutting in and out the magneto bell, on the longitudinal movement of the magneto shaft for switching, on the use of springs on the hinges of the magneto case lid for securing better contact, on the use of a polarized magneto armature, and on several mechanical details. The suits were not defended, and as in addition the decrees were entered by consent, the adjudication has effect only as concerns the specific defendant, and does not alter the situation previously existing with respect to others.

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In a paper read at the recent annual meeting of the Ohio Gas Light Association, the author remarked that ''if we are to believe the electric light man (*sic*)'' there is an advantage in a light in which ''a smaller amount of heat and obnoxious products of combustion are thrown off.'' This ludicrous attempt to say something stinging against a successful rival would not have attracted much attention, coming as it does from a gas man, but a few lines farther on he says,—and he must have underscored it in his manuscript, as it is in italics in the printed report—''being a gas man I am necessarily honest''; but we will do him the justice to suppose that he meant to be sarcastic in this.

Another Discovery.

The Buffalo *Express* reports that Nikola Tesla had lately made further improvements in his method of transmitting electricity by fluid, and has declared that he is now more certain than ever that the current can be sent from Niagara Falls to New Orleans and Chicago, and delivered there at less than it would cost to generate power on the spot by steam. The fluid he uses in the tubes, it is stated, costs scarcely more than water, and loses so little electricity in transit that the cost of transmission is little more than the cost of putting up the poles and tubes.

Professor Jules Francois Joubert.

BY ANDRE BLONDEL.

The electrical era dates, properly speaking, only from the Paris Electrical Exposition of 1881, and the most of those who had made discoveries in electricity at that epoch, and were the pioneers in its development, became electricians by chance, having previously applied their energies to entirely different occupations.

Professor Joubert, whose name should be universally known to the present generation of electricians, was himself an outsider, and, like the great Helmholtz, it was to the natural sciences and particularly to biology, to which he had devoted the first part of his career, that he owed the training which led to the discovery in electricity destined to make him most celebrated.

Born at Tours, France, in 1834, Professor Joubert began his studies at that place, and in 1857, entered the Ecole Normale Superieure at Paris. This school, the number of whose students is very small, those admitted to the scientific sections not exceeding 20 annually, is the nursery from which the State obtains its most brilliant professors for the lycées and universities; at that epoch it was, in fact, the only door open through which to enter the career of professor.

The essentially theoretical scientific education there given covers a period of three years and embraces nearly the entire extent of the sciences—from mathematics and physics to chemistry, physiology and biology—all taught by the most eminent professors. Professor Joubert was thus given the advantage of a magnificent scientific training, which enabled him afterward to make such remarkable studies in the most varied branches of sciences.

After having taught elementary physics in several of the provincial lycées* he returned to Paris to occupy the chair of physics in the College Rollin in 1874, and was thenceforth in a position to undertake special studies and investigations. The first was his thesis for the degree of Docteur es Sciences Physiques, on the "Phosporescence of Phosphorus," which he brilliantly sustained in 1874 Soon afterward he became assistant to the world-famed Pasteur in a series of biological researches, the results of which were published in *Comptes-Rendus* from 1876 to 1878. Professor Joubert can, therefore, be considered one of the pioneers in the theories and methods relating to microbes which have had such a happy influence on the progress of the natural sciences, and of medicine and surgery. At the same epoch he published two studies in optics, on "The Rotative Power of Quartz and its Variation with the Temperature" and on "The Influence of Temperature on the Rotative Magnetic Power."

ELEC. WORLD. N.Y.

Professor Jules Francois Joubert.

It was not until 1879 that, by reason of an entirely accidental circumstance, he turned toward electricity. The Jablochkoff Company, which had just been formed, was then in all the enthusiasm of its promotion stage, and flattered itself that owing to its large capital, it could monopolize for the future all systems of electric lighting; it was at that epoch that it paid $100,000 to Professor Jamin for his patent on the electric-magnetic regulation of the arc, which threatened competition with the Jablochkoff candle, but was never utilized by its purchasers. Thinking it well to secure the aid of a savant in the capacity of expert counsel, it engaged the services of Professor Joubert, who was already known for his intellectual penetration and high scientific qualities. This idea had the most happy consequences, not so much for the Jablochkoff Company, however, whose extravagant expenditures rapidly led to ruin, as for electrical science.

At that period electrical engineers groped blindly, knowing nothing either of the measurement of the currents employed, or the resistance of conductors, or of the cost and illuminating power of an arc. In order to get an idea of what was then known about alternating current machinery in France, it is sufficient to refer to the writings of Leroux (1857), of Jamin and Roger (1869) and of Mascart (1877). In other countries the situation was not much different; Maxwell had approached the question in two or three notes, but without result, and had not touched upon it in his treatise. Electricians were astonished to find that Ohm's law apparently no longer applied, and many considered the resistance of a conductor as a quantity which varied with the velocity; others, more prudent, contented themselves by adding to the formulas a term proportional to the velocity or to its square. As to self-inductance, no one thought of it.

It is to Professor Joubert that the honor belongs of having found the law of simple alternating currents, represented by the two well-known formulas

$$I = \frac{E}{\sqrt{R^2 + \left(\frac{2\pi L}{T}\right)^2}} \sin 2\pi\left(\frac{t}{T} - \phi\right)$$

$$\text{and } \tan 2\pi\phi = \frac{2\pi}{T} \cdot \frac{L}{R}$$

which define the apparent resistance effect, called impedance to-day, and the lag in phase. It would only be just to give definitively to these formulas the name of Joubert's law.

The above formulas were not obtained as deductions from the differential equation, but they were discovered as a simple experimental law, the results being represented by an expression of the form

$$I = \frac{E}{(a^2 \times R^2)^{\frac{1}{2}}}.$$

Later, he analyzed the phenomena by tracing periodic curves and interpreting them with the aid of the calculus, to-day a classical investigation. It should here be remembered how happy a chance it was that the machine experimented with by Professor Joubert was a Siemens alternator giving an E. M. F. almost sinusoidal, for otherwise he would scarcely have dared to make the hypothesis which to-day forms the necessary basis of all our calculations relating to alternating currents. At the same time Professor Joubert investigated for a particular case the phenomena of which the alternating current arc is the seat.†

In these studies is explained the method to-day well known under the name of "the instantaneous contact method" of which the applications have been so numerous and so useful. It is well to point out that Professor Joubert had indicated three methods, depending upon the employment of the electrometer, of the ordinary galvanometer, and of the ballistic galvanometer and condenser, and it is therefore incorrect to credit to others the idea of the latter combination.

The results thus far give an idea of what Professor Joubert would have been able to do in this line if his experiments had not been interrupted by the bankruptcy of the Jablochkoff Company in 1881. Happily, however, at the same period the Paris Electrical Exposition opened up a new field to his activity, and he proposed to the jury to profit from the collection of machines of such varied types to determine the principal constants by the aid of his method of measurement. These suggestions resulting in nothing, he then proceeded to work independently with Messrs. Potier, Allard, Tresca and Leblanc, and tests by this group of savants were completed with success before the official committee had finished its preparations for work.[*]

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* A lycee, or French college, corresponds nearly to the German gymnasium. Classical and scientific studies are followed from the age of 8 years to 16 or 19, when the graduate is qualified to enter the examinations for admittance to the university or State schools.

† The results of these studies are given in a slightly different form in two papers, now become classic: "Etudes sur les courants alternatifs et sur la force electromotrice de l'arc voltaique." (*Journal de Physique*, tome IX., p. 297, 1880.) "Etudes sur les machines magneto-electrique, contenant la demonstration experimentale et theorique des lois auxquelles obeissent les machines a courants alternatifs." (*Annales* de l'Ecole Normale, tome X., 1887.)

It was in the following year that Mascart and Joubert's "Treatise on Electricity" appeared, a book especially remarkable when we consider the period in which it was written. It was the first systematic treatise which placed the entire science of electricity within easy reach, and a happy combination of the theories of the French and English schools. In its pages the student was presented for the first time with a clear and concise exposé of the principles of the methods and the calculation of measurements and of their principal applications. The success of this treatise was enormous. It was translated into German and English and became rapidly a classic abroad as well as in France. Although now twelve years old, it yet remains the standard for electricians, who by its means have profited by knowledge otherwise difficult of access, particularly that relating to the work of Maxwell.[†] The publication of this work in reality crowned the scientific career of Professor Joubert, to whom it definitively assured an eminent place among the electricians of the world.

Since that time honors in France have pressed upon him. As Secretary-General of the Société de Physique from 1880 to 1890, his indefatigable activity during that long period rapidly developed the prosperity of the society, and he was elected its president for the year 1894. His work in the interest of the Société Internationale des Electriciens has not been less useful. He was also one of the most zealous organizers of its annex, the Laboratoire Centrale, where the members of the Congress of 1889 were able to see him repeat the experiments of Hertz; in its development he occupied himself especially during the years 1891 and 1892, when he filled the office of president of the Société.

In 1888 Professor Joubert was appointed Inspector-General of the Academy of Paris, and in 1892, Inspector-General of Public Instruction in France, the administrative functions of which offices have absorbed his energies in later years. His last great work was the memoire "Sur l'Electro-Dynamique d'Ampere, Davy, Faraday, etc." (two volumes, 1887-8), published in the collection of memoirs of the French Physical Society. This work is a fine monument raised to the memory of these savants, for which all electricians should be grateful to the author.

The frank and sympathetic countenance of Professor Joubert is a reflection of his character. The latter has brought him only friends, and all those who have had occasion to meet him retain the kindest remembrance of his cordial and affable welcome, so full of geniality and of consideration for all. Professor Joubert is at the same time a type of those modest savants, "modest as the violet," as his successor to the presidency of the Société Internationale des Electriciens so gracefully remarked, who, far from seeking flattery or even lending ear to the praises of the world, work silently and find their reward in the success of their work. This is a fine attribute of Professor Joubert's character, and one which has served to give to the eminent professor an extreme popularity among French physicists and electricians. I hope that this short note will aid in extending this feeling among our American confrères.

Niagara Power at Buffalo.

According to a Buffalo correspondent the Niagara Falls Power Company is not to have an exclusive franchise for transmitting and distributing electric power to the city of Buffalo, the sub-committee of Council in charge having decided to offer no franchise for the exclusive use of any one company, believing in the axiom that "competition is the life of trade." The franchise, which is practically ready, is expected to meet with the approval of the members of both houses of the Common Council. The franchise is not a long one, but it is stated that there is liable to be considerable discussion before it is adopted and that trouble will probably come from no less a conspicuous source than the mayor's advisory committee. It was agreed at first, it is said, that the franchise, which will be in the nature of a report from the sub-committee, should be signed by the members of that committee, but it is now revealed that the mayor's committee is not entirely in sympathy with all the provisions contained in the document. A meeting of the sub-committee was held behind closed doors on April 23, and only members of the sub-committee were present beside Corporation Counsel Laughlin. A few immaterial changes were made in the franchise and it will be redrafted at once. It is understood that the franchise will be free from harassing restrictions. It will contain no clause compelling the companies to fix a maximum price at which to furnish electric power. One clause of the franchise which the company will be asked to sign, however, will provide that after the price has once been fixed, the company will not be permitted to increase it after consumers have gone to the trouble of removing their steam plants and equipping their works for the introduction of electricity.

The Buffalo *Express* printed on April 24 a complete analysis of the document, the substance of which is as follows:

The first part of the franchise is given over to defining that the Common Council shall approve of all of the plans and specifications of the Power Company for the distribution of its power about the city, and will have the right to regulate the size of poles and conduits to be used, and determine the quality and nature of insulation under all circumstances and conditions. The franchise will require that all poles be of sufficient size and that the conduits shall be large enough to carry the wires of two other companies, as well as the wires of the police and fire alarm telegraph of the city. It will provide that the Common Council can direct the Board of Public Works to put in proper condition any street which may be entered by the Power Company and which the company fails to repair within a reasonable time, and the expense for replacing the same shall be at the expense of the Power Company. Another provision is that if in the street in which there is a conduit, the city deems best to construct a sewer, the Power Company shall rebuild its conduit and place it in such a position in the street that it shall not interfere with the construction of the sewer.

The franchise provides further that the Power Company shall be required to place conduits in certain streets in place of poles when the Common Council of the city shall deem such change proper and for the best interests of the citizens, and also that there shall be a uniform price charged by the company in all parts of the city so that a consumer in one part shall not be able to obtain power at a cheaper rate than a manufacturer in another section, thus placing all consumers upon an equal footing. In the franchise is also a provision that if the city demands, the Power Company shall furnish power for the water works at a rate not to exceed $20 per annual horse power and shall furnish street lights at an expense not to exceed $50 a year each, or that the Power Company may have the opportunity, in place of furnishing power and lights, of paying into the treasury of the city a certain per cent. of the gross receipts each year.

If within the radius of a mile of the lines of the Power Company, power to the amount of 2,000 hp is required by consumers, the franchise requires that the Power Company shall extend its lines within six months to the various consumers who petition for power. An important provision is that the Power Company cannot raise the price of power to a consumer after once agreeing to furnish it at a certain price. It is further provided that the Power Company shall have the current ready for delivery to customers in Buffalo by Jan. 1, 1896, in quantities of not less than 10,000 hp; also, that the company shall furnish at least 10,000 hp a year for the succeeding four years until it shall be supplying 50,000 hp, provided there is a demand for so great an amount of power.

At the end of 25 years the city, if it so desires, can buy the plant of the Power Company inside its limits. The amount to be paid by the city is to be determined by an appraisal made by three appraisers, one to be appointed by the mayor and one by the Power Company, and the third to be selected by the two interested parties. The term of the franchise is to be 25 years. No price is stipulated for general consumers. The penalty for violation of any of the provisions stipulated is a forfeiture of the franchise.

Successor to Helmholtz.

The Emperor of Germany has just appointed Dr. Friedrich Kohlrausch to the presidency of the Imperial Technical Institute, in which position he succeeds the late von Helmholtz.

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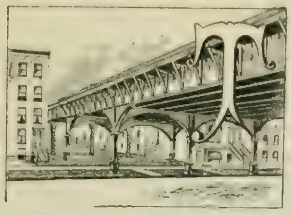
[*] The results have been published in the well known work entitled "Experiences faites a l'Exposition d'Electricite de 1881 par MM. Allard, Joubert Leblanc, Potier et Tresca," and have served as a model for subsequent expositions.

[†] The authors are preparing a second edition, which will include all the recent advances in the science. Recently Professor Joubert has written an elementary treatise on electricity, which is a model of its class in clearness and exact statement, and promises to become a classic like the great treatise of which it is an abridgement.

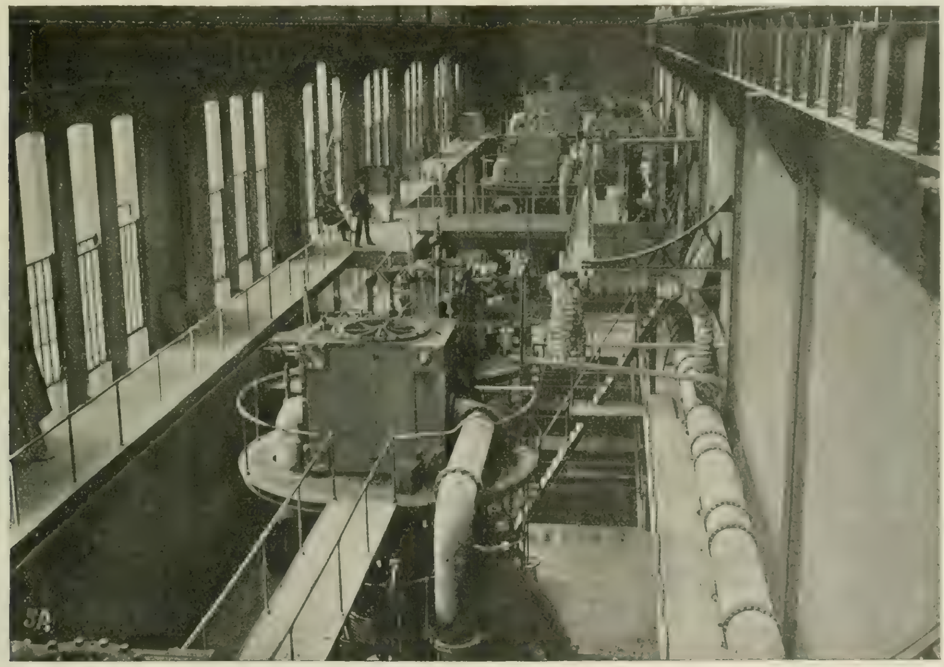
The Chicago Electric Elevated Railway.



THE opening of the Metropolitan West Side Electric Railway in Chicago, on April 21, may be called an important electrical event from the fact that it will be the first elevated railway in this country to use electricity exclusively over all of its lines. The entire road, in fact, is electrical. Its motive power is electric; its cars are heated and lighted by electricity; the air brakes that control the trains are operated by electricity, and the new rolling-lift bridge across the Chicago river is operated by the same power. A contrast of electric power on elevated structures with steam is particularly favorable to the former. The noise, smoke, dirt and inevitable dripping from a steam engine overhead are entirely obviated, and already there is some talk of utilizing the spaces under the structure for rental purposes.

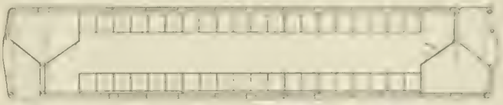
When the system now under way is completed it will comprise 18 miles of double track; the main line, covering a distance of 13½ miles, is erected; the Southwestern line running to Douglas Park, about 3¾ miles in length, is yet to be constructed. About two miles of the line is a four-track road and on this trains will be run on an express schedule at a speed about four times as great as that of the elevated railways in New York. At present trains are only running on the main line as far east as Canal street, about one-half mile from the business centre.

To Mr. A. F. Walcott, of New York, is due the credit for having projected this great enterprise and succeeded in interesting the necessary capital for carrying it through. The West Side Construction Company, with a capital of $3,000,000, was first organized in 1892, and about the same time $10,000,000 worth of 5 per cent. 50-year bonds were disposed of at very advantageous terms—90 per cent. of their face value—thus placing at the disposition of the company some $12,000,000 in cash.



VIEW OF POWER PLANT.

Profiting from the experience of the elevated railways of New York, it was concluded that it would be cheaper to buy a private right of way for the road than to run the risk of judgment to the extent of millions being subsequently entered for damages. As a consequence the only franchise asked from the city was the right to cross certain streets at an elevation, the line otherwise passing over private property purchased by the company. The land for the main line cost more than three and a half million dollars, and for the remainder of the system about three millions of dollars. Although the original plan did not contemplate the use of electricity the success of the Intramural road at the World's Fair led to its being employed as a motive power.



FLOOR PLAN OF MOTOR CAR.

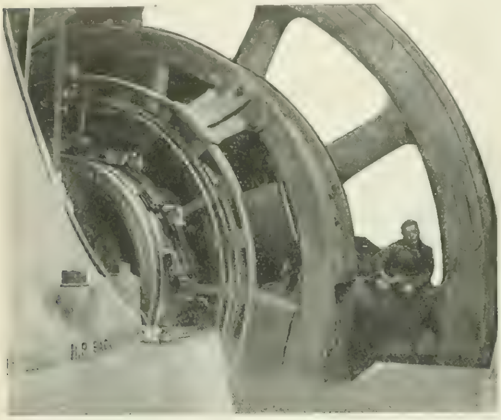
Forty-three stations will be located on the main line and the several branches as follows: Main line, 5; Garfield Park line, 3; Douglas Park line, 11; Logan Square line, 9; Humboldt Park line, 5. The stations are all built of rock faced pressed brick, with stone trimmings, and no expense has been spared to make them meet the convenience of the patrons of the road. They are regarded as the finest structures for the purpose that have ever been constructed.

The rolling stock of the line will at first consist of 55 motor cars and 100 trailers. A plan view of one of the motor cars, which were built by the Barney & Smith Car Company, of Dayton, O., is shown in one of the illustrations. These cars furnish accommodations for smokers. The two cabs provided for the motorman, located at diagonally opposite corners of the car, are built out on the platforms as far as the hood will permit. This construction makes it necessary to locate the entrance doors next to the corner posts, and as it was thought desirable to make them of the sliding type, they are pushed back into the cab, this, however, not interfering with the motorman. The weight of the car exclusive of the electrical equipment is about 20 tons. The car body is 40 feet in length over sills and 47 feet 2¾ inches over platforms. Its characteristic feature is a steel sub-frame, which it was thought necessary to add so that the car would be strong enough to pull six loaded 40-foot trailers. It was also thought advisable to add extra weight for traction purposes. The car frame is constructed of two nine inch I beams located immediately under the side sill of the body.

The exterior of the cars is finished in a dark brown shade, with handsome decorations in gold leaf. The interior is finished in well polished quarter sawed oak, with a liberal amount of carving. Each motor car is equipped with two General Electric motors known as the G. E.-2,000 type. They are similar in design and construction to the G. E.-800 type, but of larger capacity and of more substantial construction. The controller is similar to the General Electric type K controller, but modified for the heavier service for which it is to be applied.

The trucks are built on the lines of an engine truck, and equal to it in workmanship. They are, however, provided with better springs, which make the cars remarkably easy riding. The trailer cars, or passenger coaches, were built by the Pullman Company. Each car will seat 48 passengers. One hundred of these are now in service. They are unusually handsome in appearance, and each is lighted and heated with electricity in the same manner as the motor cars, the heaters in all cars to be supplied by the Central Electric Heating Company.

The road will resemble in many particulars the Intramural railway at the World's Fair. Instead, however, of using two rails, one for a feeding and the other for working conductor, there is a single rail for the conductor and heavy cables are used as feeders, the structure furnishing the return path. As in that road, the current will be conducted by a third rail and will be picked up by a sliding shoe, which is practically the same as that used on the cars on the Intramural road. A good contact is maintained by the spring attachment, and very little sparking occurs. Each motor car is equipped with a sliding shoe on either side. If, for example, the motor car is going north, the right trolley will be in circuit. Where a cross-over is to be passed the momentum of the car will carry it over, but when it strikes the south track the shoe on the left side will be thrown in circuit. Each motor car has its controller pump and trolley contacts in duplicate, that is, at each end, so there is no necessity of loops at the terminals. The track rails are carefully bonded by two copper strips, one on each side, riveted cold through holes in the web.



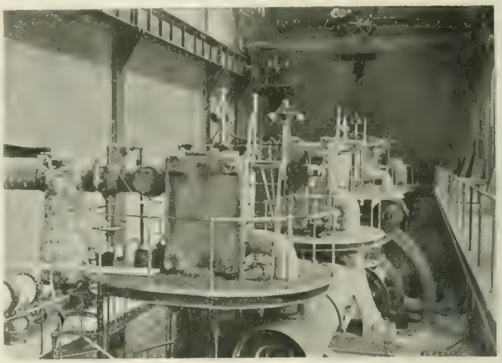
Showing Generator Commutator.

The power station, which is located on Throop street, was designed by the general superintendent, W. E. Baker, for an ultimate capacity of 3,000 horse power. Its design is such that it can be doubled in size by an extension to the street, as the site of the city lighting station has been purchased by the company. The building is 300 feet in length and 90 feet in width.

The machinery foundations are constructed of brick and concrete. The engines will be six in number, all of the vertical Corliss type and constructed by the E. P. Allis Company, of Milwaukee, Wis. Four engines, two of 1,000 horse power and two of 2,000 horse power each, have been installed. The cylinders of the larger engines measure 36 and 72x48-inch stroke and those of the smaller engines are 23 and 46x48-inch stroke. The larger engines will run at 75 revolutions per minute and the smaller at 100 revolutions per minute.

Each pair of engines is fitted with two distinct governors. One of these controls the point of cut-off, and the other is connected with a safety stop valve in the main steam pipe, so that when the speed exceeds a certain number of revolutions per minute the valve closes instantly. Each engine, it will be noticed, is fitted with a wrought iron receiver of large volume between the high and low pressure cylinders.

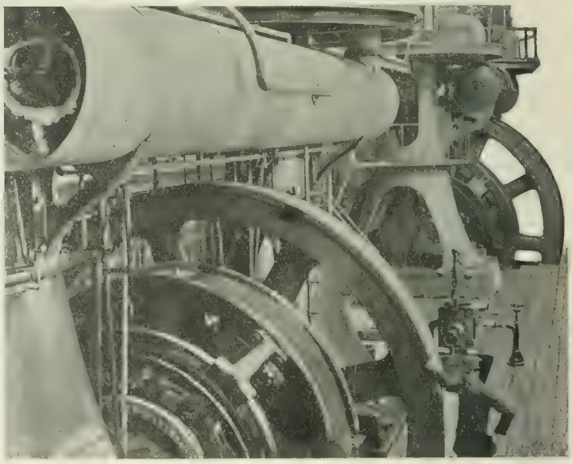
Some of the generator details may be obtained from the views presented. They are of the standard General Electric slow speed, multipolar type and direct coupled to the engines. Two are of 1,500 kilowatts and two of 800 kilowatts capacity.



Engines as Seen from Gallery.

The switchboard, which is of the latest design manufactured by the General Electric Company, is composed of the generator and feeder panels. The former are 24 inches wide and are equipped with the latest types of instruments, including a recording watt meter and lightning arresters.

The boilers, which were supplied by the Babcock & Wilcox Company of New York, are arranged in six batteries of two boilers each, each boiler being of a capacity of 300 horse power, and provided with mechanical stokers. The arrangements for receiving fuel are very convenient. Coal is dumped directly from the cars into shutes, which convey it directly to the boiler room. The furnaces are provided with smoke-consuming devices, which seem to operate very successfully. The ashes are mechanically removed from the rear.



Generators and Engine Receiver.

The officers of the company are as follows: President, Robert E. Jenkins; secretary, George Higginson; general counsel, W. W. Gurley; general superintendent, W. E. Baker; superintendent of transportation, A. S. Jones; electrical engineer, H. M. Brinckerhoff.

Experiments with Electric Waves.

BY ALFRED G. DELL.

The following experiments on electric waves were made with the apparatus described in The Electrical World of Jan. 12, 1895, in connection with a Geissler vacuum tube seven inches long.

When the pointed spark gap was widened so that no sparks could pass and the tube was connected, one electrode with each brass plate, the bulb on the right became only partially filled with light, while that on the left was filled with a violet glow; when the current was reversed, the effects were also reversed. No sparking was obtained in a resonating circle with the tube substituted for the spark gap, and with the 2 x 3 feet zinc plates set up in front of the brass plates.

In front of the brass plates two zinc plates of the same size were attached, being placed as near as possible to the brass ones without touching, but a sufficient distance left so that no sparks could pass between the two sets of plates; two parallel bright copper wires (No. 20) each 27 feet long, were next attached, an end of each to a side of the zinc plate next the spark-gap, and an electrode of the Geissler tube connected to each wire at the other end, a wooden cross arrangement being used to support the tube and wires. Then with a bright copper wire fastened on a piece of wood, and with the current in the same direction as first noted—that is, the bulb with the violet glow being on the left—the nodes along the wires were found by placing the connecting wire across the two long wires, bridge fashion, and sliding it along them. It was found that when the connecting wire was down, the spark at the gap between the brass plates was very bright; when the connecting wire was raised the spark fell off greatly in intensity.

When the spark gap was of the proper length to give a vigorous spark the bulbs were fully lighted up, but differently, the one attached to the right hand plate being more brilliant than the left hand one, the latter still containing the violet glow as when attached to the brass plates. On reversing the current the light changed sides. When the spark-gap was very close, both bulbs were exactly alike, both containing the violet light, and under these conditions no nodes could be found along the wires. In experiments made with lengths of wire from 16 to 27 feet, the first node was next to the zinc plates and extended some inches, growing in brightness. The second node extended sometimes as much as two feet, commencing with a dim light in the tube, and extending throughout the whole tube, then growing dim again, with flashes of light in the bulbs as the connecting wire was moved along the two wires. The third node was not nearly so prominent as any of the others, it giving a pale light in the tube. The fourth and fifth nodes were very distinctly marked, the tube lighting up throughout at once, and there being no changes of any account in the light.

In experiments with wires of lengths from 6 to 14 feet, the first node was very difficult to place on account of the tube being lighted up full for a considerable distance. The second node could not be determined with any degree of certainty, only flashes of light appearing in the tube. The other nodes were well determined, but here was no great accuracy as to the first and second lengths from 6 to 14 feet, the tube lighting up fully at the first point given, and flashes being obtained at the second.

The sparks between the connecting wire and the long wires were very prominent at loops half-way between the two nodes when the former was lowered or raised, but at the nodes these sparks were very small.

Lengths of Wires, measured from zinc plates.	1st Node.		2d Node.		3d Node.		4th Node.		5th Node.	
Feet.	Ft.	In.	Ft.	In.	Ft.	In.	Ft	In.	Ft.	In.
27	0	3	4	3	11	0	18	6	23	6
25	0	3	3	6	10	0	17	0	21	7
23	0	2½	3	0	9	3	15	9	18	8
21	0	0	2	6	8	3	14	2	17	0
19	2	3	7	6	12	10	15	5		
18	2	0	6	11	12	1	14	7		
16	1	6	5	10	10	9	13	0		
14	1	0	2	7	9	5	11	2		
12	0	6	2	8	7	11	9	2		
10	0	6	1	9	6	6				
8	0	4	1	5	5	2				
6	0	3	1	5	2	11				
4	0	0								

Thirteen different lengths of wire were tested. The Geissler tubes used have two quite small cup-shaped pieces of brass, to which the connecting rings are fastened. The experiments were gone over a second time, using other wire and another tube to verify the results, which are given above in tabulated form.

The General Electric at Buffalo.

According to Buffalo and Cleveland newspapers, an effort will be made to induce the General Electric Company to consolidate all of its manufacturing works at Buffalo. A member of the company is reported to have defined the situation as follows: "The matter under consideration is the combination of several of the plants operated by the company. It has half a dozen of them, and they will probably be united. We canvassed the situation at Buffalo, and then went on to Cleveland. A Buffalo syndicate has offered to erect the buildings and give the land for the plant. The value of what they offer to give is $1,000,000. An equally valuable consideration has been offered us by New Jersey parties. Whether the works come to Cleveland or not will depend upon the terms offered. It will be difficult, probably, to overcome the proposition made by Buffalo, but the field is open. There is not a great deal of choice between the two cities, as both are convenient for supplies of fuel and for copper from the upper lakes. The works will employ from 4,000 to 6,000 men. It has not been decided whether or not the Brush works will be removed from Cleveland, in case the consolidated plant goes elsewhere. It has been settled, though, that the works at Schenectady, N. Y., will be too important to be passed upon hastily."

A dispatch from Cleveland says that on Sunday, April 21, a number of officials of the General Electric Company began to drift into that city. Among them were President C. A. Coffin, Vice-President S. Dana Green, and Treasurer J. P. Orr. Others were directors of the company and men connected with its works in different cities. Half a dozen of the visitors spent most of Monday at the works of the Brush Electric Company. Then they had a quiet little conference. Soon after the adjournment they began to depart for home, and on Tuesday afternoon only President Coffin and two or three of his associates remained.

The Invention of the Telephone.

In a recent address Prof. Hughes says it is 30 years since his first experiments with a working telephone. In 1865 while at St. Petersburg fulfilling a contract with the Russian Government for the establishment of his printing telegraph instrument upon all their important lines, he was invited by Emperor Alexander II. to give a lecture before the royal family, which he did. As he wished, however, to present not only his own telegraph instrument, but all the latest novelties, Prof. Philipp Reis, of Friedericksdorf, Frankfort-on-Main, sent to Russia his new telephone, with which Prof. Hughes was enabled to transmit and receive perfectly all musical sounds, and also a few spoken words, though these latter were rather uncertain; at moments a word could be clearly heard, and then from some unexplained cause no words were possible. This instrument was based, Prof. Hughes states, upon the true theory of telephony, and contained all the necessary organs to make it a practical success. Its unfortunate inventor died in 1874, almost unknown, poor and neglected, but the German Government has since tried to make reparation by acknowledging his claims as the first inventor, and erecting a monument to his memory in the cemetery at Friedericksdorf.

Transformer Patents in Italy.

The law courts at Grosseto, Italy, says the London *Electrician*, have pronounced their decision on the action of Messrs. Ganz *v.* Messrs. Siemens and Halske, which action related to alternating current patents. The decision confirms the validity of two patents granted by the Italian Government to Messrs. Zipernowsk, Déri & Blathy, in May and August, 1885, under the title of "Improvements in the means of distributing electricity," and "Improvements in inductive apparatus for transforming electric currents." The former of these patents relates to parallel distribution by means of transformers, and the latter to the construction and use of closed circuit transformers. This decision, arrived at by the law courts at Grosseto, gives the Ganz Company practically a monopoly of alternating current work in Italy. It is said to be the intention of the Ganz Company to proceed even against polyphase installations. The legal experts, it is added, were Profs. Ferraris, Grassi and Roiti.

On the True Dimensions of the Electrostatic and Electromagnetic Units, and on the Right Use of the Terms Intensity, Strength, Force and ℋ.

BY REGINALD A. FESSENDEN.

So many electricians of eminence have written upon this subject that it requires a certain amount of hardihood upon the part of an unauthoritative writer to touch upon it. But, in general, the physicists who have treated of it have not been actively engaged in teaching, and have not, consequently, experienced to the full the effects of the few remaining imperfections of our present system of nomenclature and dimensional formulæ. When one has given an explanation, year after year, to successive classes of students, why it is that an electromotive force is not a force; why, since a force is the differential of work with respect to distance and work is of the same dimensions in electricity as elsewhere, electrical force has not the same dimensions as other forces, and the half hundred other questions which intelligent students ask of their professor, one begins to appreciate the weak points in the system. Consequently, a few words from the point of view of the teacher may be of interest.

I hope to show that the reason why force has different dimensions in the electrostatic system from that in the electromagnetic system, and from that again in the ordinary system, is because of the neglect to take into account the quantities μ and K; and that when these are taken into account, force has the same dimensions in all the systems.

Prof. Rucker (see Everett's C. G. S. Units, page 208, 1891 ed.) has shown (Phil. Mag., Feb., 1889), as an algebraic deduction from some of Maxwell's equations, that the dimensions of all electrical and magnetic quantities can be definitely expressed:

1. In terms of $M.\ L.\ T.$ and μ.
2. In terms of $M.\ L.\ T.$ and K.

Expressing the electrical and magnetic quantities in terms of these quantities, we get,

	In terms of K.	In terms of μ.
Quantity of electricity......	$M^{\frac{1}{2}}L^{\frac{3}{2}}T^{-1}K^{\frac{1}{2}}$	$M^{\frac{1}{2}}L^{\frac{1}{2}}\ \mu^{-\frac{1}{2}}$
Strength of pole........	$M^{\frac{1}{2}}L^{\frac{1}{2}}\ K^{-\frac{1}{2}}$	$M^{\frac{1}{2}}L^{\frac{3}{2}}T^{-1}\mu^{\frac{1}{2}}$
Electric force at a point......	$M^{\frac{1}{2}}L^{\frac{1}{2}}T^{-1}K^{-\frac{1}{2}}$	$M^{\frac{1}{2}}L^{\frac{1}{2}}T^{-2}\mu^{\frac{1}{2}}$
Magnetic force at a point....	$M^{\frac{1}{2}}L^{\frac{1}{2}}T^{-2}K^{\frac{1}{2}}$	$M^{\frac{1}{2}}L^{-\frac{1}{2}}T^{-1}\mu^{-\frac{1}{2}}$
Electric potential............	$M^{\frac{1}{2}}L^{\frac{1}{2}}T^{-1}K$	$M^{\frac{1}{2}}L^{\frac{3}{2}}T^{-2}\mu^{\frac{1}{2}}$
Magnetic potential..........	$M^{\frac{1}{2}}L^{-\frac{1}{2}}T^{-\frac{1}{2}}K^{\frac{1}{2}}$	$M^{\frac{1}{2}}L^{\frac{1}{2}}T^{-1}\mu^{\frac{1}{2}}$

He then points out that in every case the ratio between the dimensions in terms of K to those in terms of μ is a power of $K^{1}\ \mu^{\frac{1}{2}}\ L\ T^{1}$.

Therefore, if every electric quantity has definite dimensions in terms of $L.\ M.$ and $T.$, then $K^{\frac{1}{2}}\mu^{\frac{1}{2}}LT^{-1}$ must have dimensions $M^{0}\ L^{0}\ T^{0}$ and consequently $K\mu$ must equal T^2/L^2.

The writer has, however, gone a step further.

Since force should be of the same dimensions in all systems of units we have:

(1) $M^{\frac{1}{2}}\ L^{\frac{1}{2}}\ T^{-2}\mu^{\frac{1}{2}}$ (dim. of electric force at a point)
$=M^{\frac{1}{2}}L^{\frac{1}{2}}T^{1}\mu^{\frac{1}{2}}$ (dim. of magnetic force at a point.)
(2) $K\mu=T^2/L^2$ (from above.)
Therefore,
(A) $K=M^{-1}L^{-3}T^{-2}$.
(B) $\mu=ML$.

If we substitute these values of K and μ in the dimensional formulæ given above, we find:

That the dimensions of both quantity of electricity and strength of pole reduce, as they should, to zero.

That the dimensions of magnetic and electric force reduce to MLT^{-2} the same as the formula in the common system.

That the formulæ for electrostatic potential and magnetic potential become each ML^2T^{-2}, identical with the regular formula for work, or potential.

Similarly if we go through the whole of the dimensional formula and introduce in them the values of K and μ derived from equations A and B, we see that the whole system reduces to order, and becomes identical with the ordinary system.

Moreover this clears away all doubt as to the proper places where K and μ should or should not be introduced. For instance, Dr. Bedell, in a very interesting paper on Magnetic Potential[*] (*Cornell Physical Review*, January) calls attention to Prof. J. J. Thomson's statement that Ampere's law for the equivalence of a circuit and a magnetic shell is correct only in a medium whose permeability is unity. He gives the amended equation:

$$\mu\times\text{current}\times\text{area}=\text{magnetic moment}.$$

Now current = quantity × time, and magnetic moment = strength of pole × length.

Hence we get the identical equation:

$$\mu\times M^{\frac{1}{2}}L^{\frac{1}{2}}\mu^{\frac{1}{2}}\times T^{1}\times L^{2}=M^{\frac{1}{2}}L^{\frac{3}{2}}T^{1}\mu^{\frac{1}{2}}\times L.$$

Another and simpler way in which $K\mu$ can be proved equal to T^2L^2 is from the equation,

$$\text{Velocity of light}=(K\mu)^{\frac{1}{2}} \qquad (3)$$

Whence $K\mu=T^2L^2$.

If then to the usual definition of current we add the words "in a medium of unit permeability," as Prof. Thomson has shown is correct, we have for the various magnetic and electric quantities the following:

	—Usual formulæ— Electrostatic.	C. G. S.	Electro-magnetic.	Correct formulæ Electrostatic, C. G. S. and Electromagnetic
Quantity of elect...	$L^{\frac{1}{2}}M^{\frac{3}{2}}T^{-1}$		$L^{\frac{1}{2}}M^{\frac{1}{2}}$	Zero.
Strength of pole...		$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-1}$		
Elec. force at point.	$L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$		$L^{-\frac{1}{2}}M^{\frac{3}{2}}T^{-2}$	
Mag. force at point.		$L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$		$L^{2}MT^{2}$
Electric potential..	$L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$		$L^{\frac{1}{2}}M^{\frac{3}{2}}T^{-2}$	
Magnetic potential.		$L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$		$L^{2}MT^{-2}$
Elect. resistance	$L^{1}T$		LT^{1}	$L^{-2}MT^{-3}$
Elect capacity. ...	L		$L^{1}T^{2}$	$L^{2}M^{1}T^{2}$

It will be noted that the correct formulæ are much more understandable than the usual ones. For instance, instead of resistance being a velocity or a slowness, a thing which is not easily comprehended by the average student, we see that it is really Work × Time. It is thus perfectly analogous to the work done against friction in moving masses along a plank.

For if we have a plank of a certain length, and slide a pound mass along it, from end to end, a certain amount of work is done. If we make a succession of masses slide along the plank, so that one reaches the end every second, all moving with the same velocity, then the total resistance is evidently equal to the work done in sliding a single mass multiplied by the time. Thus we get the following conception of electrical resistance.

The electrical resistance of a wire is the work done in carrying a unit quantity of electricity from one end of the wire to the other multiplied by the time taken in doing it.

We see also that capacity means simply the reciprocal of work: *i. e.*, that condenser which requires the least amount of work to put a given quantity of electricity into it has the greatest capacity.

The electrostatic theory of cohesion[†] (see *Science*, July 22, 1893) is competent to decide whether μ is a density and K the reciprocal of an elasticity or vice-versa. It shows plainly that the former is true, and also that in Fizeau's experiment, the increased velocity of the light is not due to the fact that a certain amount of ether, of density n^2-1 travels with the water, as supposed by Fresnel, but that a certain quantity of ether whose average rigidity is n^2-1. (The reason why we do not get a current of electricity under these conditions is seen at once from a consideration of the electrostatic theory of cohesion.)

That μ is a density is proved also from considerations of equations A and B. If μ corresponds to a density and K to the reciprocal of the elasticity of the ether, we see, on substituting the values of μ and K from equations A and B, that the mass of the ether is in both cases of the dimensions ML^4 (thereby affording infinite opportunities of amusement to metaphysically inclined fourth dimensionists since our matter is the density of the ether in fourth dimensional space).

If however we take μ as the reciprocal of rigidity, we get for the dimensions of ether mass, from the one equation, ML^6T^{-2}, and from the other, MT^2, which are incompatible.

The writer has used with considerable success in his classes an ether having the following properties. Its particles have no mass, it has friction (but no frictional losses, as its atoms have no kinetic energy); it has no inertia when moved in a straight line, but possesses inertia as a whole when moved in a curved line, the amount of inertia depending on the curvature.

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[*] See THE ELECTRICAL WORLD, February 16, 1895.

[†] See THE ELECTRICAL WORLD, Aug. 22, 1891.

To the writer's surprise (for he had used it simply as the most suitable ether he could devise, and as the one best agreeing with the facts) this property is shown from the dimensional formula.

We have from equation 3,

$$m = ML^4.$$

where m is the mass of the ether. Consequently we see that the ether has inertia, depending, first on its density, and second on curvature, for $m/L^4 = m/L^3 \times 1/L$. The dimensions of magnetic induction are ML^2.

Intensity.—In the phrases, intensity of magnetizing force and intensity of current, the word intensity is used in two senses. Fortunately we have a guide as to which is likely to be the more correct.

If we read pp. 11 to 13 of Maxwell, vol. 1, we are led to the following ideas:

1. If a quantity be defined with respect to length, its intensity is the amount per unit of length.
2. If it be defined with respect to an area, its intensity is the amount per unit of area.
3. If it be defined with respect to unit volume, its intensity is the amount per unit volume.

And generally, if one quantity be defined with respect to any other quantity, its intensity is the amount per unit of that quantity with respect to which it is defined.

This principle is followed either purposely or instinctively, throughout Maxwell's book, and by almost every modern writer. Consequently, intensity of current does not mean the amperes, but the amperes per square cm of cross section of the wire, or the current density.

We may here notice a convenient fact. It is that in every instance but one, when the quantity itself ends in "ance" its intensity ends in "ity." Thus we have:

Quantity.	*Intensity of Quantity.*
Resistance,	Resistivity.
Reluctance,	Reluctivity.
Conductance,	Conductivity.
Permeance.	Permeability.
	Susceptibility.
Impedance,	Impedivity. (?)
Reactance,	Reactivity. (?)
Inductance, (?)	Inductivity. (?)
	Inductance.
{ Admittance.	
{ Susceptance.	

NOTE.—See Steinmetz: Trans. Am. Inst., 1894; p. 727.

The names marked with an interrogation point have not been used as yet, but they are logically correct. For instance:

Impedivity is the impedance when the time rate of change of current is unity.

Reactivity is the j compound of the electromotive force when the time rate of change of current is unity.

Inductance $= L\omega$, Inductivity $= L \times 1$.

(There is another reason for using the word inductance in this signification and not the usual one. It is that while current × resistance gives the working component of the voltage; current × reactance gives the j component of the voltage; and the current × impedance gives the total voltage; the current × inductance does not give the self induction part of the j component, if the word is used in its usual signification; while if we let it equal $L\omega$, it does.)

Force.—The terms electromotive force and magnetomotive force are productive of great confusion, and are a serious hindrance to the acquirement of correct physical ideas. Electromotive force is not a force, but the line integral of a force, and consequently is a potential. It is not only numerically equal to a potential, but has the same dimensions, and no distinction can be drawn, in any way whatever, between electromotive force and potential. If, therefore, either of the terms voltance or potance could be used it would help matters much. The corresponding intensities—voltivity and potivity—would be the drop in voltage per unit length; possibly gilbertance could be used for electromagnetic potential. Then $\mathcal{H}$ would be the gilbertivity. The term voltage has already been proposed.

Strength.—When we speak of the strength of a pole we mean the quantity of magnetism on one pole of the magnet. When we speak of the strength of a magnetic shell we mean the moment per unit area of the shell. For some reasons it would be advisable to give another name to one of these quantities.

$\mathcal{H}$.—The writer has been unable to see what difference there is, if any, between "strength of magnetic field" and "intensity of magnetizing force," and would be glad of any information on this point.

The above has been written from the point of view of the teacher. It is perfectly true that this system of nomenclature has been devised for the benefit of electrical engineers, and not for the comfort of professors. Yet there is no better test of the logical construction of a system of nomenclature than class work, and a system which has any rough spots in it will show it there first, and they will afterward surely be felt by the engineer. In this connection I would say that the new terms of the American Institute: gauss, weber, gilbert, and oersted, have saved quite an appreciable amount of labor in the writer's classes, and I believe that no one who has to deal much with the ideas which they represent will ever return to the old system. Prof. Crocker (Trans. Am. Inst., 1894, p. 154) has shown very clearly the advantage derived from having definite names to these quantities, and I can corroborate what he has said from practical experience.

I might point out that since $\mathcal{B}$ is the intensity of N, we can use the terms weberance and weberity in a sense analogous to resistance and resistivity.

And in general, the use of the terminations —age,—ance, —ivity, will enable us to do with one name only, where we should otherwise have to create four. For instance, if we give the name lux to a unit, and define it with respect to an area, then the *luxage* will be the name of the quantity, the *luxance* will be the integral of the quantity over an area, and the *luxivity* will be the intensity of the luxance, or the amount per unit area.

Curves for Winding Magnets.—II.

BY HARRISON H. WOOD.

Construction of Curves in Set No. II.

The symbols used in the equation from which the curves in set No. II. are plotted are the same as those used for set No. I.

L = total length of wire in feet.
R = total resistance.
r = resistance per foot at 75° F.
a = cross-section in circular mils.
E = impressed electromotive force.
C = current.

From equation

$$C = \frac{E}{R}$$

we have

$$C \times L = \frac{E}{R} \times L$$

and since

$$R = L \times r$$

the equation becomes

$$C \times L = \frac{E}{r} \qquad (4)$$

This equation will give a curve for each size of wire, showing the relation between current and total length of wire for any fixed value of E; and the curve will be a rectangular hyperbola, as were those in set No. I. These curves have been plotted in the two charts of set No. II. for each size of wire for the value of $E = 500$, values of L (total length of wire) being laid off on the axis of abscissæ and of C (current) on the axis of ordinates. Two charts have been used, Fig. 3 containing the curves for the smaller sizes of wire and Fig. 4 for the larger. The scale of ordinates has been shortened at suitable intervals in order to make the inclination of the curves as near 45 degrees as possible. Scales for L have been plotted corresponding to the values of $E = 500$, 400, 300, 200 and 100 volts, and other values to correspond to other electromotive forces can be obtained by simple interpolation.

The limits between which the curves in this set are plotted are found as follows:

From equation

$$C \times L = \frac{E}{r} \qquad (4)$$

we have

$$\frac{1}{C \times L} = \frac{r}{E}$$

and multiplying by $a \times L$ we have

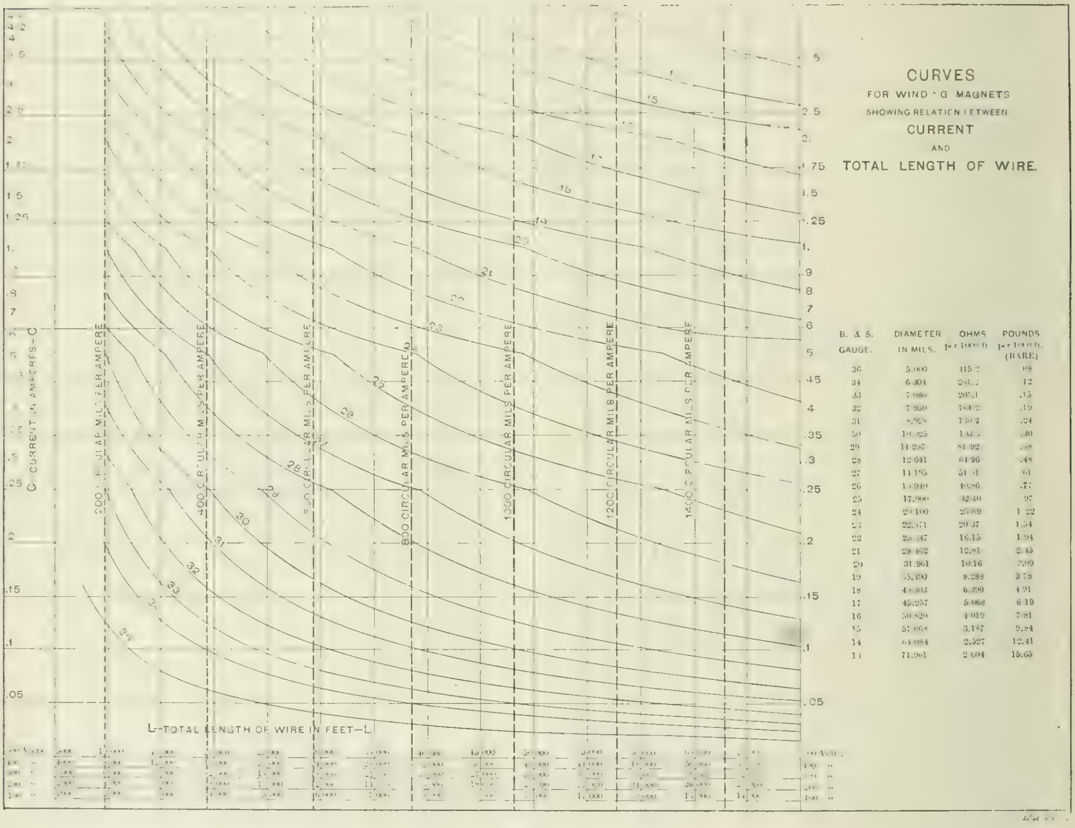
$$\frac{a}{C} = \frac{L}{E} \times a\,r$$

in which a is the cross section of the wire in circular mils and $\frac{a}{C}$ is the current density in circular mils per ampere.

Since the resistance of wire is inversely proportional to the cross section, $a \times r$ is a constant and equals 10.381 at 75 degrees F. (10.381 is the resistance of one foot of copper wire having a cross section of one circular mil);
hence

$$\frac{a}{C} = \frac{L}{E} \times 10.381 \qquad (5)$$

from which it appears that the current density is directly proportional to the total length of wire, L, and independent of all other qualities, E remaining constant. The limits of L will therefore be determined by practical values of $\frac{a}{C}$, and have been taken at $\frac{a}{C} = 200$ and 1,400. Vertical lines have been drawn at those values of L corresponding to densities of 200, 400, 600, 800, 1,000, 1,200, 1,400, thus making it possible to see at a glance to within a few amperes the current density at any point on the curves.



B. & S. GAUGE.	DIAMETER IN MILS.	OHMS per 1000 ft.	POUNDS per 1000 ft. (BARE)
36	5.000	415.2	.08
34	6.304	261.2	.12
33	7.080	207.1	.15
32	7.950	164.2	.19
31	8.928	130.2	.24
30	10.025	103.3	.30
29	11.257	81.92	.38
28	12.641	64.96	.48
27	14.195	51.51	.61
26	15.940	40.86	.77
25	17.900	32.40	.97
24	20.100	25.69	1.22
23	22.571	20.37	1.54
22	25.347	16.15	1.94
21	28.462	12.81	2.45
20	31.961	10.16	3.09
19	35.890	8.288	3.78
18	40.303	6.390	4.91
17	45.257	5.068	6.19
16	50.820	4.019	7.81
15	57.068	3.187	9.84
14	64.084	2.527	12.41
13	71.961	2.004	15.65

Fig. 3.

In the equation

$$\frac{a}{C} = \frac{L}{E} \times 10.381$$

it will be seen that r has disappeared, and that therefore the values of $\frac{a}{C}$ apply to all sizes of wire alike.

Corrections for temperature are made for the curves in this set exactly as for those in set No. I.

T = temperature in degrees F. at which the coil will be worked.
r = resistance of wire per foot at T degrees F.
r_1 = resistance of wire per foot at 75 degrees F.
L = length of wire necessary at T degrees F.
L_1 = the number to be looked for on the scale.

From equation

$$r = r_1\,(.0021\,T + .8425) \qquad (2)$$

and equations

$$C \times L = \frac{E}{r}\ (\text{at } T^\circ \text{ F.}, \qquad (4)$$

$$C \times L_1 = \frac{E}{r_1}\ (\text{at } 75^\circ \text{ F.}) \qquad (4)$$

we have

$$L_1 = L\,(.0021\,T + .8425) \qquad (6)$$

L_1 is the number to be looked for on the scale when it is desired to find the current corresponding to a chosen value of L at the temperature T degrees F., or when with L and C chosen it is desired to find the proper size of wire.

The correction can also be applied to C instead of L by substituting C for L in equation (6).

$$C_1 = C\,(.0021\,T + .8425) \qquad (7)$$

C_1 is the number to be looked for on the scale when the chosen value of the current is C and the temperature expected, T.

Uses of the Curves.

The quantities usually given in determining a field coil are the ampere-turns required, the mean length of a turn and the impressed electromotive force. With these quantities given, the curves in set No. I. will show immediately the size of wire that will most nearly satisfy them. For instance, suppose it has been found that 15,100 $S\ C$ are required for a 100-volt machine, and that the mean length of a turn of the coil will be about 1.6 feet. From set No. I., Fig. 2, we find that No. 16 will very nearly satisfy these values. It shows, further, that it will exactly satisfy them if L is made 1.65 feet or if $S\ C$ is made 15,600. From set No. II. the total length of wire necessary is shown if the field current is fixed; or if the length of wire is limited by the space it is to occupy, the resulting current is shown. Suppose the amount of No. 16 wire must not exceed 8,500 feet. The curve for No. 16 wire shows that the current will be 2.95 amperes and the density about 900. If it has been found from experiment or from empirical formulæ that with the shape of bobbin to be used a density of at least 1,300 must be allowed, to avoid overheating, the curve shows that at least 12,600 feet of wire must be used.

If E has some value lying between those for which the horizontal scales have been constructed, the location of $S\ C$ will be found as follows:

From equation (3) we have

$$S\ C_1 = 12,080\ (.0021 \times 120 + .8425) = 13,220.$$

Hence we take that point on the scale for $E = 100$ at which 13,220 occurs as the abscissa corresponding to $S\ C = 15,100$ at 125 volts and 120 degrees F.

Corrections for temperature and electromotive fôrce on the charts of set No. II. may be illustrated as follows:

Suppose No. 11 wire has been found from the curves of set No. I. to satisfy the given conditions; that $E = 250$, $T = 125$ degrees F., and that 10 amperes is the field current desired. From Fig. 2 we see that for 10 amperes, 40,000 feet of No. 11 wire would be required if the E. M. F. were 500, and the temperature 75 degrees. For 250 volts the amount of wire will be

$$\frac{250}{500} \times 40,000, \text{ or } 20,000 \text{ feet.}$$

From equation (6) we have

$$L_1 = L\ (.0021 \times 125 + .8425)$$

L_1 is the length for 75 degrees, and L for 125 degrees. Hence

$$20,000 = L \times 1.115 \text{ and } L = 17,940.$$

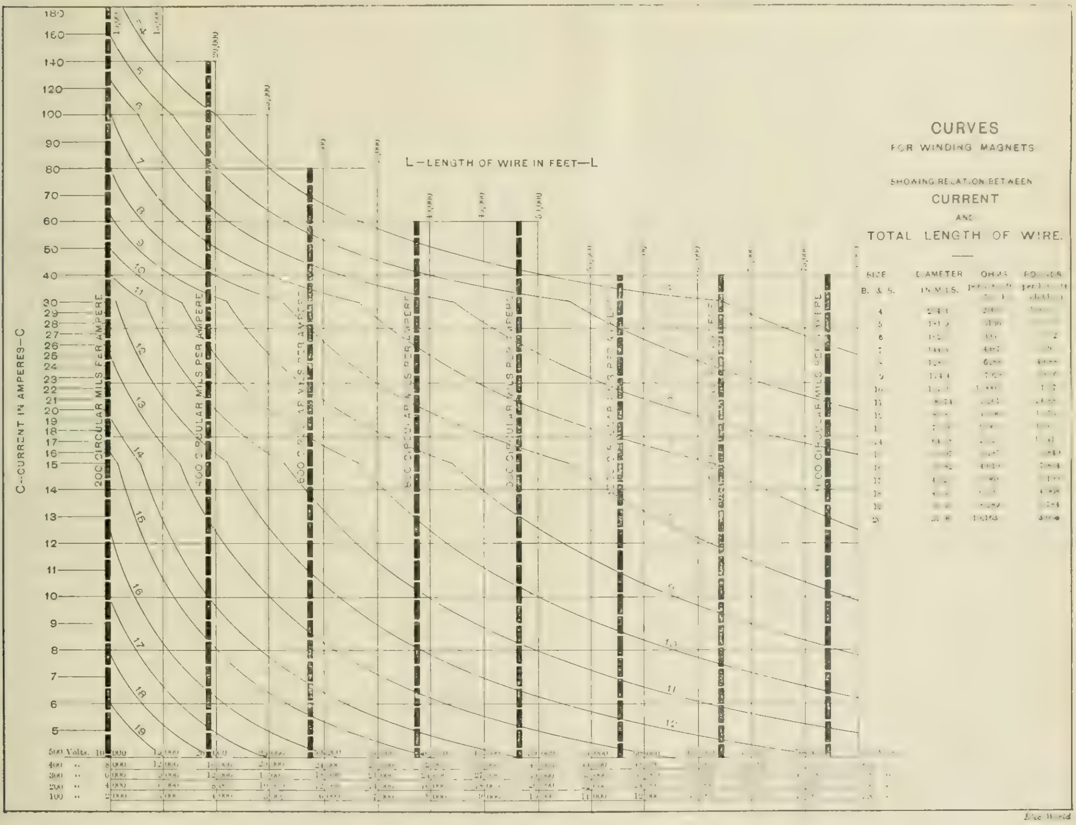


FIG. 4.

Suppose $E = 125$ volts in the above illustration. Then 15,100 $S\ C$ will occur on the scale at that point where $\frac{100}{125} \times 15,000$, or 12,080, occurs on the scale for $E = 100$. If $E = 60$, $S\ C = 15,100$ would occur at that point where $\frac{100}{60} \times 15,100$, or 25,170, occurs on the scale for $E = 100$.

To correct for temperature:

$S\ C$ desired = 15,100.
$E = 125$
$T = 120°$ F.

The correction for $E = 125$ has already been made and it has been found that the corresponding point on the scale for $E = 100$ is 12,080.

Hence 17,940 feet of No. 11 wire will be necessary to give the proper number of $S\ C$ at 125 degrees with $C = 10$. The density corresponding to 10 amperes in No. 11 wire, as will be seen from the curve, is about 820.

If instead of current we have the length of wire fixed at, say, 25,000 feet, the corrections will be made as follows:

From equation (6)

$$L_1 \text{ (at } 75°) = 25,000 \times (.0021 \times 125 + .8425) = 27875.$$

This number at 250 volts corresponds to $\frac{500}{250} \times 27,875$, or 55,750 on the scale for 500 volts. From the curve for No. 11 wire we find that 55,750 feet on the scale for $E = 500$ corresponds to 7.2 amperes, and at the density of 1,200.

Electrodynamic Machinery.—XXXIV.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

201. The activity wasted in any generator invariably takes the form of heat. These expenditures are:

(1) I^2R activity in the field magnets.
(2) I^2R activity in the armature winding.
(3) I^2R activity in eddy currents, in armature and field.
(4) Hysteresis losses in armature core and field poles.
(5) Friction in bearings and brushes.
(6) Friction in air.

202. The number of watts expended in the field magnets is equal to the product of the pressure in volts at the field terminals, multiplied by the current in amperes passing through the field. In series-wound generators, where the armature sends its entire current through the field magnets, this expenditure varies with the load. Thus, in a 10-kw series-wound generator, designed to supply a maximum current of 200 amperes at 50 volts pressure, if the resistance of the field magnet coils, when warm, be 0.01 ohm, the pressure at the terminals of the magnets will be $200 \times 0.01 = 2$ volts, and the activity, $2 \times 200 = 400$ watts. On light load, however, of say 20 amperes, the pressure will be $0.01 \times 20 = 0.2$ volts, and the activity $0.2 \times 20 = 4$ watts, so that, in the first case, the amount of heat generated in the field winding is 100 times greater than in the second case, and the temperature which the field winding would attain in the first case would be much higher than in the second.

203. In a shunt-wound generator, the activity in the field circuit is nearly constant. For example, a 10-kw generator, intended to supply 111 volts at its terminals, at full load, with a current strength of 90 amperes in the main circuit, might supply a current of 2.5 amperes through its field magnets. Consequently, the activity in the field magnet circuit would be $111 \times 2.5 = 277.5$ watts. At light load, the current strength through the field magnets would have to be reduced to say 2.0 amperes, in order to keep the terminal pressure at 111 volts, and the activity in the field would be reduced to $111 \times 2.0 = 222$ watts, so that the temperature attained by the winding on the field magnets would not be much greater at full load than at no load.

204. It is evident that the I^2R activity in the armature always varies with the load; *i.e.*, with the current strength I. At no load, this loss must be very small, the current strength being limited to that required for the excitation of the field magnets. The temperature elevation of the armature, due to the armature winding, consequently, increases rapidly with the load.

205. The activity expended as I^2R, in eddy currents in the field poles, or in the armature, is nearly uniform at all loads, especially in shunt-wound machines, in which the intensity of magnetic flux is nearly constant, and if this intensity were absolutely uniform; *i.e.*, if there were no drop in the armature, requiring a greater M. M. F. and exciting current, and if there were no armature reaction, the eddy current loss would be constant at all loads.

206. The activity expended in hysteresis in the armature and field poles would, similarly, be constant at all loads if the magnetic intensity were constant. As the magnetic intensity is increased by an increase in the M. M. F. of field and armature at full load, the hysteretic loss increases, following the 1.6th power of the local magnetic intensity at any point. The temperature elevation due to this amount of heat is developed principally in the armature.

207. The friction in bearings and brushes produces heat at those parts. The amount of heat liberated, due to pure friction, is comparatively small when the lubrication of the bearings is properly attended to. In large generators, the heat produced by the friction of the brushes on the commutator is very small compared with the heat developed by the sparking, and the powerful currents set up in the short circuited coils undergoing commutation.

The friction due to the churning of the air is comparatively small in drum armatures, but often constitutes an appreciable loss in alternators, when a Gramme-ring armature of large diameter and rough exterior is revolved at a high speed. In this friction the heat is principally developed in the surrounding air and not in the mass of the machine. The air churning assists, on the contrary, in cooling the machine.

208. The expenditure of energy as heat in a generator is objectionable, first, because it represents loss of power and consequently reduced efficiency. Ten per cent. of loss in the generator due to all these causes combined, means 10 per cent. more coal, 10 per cent. more water, and engines and boilers larger by 10 per cent. to supply a given electrical activity, than would be necessary if it were possible to avoid these losses entirely; and second, because the heat developed may raise the temperature of the generator to a dangerously high degree and ultimately limit its output.

209. There are four limitations to the output of a continuous-current generator; viz.,

(1) Insufficient mechanical strength to withstand the mechanical forces brought into play.

(2) Insufficient efficiency, or insufficient pressure at the brushes, under load.

(3) Excessive sparking.

(4) Excessive heating.

The first two cases of limitation can always, by proper design, be obviated in all but the smallest generators. It is the third and fourth considerations which limit the output in all practical cases. In modern machinery it is the heating which first limits the output.

210. The limiting temperature of the generator armature is dependent upon a variety of considerations. In the first place, the hotter the armature winding, the greater its resistance; for, if r, be the resistance of the armature at 0° C. its resistance R, at any temperature t° C., will be approximately, $R = r\,(1 + 0.004\,t)$. In other words, the resistance will rise by 0.4 per cent. per degree centigrade of temperature elevation above zero. The result is, that at high temperatures, the wasteful activity as I^2R, in the armature increases, increasing thereby both the loss in the machine and the tendency to temperature elevation.

211. The temperature of the armature must not exceed that at which any of the materials employed in its construction would be deleteriously affected; *i. e.*, either softened or decomposed. In many generator armatures, cotton is the insulator employed, four thicknesses of cotton (representing each about 1-130th of an inch) separates adjacent wires, except at specially protected places, where mica and oil paper are employed. Cotton undergoes slow thermolysis, or decomposition by heat, at a temperature approximately that of the boiling point of water, or 100° C. Consequently, it is unsafe, in practice, to maintain cotton covered armatures, even though shellac varnished, at a higher temperature than 100° C. If the temperature of the room, in which a generator is operated, never exceeded 30° C. it would require an elevation of 70° C. in the armature to reach a dangerously high temperature. As, however, some engine rooms attain, in summer, a higher temperature than 30° C., and since a margin has to be left for accidental overloads, 50° C. is the temperature elevation that the armature should not exceed at full load, and modern practice is reducing this to 40° C.; so that the temperature of the armature, as observed after several hours of full load, is usually specified not to exceed 40° C. of temperature elevation above the surrounding air.

U. S. Navy specifications usually require that the elevation of temperature shall not exceed 50° F. = 27.8° C.

212. Many large generators, however, do not use any insulation for their armature conductors, except mica, and such generators can safely carry a much higher temperature elevation without danger.

Here the dangerous temperature, so far as mechanical injury of the armature is concerned, would be that at which solder would melt. Electrically, however, the increase in the resistance in the armature would constitute a limitation long before this temperature would be reached, and if, in fact, the armature winding were to attain this temperature, the field coils, and even the bearings of the machine, might be dangerously overheated.

213. The activity in the field coils, which will elevate their external temperature a given number of degrees centigrade, depends upon their shape, size and arrangement, whether their surfaces are freely exposed to the air, or are partly sheltered from it. Usually, however, the surfaces of the field coils must afford 16 square centimetres, or about 2.5 square inches per watt of activity developed in them as I^2R heat. If the field winding consists of many layers of fine wire, the temperature of the deep seated layers will be greater than that of the superficial layer, but if, on the contrary, the layers be few, and the wire coarse, the difference of temperature in the winding will be inconsiderable. The increase of temperature on the field magnets of a generator is usually not greater than 30° C. at full load.

214. In the case of the armature, the speed at which it revolves through the air greatly increases its capability for dissipating heat and reducing its temperature, so that a much greater thermal activity can be permitted in the armature than in the field coils. The usual allowance for eddy currents, load currents and hysteresis losses combined, is about 1-5th watt per square centimetre; *i. e.*, 1⅓ watts per square inch of armature surface, including the surface

on the sides of the armature, but excluding its internal core surface, or about three times more activity per unit area than on the field magnets. In some specially ventilated armatures, in which the core discs are spaced and separated at intervals, to permit the circulation of air from the interior outward by centrifugal force, the dissipation of heat can be so far increased that two watts per square inch of armature surface have been rendered practicable. Much depends, however, upon the shape and size of the armature, as well as upon its peripheral speed, so that no exact rule can be laid down.

(To be continued.)

Laboratory of Houston and Kennelly, Philadelphia.

Rope Driving—XIV.

BY J. J. FLATHER.

[Owing to unavoidable circumstances the publication of Prof. Flather's article was interrupted, and in order that the concluding portions may be more easily followed, we print below a synopsis of the installments that have previously appeared.]

Art. I.—Introduction of rope driving by Combe and Barbour about 1860. Advantages of ropes. Ropes have, to a large extent, replaced the toothed gearing formerly used in English mills, but while the advantages of smooth running and easy handling are conceded, it is also acknowledged that the extra weight and greater width of pulleys increase the journal friction over that found with toothed gearing, and that otherwise a greater loss of power occurs, due to causes considered subsequently. General discussion of mill friction.

Art. II.—Examples of rope driven mills, showing distribution to various floors; rope wells. In multiple rope system each wind consists of a separate endless rope stretched around the fly wheel and its individual shaft pulley. In the continuous wind system one rope is wound continuously back and forth around fly wheel and pulley, making as many wraps as required, thence over a tension pulley or tightener and back to the starting end. Forms of tension carriages. Effect of atmospheric changes on length of rope.

Art. III.—Rope driving applied to dynamos. The usual high rotative speed of armature requires a large driving wheel or intermediate jack-shaft in order that the dynamo pulley shall not be too small. Much trouble is experienced in such drives where too little attention is given to size of pulley; where absolutely necessary to use a small pulley, the number of wraps should be increased so as to reduce the load on each. Coil friction. Winder pulley used by Sir Christopher Wren, 1670.

Art. IV.—Winder pulley applied to rope drive in Fifty-second street electric power house of the Chicago City Railway Company. One of the greatest fields of usefulness for rope driving is in the transmission of power to a moderate distance under conditions which are unfavorable to the use of belts or shafting. With rope driving one is enabled at a comparatively small cost to transmit power in any direction to a building remotely situated from the source of power, which would otherwise require an expensive line shaft or an independent engine or motor. The facility with which it may be carried in any direction across rivers, canals and streets, up hill or down, over houses and into buildings, is a feature very favorable to the further extension of rope transmission; but the rapid progress which has been made in the development of electrical transmission has limited the economical application of ropes to moderate distances. There are, however, certain limits between which the transmission of power by ropes is yet more efficient than by any other known method.

Art. V.—Example of power transmission by ropes to moderate distance, 600 hp about 200 feet and 600 hp about 185 feet. Discussion of power transmission by shafting: for wrought iron shafting the friction loss of bare shaft is:

$$L.P_0 = \frac{L}{d} \times \frac{HP}{1250},$$

in which L = length of shaft in feet.

d = diameter of shaft in inches.

HF = allowable horse power which may be transmitted by shaft.

Art. VI.—Cotton and manilla ropes. Cotton ropes are generally softer and more pliable than the ordinary manilla ropes, allowing smaller pulleys to be used with less injury to the fibres; there is also an advantage in that there is less internal chafing and wear on account of the smoothness of the unit fibres, and the great elasticity of the yarns. Manilla fibres are composed of a number of very fine cells which look like a bundle of tubes stuck together with jagged protections along the surface. The fibres are strong lengthwise but weak transversely; when made into rope they are compelled to slide on each other while under pressure, causing internal chafing and grinding which, if not prevented, soon wears out the rope when subjected to much bending.

Art. VII.—Twist in ropes. In general, the greater the twist the harder and more rigid the rope, and the better it will keep its form; but it is not as strong nor as pliable, weight for weight, as the more loosely twisted rope; for this reason the latter is to be preferred for power transmission purposes. Lubrication of ropes. Although the rope is materially weakened by the application of grease, yet the greater freedom of the fibres permits a heavier working strain to be carried, for it is the relative wear of the fibres that determines the life of the rope. A manilla rope with its fibres properly lubricated will, under the same conditions, outlast from two to four similar dry-laid ropes which are allowed to run dry. For cotton ropes, which are not usually lubricated, a coating of beeswax and black lead, with a little tallow, forms an excellent moisture proof covering and prevents the fibre from rising and the ropes from fraying. Manilla ropes are usually laid up in tallow or paraffine, or a mixture of graphite and tallow. Area of rope: Actual area determined by sectional prints $= 0.636\ d^2$ inches, d being the diameter of the rope. The actual area of a 3-strand rope equals eight-tenths of the area of the circumscribing circle.

Art. VIII.—Strength of ropes. For manilla rope, the ultimate strength $= 100\ d^2\ x$ in which x is an empirical coefficient equal to $81-9d$. This gives the strength of a new dry rope made of selected stock; when wet or greasy, the strength will be reduced from 20 to 30 per cent. The strength is, however, secondary to flexibility; the normal working strain should not exceed about 5 per cent. of actual breaking strength. Ordinarily $200\ d^2$ pounds may be used as the normal working tension in rope. This is an economical load for the lasting qualities of the rope; in many cases, the more convenient adaptation of smaller ropes and the use and lesser cost of smaller pulleys outweigh the greater economy obtained by the larger ropes, and loads are carried far in excess of that given.

Art. IX.—Discussion regarding selection of rope diameter. Under similar conditions and proportional stress, we should expect a rope to wear out more than twice as fast as one twice its size; practical considerations limit the diameter of ropes between ½ inch and 2 inches ordinarily, but it is better to use a diameter not less than ¾ or ⅞ inch, where it is possible to use the larger pulleys required. Coefficient of friction, $f = 0.12 \operatorname{cosec} \frac{\theta}{2}$, where $\theta =$ angle of groove. Determination of horse-power.

Art. X.—Tables of constants and horse power transmitted by different sized ropes under varying conditions. Effect of centrifugal force. At speeds less than 2,000 ft. per minute, the power absorbed by centrifugal force is very small and may be neglected as far as practical results are concerned. Beyond this the loss increases rapidly, until at a speed of about 8,500 ft. per minute the whole allowable tension ($200\ d^2$ pounds) is absorbed. Relative wear and first cost of rope shows that the best speed is about 4,500 ft. per minute for a permanent installation working under a stress of $200\ d^2$ pounds.

Art. XI.—Discussion of the catenary. Deflection of rope, $h = \frac{wl^2}{8T}$ in which h = sag of rope in feet; w = weight of rope $= 0.32\ d^2$ pounds per foot; l = distance between pulleys in feet and T = tension in rope. Hence when a predetermined tension is required, make the sag conform to above value of h. When a tightener is used, the initial tension can be made equal to $\frac{200\ d^2}{2.46}$ pounds. This includes weight of tension carriage in a vertical arrangement of tightener.

Art. XII.—Loss in engine friction is practically constant. While we may speak of the friction as being a certain percentage of the horse power of an engine, it must be understood to refer to the rated indicated horse power; at less than rated power the percentage of loss due to friction will be greater and at maximum power the percentage will be less. We may expect ordinarily that the frictional resistance will vary from 8 to 13 per cent. of normal load. Compound engines of the better class should not absorb more than about 10 per cent. and triple expansion engines not more than 12½ per cent. under full load. For small engines, either single or compound, there is probably little difference between the internal resistance, whether geared with ropes or flat leather belts. With larger engines, however, the journal friction is presumably less in engines employing ropes than in those using belts. The difference is, however, not great, and since the actual resistance in any case is also dependent upon peculiarities of type and construction, the lower values of engine friction previously given, viz.: 8 per cent. of normal horse power may be considered to hold good for rope driving plants of medium size, while 10 to 12 per cent. of the normal horse power may be taken as suitable for the larger class of engines running under favorable conditions.

Art. XIII.—General discussion of friction of shafting in factories. Belts running from the fly wheel to the main shaft and from that to a secondary or countershaft produce a load on the shaft depending upon the resultant of the several belt pulls. In addition, there is the weight of shafting and its furniture—pulleys, couplings and clutches. The resultant of these forces will be the effective load on the bearings.

The consideration of the intensity of these forces and the percentage of loss due to friction in shafting of varying diameters and lengths will be discussed in the present article. Following this the various losses peculiar to rope driving will be taken up, and the forms and proportions of rope pulleys will be considered in detail.

Assuming an angle of 30° with the horizontal for the line of action of the resultant pull on the bearings due to the tensions in the tight and slack sides of the main belt, the combined horizontal pull on the bearings will be:

$$\cos 30^\circ \times \frac{1}{4}\left(\frac{3}{2} d^3 N\right) + \frac{3}{2} d^3 N = 1.2\left(\frac{3}{2} d^3 N\right);$$

and the vertical pull will be, when W_s is the weight of loaded shaft:

$$W_s + \sin 30^\circ \times \frac{1}{4}\left(\frac{3}{2} d^3 N\right);$$

therefore, the resultant of both horizontal and vertical forces acting on the bearings will be

$$W = \sqrt{\left[W_s + \sin 30^\circ \times \frac{1}{4}\left(\frac{3}{2} d^3 N\right)\right]^2 + \left[1.2\left(\frac{3}{2} d^3 N\right)\right]^2}.$$

As previously shown the horse power necessary to overcome journal friction will be

$HP_f = \frac{Fv}{33000}$ where F is the force of friction at the circumference of shaft. If the bearing is well worn and fitted to its shaft, the resistance due to friction will probably lie between the limits $\frac{\pi}{2}\phi W$ and $\frac{4}{\pi}\phi W$, where ϕ is a coefficient which, from the results of experiments on shafting, we have assumed equal to 0.06, and W is the resultant load, in pounds, on the bearings.

From the lesser of these values there is obtained $F = \frac{4}{\pi}\phi W$; but we have assumed that the weight of a loaded shaft varies from two and one-half to four times the weight of shaft; taking an average value of three for line shafting and noting that the weight of shaft per foot of length equals $\frac{\pi}{4}(3.36\, d^2)$ we have the friction on a loaded shaft L feet long due to its weight =

$$\frac{4}{\pi}\phi\, 3\left(\frac{\pi}{4} \times 3.36\, d^2\right) L.$$

Substituting the value of W when the belt tensions are taken into account and noting that $W_s = \frac{\pi}{4}(3.36\, d_2 L)$ we have for the total friction load

$$F = \frac{4}{\pi}\phi\sqrt{\left[3\frac{\pi}{4} \times 3.36\, d^2 L + \sin 30^\circ \times \frac{1}{4}\left(\frac{3}{2} d^3 N\right)\right]^2 + \left[1.2\left(\frac{3}{2} d^3 N\right)\right]^2}$$

$$= \sqrt{[0.6\, d^2 L + 0.014\, d^3 N]^2 + [0.14\, d^3 N]^2}.$$

From the formula for the power absorbed by friction we obtain

$$Fv = HP_f = \frac{F \pi d N}{33000 \times 12} \text{ or } HP_f = 0.000008\, d N F;$$

hence the ratio of power absorbed by friction to the horse power which the shaft is capable of safely transmitting will be

$$\frac{HP_f}{HP} = \frac{0.000008\, d N F}{0.01\, d^3 N} = \frac{0.08\, F}{d^2} \text{ per cent.}$$

From this expression the following Table (XIII.) has been computed for the given diameters and lengths of shafting running at 100 and 250 revolutions per minute, the belt speed for the secondary belts being assumed at an average of 660 feet per minute.

For intermediate belts having a greater average velocity than that assumed, viz., 660 feet per minute, the friction horse power for a given number of revolutions will be less than that given in the table. Thus, if the average velocity of cross belts equal 2,640 feet per minute, the horse power transmitted being the same, it follows that the tensions in the secondary belts will be one-fourth of that obtained with the lesser speed; if the main driving belt have the same velocity, the tension in this belt may be considered equal to that existing in the intermediate belts; therefore, as the velocity of the belt increases for a given horse power and speed of rotation, the sum of the tensions acting on the bearings will decrease, and the maximum horse power transmissible by the shaft will be exerted with a decreasing friction loss.

If, in any case, the shafts are belted vertically or at any other angle than that assumed, the formula for F will be modified accordingly.

(To be continued.)

TABLE XIII.—POWER ABSORBED BY FRICTION IN LINE SHAFT.

Diameter of Shaft in Inches.	Revolutions per Minute.	Percentage of Loss when Length in Feet			
		100	200	300	400
2	100 250	5.5 7.8	10.1 11.6	....	....
2½	100 250	5.8 8.9	10.3 12.4	15 16.6	....
3	100 250	6.1 9.9	10.4 [illegible]	15 17.2	19.6 21.5
3½	100 250	6.8 11.4	10.6 14.2	15.4 18	20 22

Line of action of resultant of main belt tensions = 30°.

Velocity of main belt 2,640 feet per minute. Belts from line shaft are horizontal and run at an average of 660 feet per minute.

All the belts are assumed to drive from one side of the shaft toward the engine. Weight on bearings three times weight of bare shaft.

Induction Motors.

To the Editor of The Electrical World:

Sir: I have been interested in looking over Mr. Rothert's note on non-synchronous induction motors, which contains several considerations of interest from a theoretical point of view. I desire, however, to take sharp exception to his statement, which may have been derived from foreign authors making the same egregious blunder, that the insertion of a resistance in the secondary circuit of an induction motor involves the use of collecting rings and brushes.

The General Electric Company has at present in successful operation nearly thirty 3-phase and monocyclic plants, a large proportion of which are equipped with induction motors. Of these every one which has been sent out is arranged with a resistance in the secondary circuit at starting which, as Mr. Rothert says, produces a powerful starting torque with but a small current at the moment of starting. None of these motors, save a single one intended to run at a wide variety of speeds, possesses either collecting rings or brushes. In every case the starting resistance is put inside the rotating member of the motor and short circuited either all at once or in several successive steps by a solid brass ring sliding along the armature shaft and actuated by a small handle close to the bearing of the motor; an arrangement which gives absolutely no trouble and effects the result in a very simple and efficient manner.

Inasmuch as, so far as I have been able to ascertain, this particular type of polyphase motor forms not less than half of all the non-synchronous induction motors in operation in the world, I must object very strongly to the statement on the part of Mr. Rothert or anybody else that collecting rings are necessary for the successful operation of a motor having initial resistance in the secondary.

Louis Bell.

Chicago, Ill.

Telephone Service in Venezuela.

Telephony is becoming more and more recognized in Venezuela as a commercial necessity and the service is rapidly growing. The Venezuelan government has recently contracted with the American Electric and Manufacturing Company for the establishment of telephone service throughout its public offices, connections being also provided with the existing lines between Caracas, La Guayra, Las Tegues and other points. There are already in operation several long-distance lines between remote points, with good prospects for an increase in the number.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors, or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 927 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French, or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Alternators in Parallel.—The "Elek. Zeit.," April 11, reprints a long abstract of the recent paper of Messrs. Bedell and Ryan on "Action of a Single Phase Synchronous Motor" (see ELECTRICAL WORLD, March 30, p. 391, and April 6, p. 422), and comments on it editorially. In the editorial it is stated that three theories have been advanced for the parallel coupling of alternators, that of Dr. Hopkinson, that of Mordey and a third which leads to the conclusion that the resistance is in all cases objectionable and that a certain minimum self-induction is absolutely necessary to insure parallel running or driving of motors; these three different theories, all of which are due to competent authorities, cannot all possibly be correct in the whole of their scope, even though each may have been confirmed practically; in the Hopkinson theory for instance the condition of the equality between the resistance and the reactance seems to be confirmed by the fact that by decreasing the reactance the alternators will run better in parallel; the reverse however is not the case, as with an increase of the resistance parallel running becomes more difficult; Mordey and his followers have omitted to notice that armatures without iron still have a very decided self-induction and that therefore the condition of a negligibly small reactance cannot in practice be fulfilled even approximately; experiments with the Mordey and similar machines therefore furnish no proof for the assumption that parallel running is rendered more reliable the smaller the self-induction; the third theory was also substantiated in practice by the fact that in general there is absolutely no difficulty in running such machines, with iron in the armature, in parallel or to use them with motors. In view of these differences of opinion regarding the nature of parallel running, the experiments described in the paper of Bedell and Ryan are claimed to be of great value; the results are briefly summarized as follows: If the generator and motor were constructed with absolutely no self-induction, transmission of power at equal voltage would be impossible, it would be possible only if the voltage of the motor was less than that of the generator; in practice alternators which have self-induction can be used for the transmission of power with equal voltage as also when the motor voltage is less or greater and the action of the motor will be more stable if its self-induction has a certain value; the results show very clearly that the first motor used had not enough self-induction and that transmission became possible only after a self-induction was added to the circuit; they also show that when the circuit contains the smallest required self-induction the action will be more stable within a wider range; another valuable result is to show the practical value of vector diagrams for the predetermination of the action; the graphical treatment of alternating current problems is extremely simple; they have also shown that there are really no objections to the graphical method and that it is not necessary to make use of complicated mathematical treatments.

Efficiency of an Alternating-Direct-Current Transformer.—In "L'Elettricista," April 1, Mr. Arno publishes the results of some experiments undertaken on a plant converting alternating into direct currents This plant which is fed by a 5-hp Ganz transformer, connected to the supply mains of Turin, consists of a Brown non-synchronous motor, belted to an Oerlikon dynamo. At full load the motor absorbed 83 amperes at 104 volts, and 6,411 watts, the power factor being therefore 0.75; the speed was 1,224 revolutions per minute and the frequency 40. The dynamo gave 47 amperes at 64 volts; the commercial efficiency of the whole plant was therefore 0.48. This low figure is attributed to the use of belting, and the complicated arrangement of the plant, the motor and the dynamo not being combined into one machine.

Uncoupling Shunt Motors.—Klingelfuss' system is described and illustrated in the "Elek. Anz.," April 4; the object is to enable a shunt motor to be uncoupled very quickly without causing trouble due to the spark of the extra current; by means of a peculiar switch, and a magnet on the machine he utilizes the extra current obtained when the circuit is open, to release a mechanical coupler of the shaft.

Dynamo with Single Bearing.—A very full table of electrical data of the different sizes of the machine mentioned in the Digest last week, is published in the Lond. "Elec. Eng.," April 12.

Ball Dynamo.—A detailed description of the dynamo and the "improved Ball system of electric arc lighting" is given in the "Elec. Age," April 20.

LIGHTS AND LIGHTING.

Illumination.—A long and well illustrated extract of the recent publication of Mr. Marechal, an illustrated abstract of which was given in the Digest, Aug. 11, 1894, is published in the "Zeit. f. Beleucht," March 15 and 31; the latter number contains diagrams showing the lines of equal illumination (analogous to contour lines in typographical maps) for different dispositions of lights; the article includes estimates of the cost of lighting. The present article is much more complete than the one from which our former abstract was taken; an extract with some of the curves is published in "La Nature," April 6.

Arc Lamps of Adjustable Candle Power.—The "Zeit. f. Beleucht.," March 15, gives a description from a German patent of an arc lamp in which the candle power may be adjusted to any desired amount, the device being that of Messrs. Schoeller & Jahr. The adjustment is effected without making any change in the lamp itself; it may be done by means of a resistance shunting the series coil or one in series with the shunt coil or both; this resistance may be placed wherever convenient and at any distance from the lamp; a diagram and a calculation of the required resistances are given.

Electric Elevators.—An editorial in the "Elec. Eng.," April 24, calls attention to the system of charging for electrical elevators taking current from the Edison station, from which 250 elevators are run; a minimum charge is made for each elevator and it is shown that in but a few cases is the charge for actual current consumption smaller than this minimum charge of $3 per month; in Mr. Leonard's recent paper he advocated a very high charge for elevator service on account of the very intermittent nature of the load, but it stated that "experience has abundantly proved to the company that the compensations brought about in a large system of distribution have made groundless the fears on this score."

POWER AND HEAT.

Long Distance Transmission.—According to "L'Elettricista," April 1, the Edison Company of Milan, Italy, will undertake the construction of a large plant to transmit 10,960 hp from the river Adda to Milan, a distance of 31 km. A tunnel 4 50 metres in diameter will be constructed, four groups of turbines and dynamos will be installed.

Power Installation in Quarries.—An illustrated description of a very large traveling crane and other electrical machinery used in a quarry in France, is published in "L'Elec.," April 6, including a detailed statement of the first cost and cost of operation.

Electricity in Agriculture.—A brief description of a plant in Tarn, in which very satisfactory results were obtained with electrical plowing, is given in "L'Elec.," April 6.

Thermopile.—An illustrated description with data, of the latest form of the Guelcher thermopile, is published in the "Zeit. fur. Elek.," April 1; the "total electrical energy" (presumably including that lost in internal resistance) amounts to about 70 watts per cubic metre (35.3 cubic feet) of gas per hour.

Governing of Steam Engines.—The Lond. "Elec.," April 12, contains an article by Mr. Addenbrooke on this subject.

TRACTION.

Traction.—The bulletin of the "Soc. des Ing. Civils" for January, contains a paper by Mr. Badois on "The Comparative Efficiencies of Electrical and Compressed Air Traction" in which he criticises the figures in a recent paper by Mr. de Marchena read before that Society (see Digest, Oct. 6, 1894); he differs in that he believes motor cars preferable to locomotives, and believes that the efficiencies for electrical traction were too high and those for compressed air traction much too low, claiming that they do not agree with the results obtained in practice on lines where compressed air traction is used; these results are discussed in detail; the paper favors compressed air traction. The same bulletin contains a paper by Mr Regnard forming part of a discussion of the same paper. It also contains a reply by Mr. de Marchena in which he gives detailed data to substantiate the values which he gave.

[illegible] Road.—According to "L'Elec.," April 6, a railway 2.5 miles long near Paris is to have its motive power changed from steam to electricity; this will be the first railway in France in which this change is to be made. There will be two locomotives of 400-hp each, drawing trains of eight and ten cars (presumably like those usually used in France which are not much larger than a large American street railway car); they are to run at a speed up to 90 km (about 54 miles) per hour; contact will be made by means of a central rail placed on the sleepers but in the stations the current will be taken from an overhead conductor; the construction of the road has already been begun and it is believed that it will be finished by autumn.

Accumulator Traction.—In a communication to the "Elek. Anz.," March 21, the promoters of the system of accumulator traction with which experiments are being made in Hagen and Vienna, state that the recent articles in which it was claimed that the system was a failure, are mere inventions; it believes that no competent authority will deny that these roads furnish another proof that accumulator traction is quite practical; (the alkaline accumulator is used on these lines).

According to the German journals the construction of an accumulator road from Hagen to Eckesey is about to be begun, and it is expected that the road will be running during the summer; several other similar roads are under consideration.

Conduit Road.—A note in the "Elek. Anz.," April 4, states that the firm of Siemens & Halske have for nearly a year been experimenting with the Lachmann system and are now about to construct a longer road; the system is not described, but it is stated that the cost is no greater than that of the overhead system as used in this country.

Trolleys and Other Collectors.—The Lond. "Elec. Eng.." April 12, contains a paper by Mr. Smith on "Some Methods of Collecting the Energy in Electric Railways and Tramways," which was read at the Northern Soc. of Elec. Eng.; he treats the subject chronologically, but considers only those devices which have been or are in use; it is not illustrated.

Mountain Climbing Railways.—The Lond. "Elec. Eng.," April 12, begins an article by Mr. Scott on this subject; he discusses rack railways and gives some information about existing rates chiefly in Switzerland, in most of which, however, electricity is not used.

American Electrical Tramway Gearing.—The Lond. "Elec.," April 12, contains an illustrated paper of Mr. Dallas on this subject.

Rome.—According to "L'Elettricista," April 1, a new line of electric tramways will be started in Rome during the present year; the power will be supplied from the Tivoli-Rome alternating current transmission plant by means of a Schuckert rotary converter or dimorphic dynamo, which is a continuous current dynamo having both an ordinary commutator and two collecting rings connected to two opposite points of the armature winding.

Electric Towing of Canal Boats.—A description of the system which has been in use for some time on the Bourbogne canal, and which has already been referred to frequently in these columns, is reprinted from the "Ann. des Ponts et Chaussees" (no date) in "Rev. Ind.," March 30; it includes very good illustrations of a number of the details; the current is taken from an overhead line and the traction is accomplished by means of an anchored chain running over pulleys. The accumulators used to equalize the load proved to be of little use; without these the total cost of the system is said to be $4,000 per km; the cost for transporting 1,000 tons by steam in 11.65 hours is stated to be $20.40 and with electricity in 11.01 hours, $14; it has been in use too short a time to draw definite conclusions.

Electromagnetic Towing of Canal Boats.—The bulletin of the "Soc. des Ing. Civils" for January contains a long paper by Mr. de Bovet in which he discusses in detail mechanical traction as applied to canal boats, describing briefly some rudder motors and giving a full description together with several plates of illustrations of his system and its application in France, in which an anchored chain is clutched by a magnetic device which was described and illustrated in these columns several years ago.

Emergency Brake.—The "St. Ry. Gaz.," April 20, speaks very highly of the Bonta emergency brake used by the North Hudson County Railway Company; it has been in use for several months and is said to have proved itself thoroughly reliable, most of the cars being equipped with it. It is not described, but it is stated that the energy of the moving car is utilized as a force to prevent the turning of the armature, and the brake is operated by the reversing switch handle, being entirely independent of the usual brake; a quarter of a turn of the lever is all that is required to apply the brake; it is claimed that the strain on the gears is not as great as would be supposed, as the force applied rises gradually from zero to its full power; a car can be stopped on a grade, going at full speed, within less than the car's length.

Counter-weight System at Providence.—An illustrated description of the Kuhlmann system is published in the "St. Ry. Rev.," April 15; by means of that system electric cars are drawn up short, steep grades by connecting on to a short cable in a slotted conduit; it is in use at Seattle, Portland and Providence.

Jungfrau Electric Railway.—The "St. Ry. Gaz.," April 20, reprints from the London "Graphic" two illustrations of the contemplated electric railway and elevator to the top of one of the highest mountains in Switzerland; (the data concerning this road has already been given in these columns).

Trolley War in Connecticut.—Mr. Gager's argument before the committee of the Connecticut legislature, in favor of the street railway companies, is published in full in the "Elec. Rev.," April 24. An article of some length discussing this subject is published in the "St Ry. Rev.," April 15.

Chicago Elevated Road.—A brief illustrated description of this road, which was recently opened, is given in the "Elec. Eng.," April 24.

Chicago.—An illustrated description of the California avenue power station is given in the "St. Ry. Gaz.," April 20.

Locomotive.—A brief illustrated description of the Sprague 67-ton locomotive for handling heavy freight, which was just completed by the Baldwin Locomotive Works, is given in the "Elec. Rev.," April 24.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electric Light for Railroads.—The whole of the discussion of Mr. Langdon's paper (see Digest, April 20) is published in the Lond. "Elec.," April 12. A number of the speakers gave data regarding similar installations. Mr. Fletcher referred to a plant run entirely by city gas at 75 cts. in which they produced a current at 5 cts. per kw hour including all charges; the capacity of the plant was 750 incandescent and 36 double carbon arc lamps, and the engine used was an entirely new one built on the tandem principle without any stuffing boxes. Dr. Preller stated that the practice on the Continent was to suspend the arcs 50 to 60 feet above the rails and make them 80 to 100 feet apart, the globes being opalescent and the lamps requiring 10 to 16 amperes. Mr. Langdon stated that as all the machinery must be kept in perfect order there is no possibility of allowing it to depreciate, and hence there should be no item of depreciation except in so far as it may be necessary to replace existing machinery with that of an improved character at some future time, and for this he allows 5 per cent. Mr. Leonard greatly preferred the clear globes when the lamps are placed very high. Mr. Manville spoke very highly in favor of the rectifiers which he had used since they were first introduced and which have proved themselves eminently satisfactory, having also achieved great economy. Mr. Albright condemned high tension direct current series arc lighting on account of the danger; he preferred the multiple arc system and stated that one could now rely on 220-volt incandescent lamps. Mr. Trotter spoke at some length about the question of illumination, and called attention to the question of whether a high maximum or a high minimum illumination is the important thing; he gave the maximum and minimum values of the illumination in foot candles for different arc lamps at different heights and distances; in this kind of lighting the ratio of the distance apart to the height is the important factor; taking Mr. Langdon's figures the lamps were six times as far apart as they were high. Mr. Siemens stated that the height ought to be about two-thirds of the distance between the lamps in order to get the maximum illumination in the centre of the space between the two posts. Mr. Chamen spoke of inverted arc lamps which had been installed in a warehouse to replace incandescent lamps which were unsuited; the result was a considerable economy in current, the amount of energy being about half of that used by the incandescent lights while the lighting was everything that could be desired; the shed measured 350 x 120 feet and the lighting was done with 12 lamps of 10 amperes. Mr. Mordey stated that he was an advocate of direct currents for arcs where they did not want a large amount of other work which could be done better in other ways, but if the arc lighting is a small part it should be done by alternating currents or with rectified alternators; he thought that the argument against alternating current arc lamps, that they did not give as much light, was exploded. Mr. Crompton among other things stated that it was very bad practice to use alternating current in a freight yard.

Train Lighting.—Some data regarding the system which has been in use in Germany is given in the "Zeit. f. Beleucht.," March 15; the result is said to be very good financially; it is stated that the cost of electric lighting is only about 50 per cent. of that of gas lighting as formerly used; of the 64 postal cars in use 27 are now provided with this system of electric lighting while the remainder will also be equipped in the course of time

Best Combination of Electric Light Undertaking.—The paper of Mr. Dawbarny (see Digest last week) is concluded in the Lond. "Elec. Rev.," April 12. He recommends that each alternator should have its own exciter, that all the alternators are run at a constant pressure and that no adjustment whatever of the exciter fields be made, all the regulation being effected by an impedance coil or augmentator in each feeder circuit. He discusses switchboards, means of obtaining an uninterrupted supply, mains and accessories outside of stations, etc.; for the primary wires he recommends the drawing-in system and for the secondary, steel-armoured concentric cables laid directly in the ground without further protection. The paper contains a number of practical hints and suggestions.

Consumers and Charges.—In a short article by Mr. Barnard in Lond. "Lightning," March 28, on this subject he gives a diagram in which the consumptions by different customers are compared in the following manner: eight consumers are supposed to have used an equal quantity of energy, each of which is represented by a rectangle on cross-section paper, the abscissæ of which give the time of the day when these loads are put on and taken off, while the lengths of the ordinates give the proportion between the amounts of capital necessary to provide the plant, in order to supply these eight consumers with equal quantities on the same day. He favors the Brighton system of charging (see Digest last week) and discusses the difference between it and the ordinary system.

Charging for Electric Supply.—In a brief communication by Dr. J. Hopkinson he refers to the recent paper of Mr. Wright (see Digest last week) and states that he considers Mr. Wright's method of applying his (Hopkinson's) principle a decided improvement upon his own; Wright charges a high price until the maximum strength of the current has been used for a certain number of hours and subsequently charges a lower rate; he thus avoids the necessity of asking the consumer by which system he will be charged.

Cost of Electrical Energy for Private Installations.—The Lond. "Engineering," April 12, compiles some figures from the recent paper of Mr. Laugdon (see Digest, April 20), from the discussion of his paper (see Digest this week), and from the weekly figures published in Lond. "Lightning," with a view to showing when it is more economical to obtain the current from central station or when it is cheaper to generate it on the premises; the conclusions are that there is no very great economy in a private installation even up to 200 or 300-hp; it is the load factor which governs the cost, if the machinery can be kept running for a greater portion of the time than is the case in the average central station then there is the prospect that it can be run cheaply

Comparative Cost of Light and Power from Private and Central Stations.—A long article in which this subject is discussed very thoroughly is contained in the first three numbers of the "Maschinen Informator," by Prof. Zickler; he deduces curves which represent the conditions under which the cost is the same.

Amortization—The discussion is continued in the "Elek. Zeit.," April 11, by a communication from Dr. Haas and another from Mr. Pruecker.

Automatic Switch.—"L'Eclairage Elec.," March 16, gives a well illustrated description of the Hopkinson automatic switch for use in charging a series of accumulators.

England.—The Lond. "Elec. Eng.," April 12, publishes two large tables in the form of a supplement giving a list of the central stations in operation in London and the Provinces and another of those in progress, contemplation, etc.; tabular data is given for each station including the cost of installation, the working expenses and receipts; no claim is made that the table is complete. That journal has always contended that central stations should be in the hands of local authorities and not in the hands of companies. No general summary of the conclusions is given.

Rome.—The Electric Supply Company of Rome publishes in "L'Elettricista," April 1, an account of the work of the past year; 3,571 metres of underground network were added; the whole length of mains in Rome now amount to about 34 miles exclusive of the transmission from Tivoli. There are now installed 733 arc lamps and 37,828 glow lamps; the equivalent number of 8-cp lamps amounts to 66,812, of which 15,538 were added in 1894.

Installations in Switzerland and Savoy.—The bulletin of the "Soc. des Ing. Civils" for January publishes a paper by Mr. Lavezzari in which he describes a number of lighting, power and railway installations.

Salzunger.—A description of this accumulator station is published in the "Elek. Anz.," March 21 and 24; it includes two large double page plates showing the ground plan and the complete system of connections.

Belfast.—A description of this accumulator station is published in Lond. "Lightning," April 4.

Ship Lighting Plant.—An illustrated description with data of a recently installed plant, is given in the Lond. "Elec. Eng.," April 12.

Transformer Boxes on Streets.—The "West. El.," April 27, reprints the illustrations from a German journal showing a transformer chamber as used in the Chemnitz station.

Varying Cost of Electricity Supply.—Mr. Wright's article abstracted in the Digest, April 27, is reprinted in "El'ty," April 24.

Three-phase Plant at St. Hyacinthe.—A brief description of this plant, which is said to be the first three-phased plant in Canada, is given in the "Elec. Eng.," April 24.

Baltimore.—An illustrated description of the new Brush station is given in the "Elec. Eng.," April 24.

WIRES, WIRING AND CONDUITS.

Explosions.—The report of the committee of the Royal Society and the Institution of Electrical Engineers regarding the alkaline deposit in the case of the St. Pancras explosion, is published in full in the Lond. journals, April 12. The committee is of the opinion that the explosion was due to a mixture of coal gas and air ignited by sparks caused by the incrustations which were found; such sparks may be caused either by the incrustation itself acting as an imperfect conductor or by moisture in contact with metallic sodium or potassium, both of which metals were found in the incrustation; these metals were produced by the electrolytic decomposition of alkaline salts derived chiefly from the soil and conveyed by moisture along the fibres of the wooden bearers toward the negative conductor; to avoid a repetition of the accident the bearers of the insulators should be replaced by others through which moisture cannot travel. An analysis of the deposits is given.

Present Methods of Electric Wiring.—An article by Mr. Bathurst referring more particularly to conduits vs. casing, is published in Lond. "Lightning," March 28, and is discussed by others in succeeding issues.

Practical Wiring Specifications.—In a short article under this heading in the "Elec. Eng.," April 24, Mr. Dobbs calls attention to the loose form of specifications often met with, and points out the importance of employing experts to draw up the specifications and supervise the work; a few hints are also given.

ELECTRO-PHYSICS AND MAGNETISM.

New Electrical Theorem.—The Lond. "Elec. Rev.," April 12, abstracts a recent Physical Society paper by Mr. Blakesley, vol. 13, part 1st, p. 65. "If in any system of conductors, however reticulated, two or more modes of disposition of source of E. M. F. produce in every part of the same network the same current, such systems of disposition are called equivalent systems. Then the theorem is as follows: If any system of conductors, possessing seats of E. M. F. at any number of points, and if any of these sources be supposed to move continuously along the various bars of the conducting system, and where a point of juncture is encountered, each to become a seat of the same E. M. F. in each of the newly encountered bars (of course, leaving the resistance of the source behind), then the disposition at any moment is equivalent to that at any other moment, and, therefore, to the original disposition. (Of course, the direction of the E. M. F. must be carefully maintained the same; if it is towards the knot before crossing it, it must be away from the knot after passing it.)" Equivalent systems might have been defined as those which produce the same expenditure of power in each part. Several propositions which follow from the theorem are given.

Dielectric Hysteresis.—A Royal Society paper by Messrs. Porter and Morris is reprinted with illustrations in the Lond. "Elec.," April 12. They describe experiments to ascertain whether the additional dissipation which was found when a condenser discharged itself through a coil containing induction, is the result of viscosity only or true hysteresis; they claim that a sharp distinction should be made between the two, viscosity being a time effect while hysteresis does not in any way involve the rate at which the changes in the quantities are made; the results are given in tables and curves and the method used is described; the results show that while the condenser, in which paraffined paper was used, exhibits marked viscous effects, yet they could detect no hysteresis.

Dielectrics.—The paper of Mr. Appleyard (see Digest, Oct. 27) is published in full in the Lond. "Proc. Phys. Soc." for January.

Conduction of Heat and Temperature in Geissler Tubes.—A paper by Mr. Warburg from the "Weid. Ann.," 54, p. 265, is abstracted in the Lond. "Proc. Phys. Soc." for April. Among other things he states that since a rise of temperature of several hundred degrees has no effect on the brightness with which the tube glows he concludes that the glow is a direct effect of the current and is not due to the temperature.

Theory of Electrical and Optical Phenomena in Connection with Movable Bodies.—A mathematical essay by Mr. Lorentz is abstracted at some length in the Lond. "Proc. Phys. Soc." for March and April.

Saturation Pressure of a Vapor in an Electric Field.—A paper by Mr. Sokolow from "Jour. de Phys.," 4, p. 53, is abstracted in the Lond. "Proc. Phys. Soc." for April.

Nature of Maxwell's Displacement Current.—A paper by Mr. Vaschy from the "Comptes-Rendus," 120, p. 255, is abstracted in the Lond. "Proc. Phys. Soc." for April.

Electrostatics—Mr. Pellat's article mentioned in the Digest, March 23, is continued in "L'Eclairage Elec.," March 16.

Action of Cathode Rays on Salts.—A paper by Mr. Goldstein from the "Weid. Ann.," 54, p. 371, is abstracted in the Lond. "Proc. Phys. Soc." for April.

Luminescence of Glass Due to Cathode Rays.—The paper of Mr. Burke abstracted in the Digest, Jan. 26, is published in full in the Lond. "Proc. Phys. Soc." for April.

Magnetic Circuits.—In an article in "L'Elettricista," April 1, Mr. Giorgi lays stress on the practical utility and the scientific character of magnetic circuits; he points out the principal differences existing between the laws of propagation of heat, according to Fourier's theory, and the laws of magnetization; he shows that there is no advantage in applying the same methods of calculation used for thermal problems, to magnetic circuits as was suggested by Prof. Ascoli, this question is discussed at some length.

[illegible]—Prof. Perry's paper mentioned in the Digest, Oct. 20, is published in the Lond. "Proc. Phys. Soc." for February.

[illegible]—A paper by Mr. Ascoli from the "Weid. Ann.," 54, p. 381, is abstracted in the Lond. "Proc. Phys. Soc." for April.

Mirrors of Magnetism.—The paper of Mr. Thompson and Mr. Walker abstracted in the Digest, Feb. 23 (see also March 2, 1894), is published in full in the Lond. "Proc. Phys. Soc." for April.

Electromagnetic Rotation of Solutions of Hydrochloric Acid.—A paper by Mr. Schoenrock from the "Zeit. Phys. Chem.," 16, p. 29, is abstracted, including a table of results, in Lond. "Proc. Phys. Soc." for April.

Automatic Air Pump.—An article by Mr. Kiss describing the Schuller pump is abstracted in the Lond. "Proc. Phys. Soc." for April; he combines a water and mercury pump to form an automatic apparatus.

[illegible] Physical Papers.—Beginning with the issue of January, 1895, the Lond. "Proc. Phys. Soc." contains a large number of abstracts of physical papers from foreign sources among which are quite a number on electricity; many of them are of not very recent date; most of them have been noticed in the Digest; beginning with the April number of these Proceedings, those abstracts which have not been noticed in the Digest will be referred to in these columns.

ELECTRO-CHEMISTRY AND BATTERIES.

Thermo-Chemical Carbon Cell.—The Lond. "Elec.," April 12, calls attention to a recent French Academy paper by Mr. Korda on this subject. He finds that if barium peroxide is heated to redness in contact with a carbon plate it becomes reduced to baryta producing a difference of potential of about one volt, the carbon plate being negative. A similar result was obtained with cupric oxide when a layer of potassium carbonate was placed between the oxide and the carbon, the difference of potential being 1.1 volts; the experiments were made by placing the salt on a plate of gas-retort carbon and dipping the platinum wire into it; when heated to a dull red carbon dioxide is evolved causing violent effervescence. A longer abstract is published in the "Rev. Ind.," April 6, in which it is also stated that the electrical energy accompanying the reaction represents but a small fraction of the chemical energy developed most of which is transformed into heat; if, however, graphite is used instead of artificial carbon, the voltage will remain the same and the quantity of copper and peroxide formed bears a better relation to the weak current produced; in any case the law of Faraday does not apply on account of the heat energy which is present in reaction.

Borchers' Battery.—In the "Zeit. f. Electrochem.," April 5, Dr. Borchers reprints the recent article of Messrs. Barnes and Veeseneyer (see Digest, Feb. 23), and replies to it. He grants that those experiments may have been made with great care but he claims that they have gone too far in the deductions; he states that a fundamental condition for the generation of current by a chemical process is "the separation of the material of the annode from the substance which oxidizes or dissolves it," referring to a recent paper by Dr. Ostwald; as the experimenters stated that there was a diffusion of the oxidized liquid through the porous cell to the annode, he states that such a cell could not have given the expected result; if it can be shown that copper solutions have this property with all porous diaphragms, then it would only prove that any apparatus with a porous diaphragm would not be suitable for such a cell and the apparatus proposed but not yet tried by him would then require to be modified; but these experimenters have not proved this for they have not tried different diaphragms; a proof to the contrary was shown by Mr. Tatlow (see Digest, Feb 9); there appear to exist, therefore, diaphragms which are capable of keeping cupric and cuprous solutions separated from each other. He denies that these experimenters adhered to the conditions given by him. In conclusion he states that as soon as he has time he will work out and publish the "complete chemical balance sheet" called for by the Lond. "Elec."; until then he declines to discuss the subject further.

Improvement in the Callaud Cell.—The "Zeit. f. Electrochem.," April 6, contains an article by Mr. Bolton in which he describes an improvement which he has recently tested. An important objection to the present form is that the copper sulphate is apt to come in contact with the zinc occasioning a loss in both substances; to overcome this he mixes one of the solutions with a sufficient amount of gelatine and allows it to set; the diffusion while at rest, from the gelatinized solution to the other and the reverse, is approximately the same as with the simple solutions, but the diffusion will in no way be affected by mechanically shaking the battery, and such a cell therefore becomes transportable. He describes a number of tests made with the ordinary cell, with another in which the copper sulphate was gelatinized and with another in which the zinc sulphate was gelatinized; the results of the tests covering 12 days are given in detail; in order to prevent diffusion some zinc shavings were laid on the top surface of the gelatinized copper sulphate; although the zinc in the ordinary cell was soon covered with the usual copper deposit, that in the gelatinized cells remained quite clean; the internal resistance of the gelatined cells was increased only 12.5 per cent., which in a week was reduced to 10.2 per cent.; that in which the zinc solution was gelatinized gave better results than the one in which the copper solution was so treated; in the former a plain solution of zinc sulphate was poured over the gelatinized zinc solution. It is claimed that this is much better than to use paper, sawdust, or other separators, as it is much cleaner and there is no copper deposited, while at the same time it is transparent.

Accumulator.—The "Zeit. f. Electrochem.," April 5, gives a brief description of the Riguelle accumulator from the English patent; the spongy lead is replaced by a spongy mass of an alloy having the formula three atoms of lead and one of tin; if the useful voltage of the ordinary lead accumulator is taken as 1.97 that of the present form will be 2.25.

Purification of Edible and Lubricating Oils by Means of Electricity.—The "Elec. Tech.," March 15, states that Mr. Levatt, of Paris, made the following experiments: A cylinder was filled with olive oil of a poor quality, sour taste and brown color, and enough water was added to make a layer 1 to 1½ in. deep; two electrodes connected with a dynamo were inserted in this water and a current at two or three volts was allowed to pass until the water was nearly all decomposed, after which the oil had a bright color, its taste was completely changed, becoming quite pleasant, and the acidity had disappeared; about 20 low-class oils were tried and in all cases were greatly improved; a number of lubricating oils of a poor quality were also tried containing at least 5 per cent. or more acid which was reduced to 1 per cent. and by a repetition of the process down to $\frac{1}{10}$ per cent., but the remaining acid could not be extracted by any means; no further details are given.

Purification and Sterilization of Drinking Water by Electrolysis.—A paper by Mr. Oppermann is abstracted briefly in the Lond. "Proc. Phys Soc." for April. In the electrolysis of water small quantities of ozone and hydrogen dioxide are formed; he describes a technical process for preparing drinking water by the use of ozone, the best conditions for the production of which are, a temperature below five or six degrees C., small platinum electrodes and a high current density; an excess of ozone makes the water unfit for drinking; to get rid of the ozone and hydrogen dioxide he proposes to submit it to a second electrolysis with aluminium electrodes; after filtering, the water is fit to drink.

Metallurgy of Gold.—A new process invented by Mr. Lossen is described briefly in the "Elek. Anz.," March 28. The solution for dissolving the gold from the finely pulverized ore consists of potassium bromide which has been electrolyzed without a diaphragm, and changed into an alkaline solution of bromium; the ores are treated with this in large revolving drums, sufficient solution being added to keep it alkaline until all the gold is dissolved; other metals contained in the same ore will be changed into insoluble hydro-oxide compounds; after filtering, the gold is deposited by means of iron or coal and the solution is thereby re-converted into bromide of potassium, which is then electrolyzed and used again; the process is to be tried in a mine in Oregon.

Electrolysis of Gold.—The discussion of Dr. Keith's recent paper is continued in the form of an article by Mr. Fitzgerald in the Lond. "Elec. Rev.," April 12; it is devoted mainly to quotations from standard works regarding the definition of the term electrolysis.

Dye Products by Electrolysis.—The Lond. "Elec. Rev.," April 12, states that naphthazarin and its products may now be prepared electrolytically; to prepare it a hot sulphuric acid solution of 1.1′-dinitronaphthalene is submitted to the action of the current; one kg of the mother substance is dissolved in 20 kg of acid and the temperature carried to 130 degrees C.; a porous diaphragm is used; the cathode is in the hot solution and the annode in the sulphuric acid, a porous diaphragm separating them; a current of 15 amperes per square "diameter" (probably decimeter) is used.

Soap.—A process for making sodium or potassium soaps from salts, fats and resins by electricity is described briefly in the "Elek. Anz.," March 31. At the negative electrode the potassium or sodium which is deposited is converted into a compound of these metals with the fatty acids, while at the positive electrode the chlorine combines with the tin of the electrode, forming the chloride which owing to its specific gravity, falls to the bottom of the tank, where it can be collected; the system appears to be that of Mr. Roth.

Nickle and Cobalt.—An electrical method for obtaining pure nickle and cobalt, used by Winkle in his experiments to find their atomic weight, is described in the "Zeit. f. Electrochem.," April 5.

Electrolysis and Polarization of Mixtures of Salts.—Acording to Buff when a mixture of two salts is electrolyzed there is a fixed ratio between the amounts of each, decomposed by the current, and this ratio is independent of the strength of the current. The Lond. "Elec. Rev.," April 12, abstracts briefly two papers of Mr. Houllevigue, one dated 1890, and the other from the "Ann. de Chim. et de Phys.," 7, 2, p. 351, in which he shows that the deposit varies greatly with the intensity of the current, which is therefore contrary to the results obtained by Buff. The ratio between zinc and copper deposits increases with the current and is a hyperbolic function of the intensity. When mixtures of variable compositions are electrolyzed he finds that the weight of the one more readily electrolyzed increases regularly with the amount in which it is added to the mixture, except when the total amount is very small; the polarization depends on the nature of the constituents even when only one undergoes electrolysis; he believes that Lippman's law of the polarization of an electrode holds good only for very small currents.

The Work of Electrolysis.—The second installment of Mr. Gross' article is published in the "Elektrochem. Zeit." for April.

Thermo-dynamics of Galvanic Polarization.—A paper by Messrs Jahn and Schoenrock from the "Zeit. Phys. Chem.," 16, p. 45, is abstracted in the Lond. "Proc. Phys. Soc." for April.

Ions.—The conclusion of Dr. Gerstman's article is given at considerable length in the "Elektrochem. Zeit." for April.

Cathode Polarization.—A paper by Mr. Roszkowski from the "Zeit. Phys. Chem.," 15, p. 267, is abstracted in the Lond. "Proc. Phys. Soc." for April.

Electrolytic Conductivity Curves.—A paper by Mr. Swarts from the "Zeit. Phys. Chem.," 16, p. 118, is abstracted briefly in the Lond. "Proc. Phys. Soc." for April.

Progress of Scientific Electro-Chemistry.—A third installment of Mr. Luther's article is published in the "Zeit. f. Electrochem.," April 5.

Electro-Metallurgy of Gold.—The "Eng. & Min. Jour.," April 20, gives an abstract of the recent litigation and decision in the English court regarding the MacArthur-Forrest patents.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Universal Electrodynamometer.—A small pamphlet published by Springer, Berlin, gives a very complete description of an instrument devised by Prof. Zickler which can be used for measuring current, voltage, and watts, of both direct and alternating currents within no small limits; it consists of an electrodynamometer in which the deflection of the movable coil is balanced by a spring, as usual in such instruments, the deflection being always brought back to zero; the movable coil contains two windings one of fine wire and one of coarse, while the fixed coil is made of quite a number of coils of different sized wire and number of windings; the connections to all of these coils lead to binding posts by means of which they may be conveniently coupled in a number of different ways, thus enabling the instrument to be used as an amperemeter, voltmeter, or wattmeter of adjustable ranges; the data concerning the instrument is given in detail.

Students' Simple Apparatus for Determining the Mechanical Equivalent of Heat.—Prof. Ayrton and Mr. Haycraft's paper abstracted in the Digest, Jan. 12, is published in full in the Lond. "Proc. Phys. Soc." for April.

Clarke Cell when Producing a Current.—A paper by Prof. Skinner abstracted in the Digest, Oct. 20, is published in full in the Lond. "Proc. Phys. Soc." for February.

Resistance Material.—A table of the values of the nickle alloys (mentioned in the Digest last week) is published in "Elek. Anz.," April 4, to which is also added a table for the maximum currents for these wires.

Measurement of Intensity of Light by Chemical Action.—A paper by Mr. Lemoine from the "Comptes-Rendus," 120, p. 441, is abstracted briefly in Lond. "Proc. Phys. Soc." for April.

Determination of Luminous Flux.—The recent paper of Prof. Blondel from the "Comptes-Rendus," 120, p. 311, is abstracted in Lond. "Proc. Phys. Soc." for April.

Resistance Determination in Absolute Measure.—A paper by Prof. Himstedt from the "Weid. Ann.," 54, p. 305, is abstracted in the Lond. "Proc. Phys. Soc." for April.

Alternating Current Method of Determining the Resistance of Electrolytes.—A paper by Prof. Kohlrausch from "Zeit. Phys. Chem.," 15, p. 126, is abstracted in the Lond. "Proc. Phys. Soc." for April.

Determination of Induction Coefficients of Solenoids.—A paper by Prof. Himstedt from the "Weid. Ann.," 54, p. 335, is abstracted at some length in the Lond. "Proc. Phys. Soc." for April.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Reduction of Telephone Rates.—In a communication to the "Elek. Zeit.," April 11, Mr. Ross disagrees with the opinions recently expressed in that journal (see Digest, April 20), that the reduction in telephone charges can be accomplished only by the use of conversation meters; he argues that, taking the Vienna system as an example, the apparatus is used during only 8 per cent. of the 10-hour day and he believes that in this the difficulty lies; to reduce the cost, the apparatus should be in use during a longer time, and this may be accomplished only by a system similar to that of Mr. Nissl which has already been fully described.

Telephone Charges.—In the conclusion of the article on this subject in the "Jour. Teleg.," March 25, a table is given containing the charges in most of the countries of the world except the United States; also those for interurban and international lines.

Telephone Systems in Large Cities.—A very long paper by Mr. Wabner is reprinted with the discussion in the "Elek. Zeit.," April 4. He discusses the functions of the central stations and the apparatus, and criticises the propositions which have been made for large stations; he refers more especially to the question of whether it is possible and practical commercially to have one large central station for a large city or whether it would be better to have several central stations with a limited number of subscribers; he thinks the limit for one station should be 5,000 to 6,000 subscribers; in the discussion which follows, differences of opinion were expressed regarding the latter.

Telephone Switchboards.—"L'Eclairage Elec.," March 16, contains a well illustrated article by Mr. Vartore in which he refers to the recent article of Mr. Kingsbury and supplements it with an illustrated description of the three principal types of switchboards, which he says "have until now characterized the development of telephony;" they appear to be chiefly of American origin.

Telephone Service.—The proceedings of the meeting of the Parliamentary Committee are published in the Lond. "Elec. Rev." and "Elec. Eng.," April 12.

Long Distance Telephony.—The "Jour. Teleg.," March 25, begins an article by Mr. Collette.

Application of the Telephone for Fire Alarm Purpose.—The "Jour. Teleg.," March 25, abstracts from a report on this subject from the German Government Statistics for 1893.

Brake Regulator for Synchronous Movement.—A paper by Dr. Raps describing a new regulator of Siemens & Halske adapted more especially to the Hughes typewriting telegraph, is published in the "Elek. Zeit.," April 11. He gives a short mathematical discussion of the theory and describes the apparatus, which is said to give a very uniform motion and has other advantages; it has been in use for almost a year in Berlin, where it has given very good results.

Telegraph Statistics for Germany.—The "Elek. Zeit.," April 4, gives in some detail the statistics for Germany for the year 1893. The length of the telegraph lines was 106,352 km and the length of the circuits 394,552 km; the total number of telegraph stations was 16,902; the total number of telegrams was 30,573,522.

Submarine Telegraph Cables.—The first part of a lecture of a semi-popular nature by Mr. Trott is reprinted in the "Elec. Eng.," April 24; he gives a few details regarding cable laying and repairing from a sailor's point of view, intimating that the sailors as distinguished from the technical engineers are "the men best qualified for this important work."

Automatic Telephone Exchange.—The Deckert and Homolka system (which has been in use in Prague for a number of years) is described and illustrated by Mr. Berthold in the "Elec. Rev.," April 24; (a reference to the original description was given in the Digest, Feb. 23).

Early History of the Telephone.—The recent remarks of Prof. Hughes referred to in the Digest, April 1, are reprinted in the "Elec. Age," April 20.

Death from 280 Volts.—In a communication by Mr. Carr to the "Elec. Eng.," April 24, he states that a fatal accident recently occurred in the mines of the Leavenworth Coal Company in which a laborer was instantly killed while handling a machine the E. M. F. of which did not exceed 280 volts; a number of others received the shock at the same time without injury; he asks for an explanation.

Biographical.—A portrait of Coulomb and the titles of seven of his memoirs, are given by Prof. Mayer in the "Elec. Eng.," April 24.

Opportunities in Electrical Engineering.—An article by Mr. Atkinson on this subject is begun in "El'ty," April 24; he believes that an electrical career presents to-day as many opportunities as other careers.

MISCELLANEOUS.

Calcium Carbide and Acetylene.—The "Zeit f. Electrochem." contains an article by Dr. Borchers in which he gives the history of these materials stating that in 1891 he published a description of experiments made by himself, from which it follows that there can be no controlling patents for their manufacture, as he then showed that metals containing carbon, that is, metallic carbides, can be produced electrically by heating a mixture of the metallic oxide and powdered coal; (he does not give the reference to his publication). He quotes the recent estimate of Mr. Willson stating that he has no confidence in it, the cost of the electric power being far too low, as also the allowance for labor, etc.; his own experiments show that the amount of power consumed was very much greater; according to his own estimates to produce 1,000 kg of calcium carbide will require 900 to 1,000 kg of burnt lime according to its purity, 800 kg of coal and 450 to 480 electrical hp during the 12 hours. He discusses the various properties and applications of alkaline carbides and acetylene, and states that the latter may be produced by the direct combination of carbon and hydrogen when an arc is formed between two carbons in an atmosphere of hydrogen. An important property of acetylene is that it can be combined directly with nitrogen, forming hydrocyanic acid, by the action of the electric spark.

Foundations of Electrical Science.—The Lond. "Elec.," April 12, contains a communication by Mr. Giorgi on this subject in which he criticises some recent statements by Prof. Cornu (see Digest, April 6); he discusses the question of what is the most consistent and logical conception of electrical science; he believes that it is about time that old-fashioned theories should be left out for more scientific ones; he suggests that by assuming the current to be a fundamental conception, the definition of electromagnetic quantities easily follows, electromotive force for instance may be defined as the coefficient of current in the expression of power, that is the power per unit current. He believes that such a method would be a rational one for the establishment of electrical science.

[illegible] The "Prog. Age," April 15, contains a short paper by Mr. [illegible] on "Carbide of Calcium" read at the recent meeting of the Ohio Gas Light Association; he gives a brief summary of the subject; he states that even at $100 per ton it might rob the gas man of some business; "it looks very much as though in a very short time it would own the field for car and isolated lighting." This is followed by another paper on the same subject by Mr. Goodwin, giving however very little technical matter; he states that this material may possibly have an influence on the gas business not realized or dreamed of at this time.

Death from an Electric Shock. The "Elec. Rev.," April 24, contains an article by Dr. Bleyer on "Dynamic Apoplexy" in which he claims that the cause of death after receiving a lethal dose of current is due to what he terms dynamic apoplexy, a fact which he ascertained by close investigation. Microscopic specimens of the brain of the criminal Hampton, who was recently executed in New York, are shown, demonstrating the rupture of many blood vessels both in the cerebrum and in the cerebellum, which furnish proofs that point toward the great dynamic power of the current to rupture the blood vessels in these regions, as well as in others such as the liver. He advocates the use of artificial respiration in case of accidental shock.

New Wood Multipolar Dynamo.

The accompanying illustrations represent a new 60-kw medium speed dynamo for incandescent lighting or power, designed by Mr. James J. Wood, electrician and mechanical engineer for the Fort Wayne Electric Corporation. Fig. 1 shows the complete machine, which, like all of Mr. Wood's apparatus, presents a very attractive and substantial appearance, while the mechanical perfection of detail, workmanship and finish characterize it as a modern high grade machine. In the several sizes up to and including 120 kw, the lower portion of the field, pedestals and base are made in a single casting, while in the larger sizes, which have an outboard bearing, the parts are cast separately and bolted to the base, making the dynamo easier to handle in making installations. A notable feature in this generator is the absence of most of the loose cables, wires and connections so generally used, the connections in this case being made within a closet in the journal pedestal, which is normally closed by a grating. The main terminals are mounted on slate bases at each side of the pedestal, as shown in the cut. The two small binding posts shown in front are for the field rheostat connections. The dynamo is compound wound and can be run in either direction by simply changing the brush holders on the studs without changing any of the connections, the brush holders being so proportioned with relation to the commutator that the act of reversing them on the stud changes the point of contact 90 degrees, placing them in the correct position for commutation when the dynamo is run in the opposite direction. The curved pedestal on the commutator end is also a decided advantage, as it not only reduces the floor space and weight of metal required in the base, but allows the dynamo to be turned end for end on the sub-base if desired. The bearings are self-oiling and aligning, and are of ample proportion to withstand the strains to which they are subjected. The field coils are wound on steel spools with brass heads, making them very easy to replace in case of an accident.

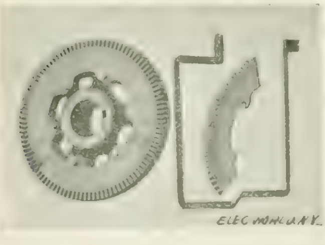


Fig. 2.—Armature Details

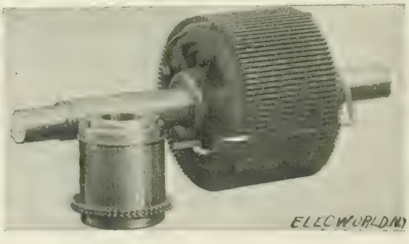


Fig. 3.—Armature Core and Commutator.

The armature construction of this machine embodies several novel features. Fig. 2 shows the commutator and complete core with one of the coils in place, and Fig. 3 shows one of the armature punchings, the method of building up the core, and one of the coils before being insulated. As will be seen from the cut, the armature core is built up of segmental punchings, having hooks projecting from the inner edge, which partly enclose the clamping bolts. These punchings alternate with one another in order to break joints, the hooks making contact with the bolts on opposite sides, but without completing the magnetic circuit around them. This construction renders the several segments self-supporting, there being no strain on the spider or bolts other than that produced by the torque, and as a consequence the spider can be of exceedingly small cross section and in marked contrast to the heavy cast iron or steel structure usually required. The hooks which engage with the clamping bolts not only break joints but alternate in position leaving spaces between the adjacent segments equal to the thickness of the iron punchings, which gives a very great increase in the radiating surface of the core.

A careful set of tests are said to have shown that with this construction there is absolutely no current generated in the clamping bolts or spiders. The advantages claimed may be summed up as follows: Minimum weight of armature; greatly increased radiating surface; self-supporting core construction; simplicity of spider construction; economical use of sheet iron, and small cost for punching dies and their maintenance. This method is particularly advantageous in the construction of armatures of large diameter.

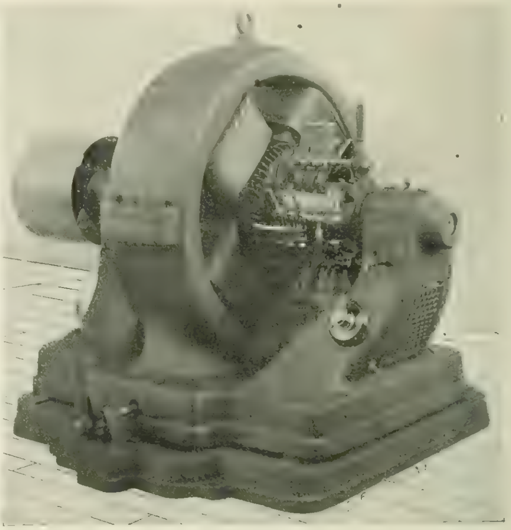


Fig. 1.—Wood Generator.

The armature coils present features of rather greater simplicity than the bar method of winding heretofore employed and embodies decided electrical and mechanical advantages.

The coil is composed of four bare wires, wound on a former, with a heavy copper connector soldered at one end, which makes connections by screws to the commutator segments. This construction obviates joints at each corner of the winding, and reduces the number of soldered joints from five to one, as compared with the bar method. As a consequence the resistance of a turn and the C^2R losses in the armature are materially reduced. After being formed in shape, shown in Fig. 3, the coil is carefully insulated and placed in position on the core, as shown in Fig. 2, the return ends being soldered into holes in the commutator connector referred to. The commutator is then slipped on the shaft and each connection secured to its proper segment by two screws.

The commutator is constructed of hard drawn copper with mica insulation, and put together by hydraulic pressure. The commutator segments, brushes and brush holders are of ample cross section for the currents which the dynamo is intended to generate. The armature circuits are so arranged and connected that either two or four sets of brushes can be used on the commutator; either set can be removed while the dynamo is running, and the remaining set will carry the current without over-heating. On a recent test a 60-kw dynamo was run on a load of 525 amperes at 120 volts for 10 hours, after which careful readings were taken, and the result showed the maximum rise in temperature in any part of the machine to be only 35 degrees C. above that of the room.

The dynamo weighs complete 7,300 pounds, while the armature complete weighs but 950 pounds, and at a speed of 650 revolutions per minute delivers 500 amperes at 120 volts, which can be raised to 140 if required.

An Electrical Porcelain Factory.

Owing to the difficulty experienced in obtaining in very great quantity porcelain possessing the requisite character for electrical work, the General Electric Company established some time ago a very complete porcelain factory as an integral part of its immense plant at Schenectady, and this has been in constant operation ever since with excellent results.

This porcelain factory, although only a pottery in miniature, is nevertheless complete as to details, comprising kilns, mixing, moulding, and drying rooms, and a full equipment of the latest and most approved machinery.

MIXING ROOM.

VIEW OF KILNS.

The building is a two-story brick structure covering an area of about 14,000 square feet. On entering by the main door one is admitted immediately to the mixing room where crude kaolin, or china clay is brought to be washed, manipulated and mixed. After passing through the mixing machine, the clay is strained through bags to remove any hard material which might interfere with the succeeding operations. From the straining press it comes in large lumps, and in that condition is partly dried, placed in a pulverizer and reduced to the necessary condition for use in the press room, to which it is taken in the shape of moist, grayish, disintegrated clay.

PARTIAL VIEW OF PRESS ROOM.

The pressing room is immediately over the mixing room. The machines in which the porcelain is moulded are upright screw presses and stand along three sides of the room directly under large windows. The moulds used are made of special tool steel by a corps of experienced tool makers in the works. In designing these moulds, or dies, the shrinkage of the porcelain due to the drying and pressing is calculated to a nicety, in order that when the porcelain leaves the kilns in its finished state, the metal pieces, which have been punched out in the stamping department, may fit accurately. The catalogue number of each piece of porcelain is cut in the die, so that the number appears in relief on the base of the finished piece. The lower part of the die is fixed to a small table, which can be moved up or down by means of a foot lever and sets in a hollow space in a larger table forming the base of the press. The upper part of the mould is fitted to a sliding bar, which is elevated or depressed by a lever and screw. When the die is fixed in position, the pressman weighs out the proper quantity of pulverized clay to be used. With a small brush the two dies are then thoroughly dampened. The bottom one is then lowered to its normal position and the operator pours in the clay and presses it down evenly with his hands to give it a preliminary packing. A vigorous twist given to the lever brings the upper die down upon the clay with considerable pressure; another twist in the opposite direction raises the upper mould, and at the same time the lower one is elevated by the foot lever. A depression of the latter then lowers the bottom die, and leaves the mass of clay, pressed into the desired form, in the hands of the workman. This is laid with others upon a rack to undergo the process of air drying. The entire space in the centre of the press room as well as a part of the second floor in the main building is occupied by these racks.

The door in the press room opens into a spacious room which occupies part of the second floor at the left wing and the whole of the main building. In this room all the pieces are touched up; the burrs are removed from all holes through which screws and punchings are to pass; the marks of the dies are cut off and the pieces put into final condition for baking and sent to the kilns.

Descending from the finishing room, the kiln room on the ground-floor is reached, where are to be found four pottery kilns constructed after the latest approved methods. Around the kiln stands piles of yellow "billers" and "saggers" which are made in one corner of the kiln room. These are filled with the moulded pieces of clay, covered and hermetically sealed. The kiln is then filled with them and the doors closed.

After the first baking the porcelain comes out in the form of a hard, white, compact "biscuit." For certain insulating purposes, this "biscuit" is employed as it comes from the kilns. It is non-absorbent to a high degree, and is used for socket bases and other purposes where the porcelain is not exposed. For switch bases, insulators, cut-outs, etc., however, the porcelain is glazed, and subjected to another firing. When it leaves the firing kiln it is beautifully white, compact in texture, extremely hard, and has exceedingly high insulating properties.

From the kilns the porcelain which is to be used in cut-outs, switches, sockets, transformer connecting boards, and in many other appliances, is taken to the second story of the right wing of the building, where the metal parts are attached.

The insulators for special work, such as for transmission at very high voltages, are tested in a small room adjoining. Each insulator is subjected to as severe a test as could be devised, and before being accepted as satisfactory must show a capability of withstanding a pressure of 25,000 volts alternating current. In order to test the endurance of these insulators, the testing current has been raised as high as 52,000 volts before any of these special insulators gave way. The only trace of the enormous pressure then apparent on the outside of the insulator was a pin point hole scarcely perceptible.

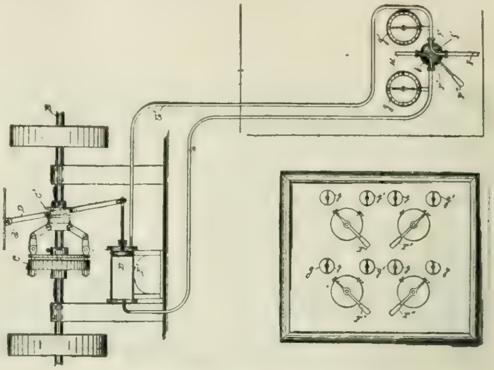
Electric Towels and Underclothing.

A person (or persons), says the London *Electrical Review*, under the style of the Anti-rheumatic Towel Company, is endeavoring down at Manchester to exploit the ailments of valetudinarians and other weak-minded and feeble-bodied humans, by advising them to purchase electric towels and electric underclothing. An extract which speaks for itself, and taken from one of the circulars, is as follows: "The anti-rheumatic towel is made from a fibre which generates electricity on any part of the human body by friction. Cotton and linen produce it similarly, and woollen is more powerful than either; but these and all other known fibres absorb what they produce. The anti-rheumatic towel, having a negative power, compels the body, or part on which it operates, to absorb the electricity it generates. The work there begun by the towel can be carried on by wearing underclothing made from the same fibre. The slight friction caused by the movement of the limbs continues, by a gentle process, to permeate the system with electricity, and invigorates the blood to a lively circulation. Thus the body is strengthened, and the healthful glow which results is a permanent resistant against change of temperature." The confiding public is then assured that a cure in a natural way "is effected if the towel is applied freely to the parts affected, and if this treatment is followed up by the wearing of electric knee-caps, cuffs, waist-belts, chest protectors, vests, pants, combinations, etc.," which seems rather a lot of clothes to wear all at once.

Partial View of Assembly Room.

An Hydraulic Clutch Operating Device.

In the operation by hand of friction clutches considerable effort is required on the part of the attendant, and a great deal of running about is necessitated between the points where the clutches are operated and the switchboard, etc., and it is of the greatest advantage to be able to control the operation of these clutches from the point where the general control of the station is centred, namely, the switchboard. By the use of the system here described, which is an invention of Mr. J. Brodie Smith, of Manchester, N. H., it is possible by the simple turning of suitable valves to control the operation of any number of clutches or other power transmitting devices from the switchboard or other central point, irrespective of the distance at which are located the different devices controlled.



Hydraulic Clutch Controller.

The action of this device will be understood from an inspection of the accompanying cut, from which it will appear that each clutch is provided with a double-acting hydraulic cylinder connected with the lever. This cylinder is connected to a source of hydraulic pressure and to the operating point by means of piping, and situated at the operating point is a four-way valve, suitably arranged to provide for the turning on of the pressure to either end of the hydraulic cylinder or of cutting off the pressure altogether. In one of the positions of this four-way valve the hydraulic pressure acts upon the piston so as to throw the clutch in; in the reverse position of the valve, the pressure acts oppositely on the piston, and throws the clutch out. By a careful manipulation of the valve the clutch may be thrown in and the load "picked up" very gradually. In connection with the hydraulic cylinder may be electrical contacts so arranged as to indicate at the controlling point the position of the clutch—whether in or out, and pressure gauges are provided corresponding to each clutch, showing in which direction the clutch is being moved, how fast it is moving, and whether or not it has reached the end of its travel.

It is obvious that there is hardly any reasonable limit to the number of clutches which can be handled from a given point, and a controlling board for four clutches is shown in the lower left hand corner of the illustration.

The character of this device would seem to be such as to appeal with great force to the practical central station man who has tried to accomplish the somewhat difficult task of being in two places at once—at the clutch lever and at the regulating rheostat—and it is believed that this arrangement is capable of extensive application throughout installations employing this method of transmitting power to or from electrical machinery.

An Efficient Oil Engine.

Oil engines are now being extensively used in Europe, and have proved very successful and economical there for isolated electric lighting plants and other purposes. As this fact is rapidly being recognized in this country a description of the oil engine built by Priestman & Co., Philadelphia, Pa., will be of interest.

This engine is shown in Fig. 1. It is operated by the ignition of a fine oil spray which is drawn into the cylinder of the engine behind the piston in quantities varying in proportion to the load being driven. By varying the spray of oil excellent regulation is obtained without the necessity of suppressing expansions, and the uniform speed thus obtained has secured for the engine an excellent record in incandescent work. In this connection an inspection of the indicator card shown in Fig. 2 will be interesting.

In many respects the engine is similar in its mode of working to gas and other forms of internal combustion engines, but there are essential differences to be considered, one of the most important of which consists in the use of high fire test safety oil (150 degrees). The oil is not carburized, and then used as a gas, however, but is broken up into a fine spray by a special device, and passes into the mixer (which corresponds somewhat to the steam chest of a steam engine and is shown directly below the back end of the cylinder) where it is kept warm by the exhaust passing around it. It is thence drawn into the cylinder and there ignited by means of an electric spark, which is caused to pass between two platinum points just as the piston passes the centre.

The Priestman engine is especially adapted for long runs. As will be seen from the illustration it is modelled after the design of the Straight Line steam engine, provided with centrally hung fly wheels, ample bearings, and a lubricating system designed for continuous feeding through extended periods of service. The piston requires no lubrication, as it works constantly in an oily atmosphere. The engine occupies comparatively little space and its working parts are few and easily accessible. It is built with a solid bed plate, and is self-contained, requiring a minimum amount of foundation work.

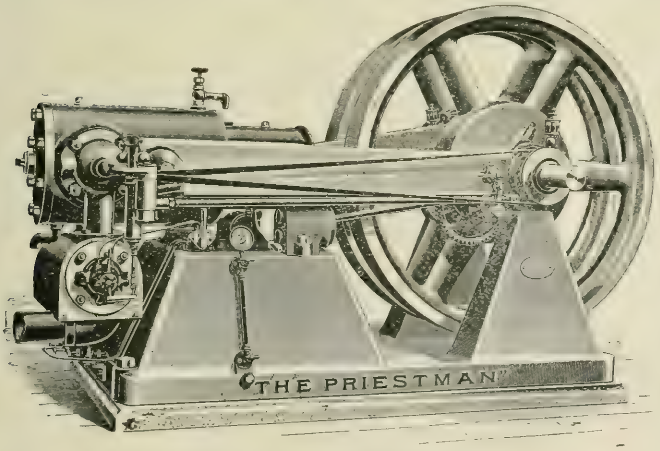


FIG. 1.—IMPROVED OIL ENGINE.

One of these engines has recently been placed in the basement of the rectory of a church in a suburban district, where it is employed for driving a deep well pump and a dynamo which furnishes current to operate an electric motor, working the bellows of the church organ. The dynamo also furnishes current for lights at the rectory as well as a small motor and pump combination at a neighboring house. The engine is started by a member of the rector's household, and is left for hours together without any attention. This can be safely done for the reason that the exhaustion of the supply of oil simply causes the engine to stop, and entails no danger whatsoever. There is no extra insurance incurred, which is due to the use of high test oil.

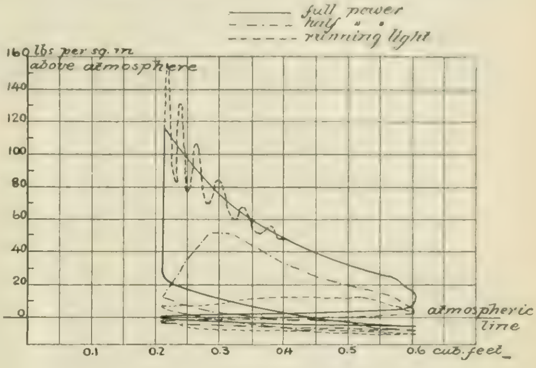
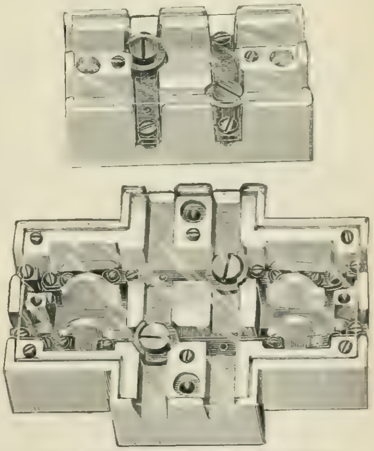


FIG. 2.— INDICATOR CARDS.

The Franklin Institute has recently awarded the John Scott Legacy prize and medal to the inventors of the Priestman engine in recognition of its merits.

New Cut-Outs.

A new line of cut-outs has recently been placed on the market by Edward J. McEvoy, 157 Cedar street, New York, late electrical constructor of the William Cramp & Sons Ship and Engine Building Company, of Philadelphia. The connecting bars are made from metal of the best conductivity, and run from end to end in grooves at right angles with the main wire grooves, which are separated by a solid wall of porcelain, thereby making it impossible for a short circuit to occur. The binding screws for the main connections are unusually stout. The branch connections are made by inserting the wires in a solid piece of metal, through which a set screw penetrates, thereby making a secure and efficient contact. Between the main and the branch connections is a receptacle in which a porcelain fuse cup is inserted. The replacing of the fuse entails no further labor than is involved in the loosening of two screws, and detaching the fuse cup, which can readily be replaced without the slightest danger of short circuiting or arcing. Particular attention is paid throughout to the constructions of these appliances in order that absolute reliance may be placed in them. The larger sizes are specially adapted for large feeders, taking a 3-0 or 4-0 wire easily. The medium sizes are the same type, and the smallest is a fuseless branch block mostly used in marine construction, and is now being employed on the St. Louis and St. Paul of the American Line of ships being constructed at Cramp's ship yard.



SINGLE AND DOUBLE BRANCH CUT-OUTS.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, April 27 1895.

THE ELECTRICAL STOCK LIST maintained a pretty steady front this week, and most of the uncertainty caused by the announcement of the Standard Telephone Company's organization and by the reports concerning the General Electric Westinghouse deal, has been either dispelled or lulled by the lack of development in both directions.

AMERICAN BELL rallied early in the week from last Saturday's closing to 183, and did not at any time lose any of its first advance. Competent judges of the situation express the belief that the Bell Company will gain at least 60,000 telephones this year, but as there is no reason to believe in a maintenance of old rentals the gain in the output may mean comparatively little financially. Friends of the Bell interests base their sanguine views upon the Bell Company's prosperity in Canada, where the telephone patents have been free for several years.

THE WESTINGHOUSE AND GENERAL ELECTRIC fiasco is explained, by those claiming to be posted, as being due to the fact that the first consultation between the General Electric's committee and its own executives developed "fundamental objections to negotiations on the outline proposed." As a consequence the G E. committee had no meeting with the Westinghouse committee, but reported the facts back to the General Electric board, and asked to be discharged. No subsequent action has been taken, so far as it is possible to learn.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	97¼	98⅛
" " " Brooklyn	100	..	108
" " " Boston	100	124	125
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	28	29
General Electric	100	33½	33¾
General Electric, pref	100	63¾	64¼
Westinghouse Consolidated, com.	50	34	35
" " pref	50	..	52

BONDS.

	Par.	Bid.	Asked
Edison Electric Ill., New York	100	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co. deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

	Par.	Bid.	Asked
American Bell Telephone	100	183	184
American District Telegraph	100	30	40
American Telegraph & Cable	100	91	..
Central & South American Telegraph	100	117	120
Commercial Cables	100	141	..
Erie Telephone	100	53	53½
Gold & Stock Telegraph	100	105	..
New England Telephone	100	67	68
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63½	..
Western Union Telegraph	100	89	89¼

ELECTRIC TRACTION STOCKS.

	Par.	Bid.	Asked
Baltimore Traction	25	16⅝	16⅞
Binghamton RR. com	100	100	..
Brooklyn Traction	100	9	11
" " pref.	100	..	53
Buffalo St. Ry	100	66	69
Cleveland City Ry.	100	68	70
Cleveland Electric Ry.	100	59	60
Chicago City Ry	100	305	315
Columbus St. Ry	100	46	49
Consolidated Traction of N. J	..	30	33
Electric Traction, Philadelphia	50	71	71½
Long Island Traction	100	9	9¼
Louisville St. Ry. com.	100	37	39
" " " pref.	100	87	88
Metropolitan Traction, Philadelphia	100	89½	90
New Orleans Traction	100	15	18
" " pref.	100	56	60
North Shore Traction	100	..	..
" " pref.	100	74	83
People's Traction $30 pd.	25	58½	59
‡Philadelphia Traction	50	81½	82
Rochester St. Ry	..	38	..
Union Ry. (Huckleberry)	100	112	115
West End, Boston	100	64¾	65
" " pref	100	88	..
Worcester Traction	100	13	16
" " pref	100	81	85

BONDS.

	Par.	Bid.	Asked
Buffalo St. Ry. 1st con. 5s	100	101	..
*Binghamton Railroad Co. 5s	100	99	100
*Columbus St. Ry. 1st 5s.	100	9	..
Rochester St. Ry. 1st. 5s.	100	95	97
*Union Ry. 1st. mtge 6s.	100	105	108
*Westchester Electric 1st. mtge. 5s.	100	98	101

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* With accrued interest.

‡ Ex-rights.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD.
253 BROADWAY, NEW YORK, April 29, 1895.

THE OAKMAN ELECTRIC COMPANY, 136 Liberty street, has assigned, with Wm. D. Murray as trustee.

WATKINS GLEN will be lighted electrically this year, and there can be no doubt as to the magnificent results provided the lights be judiciously located and arranged.

MR. MAURICE W. THOMAS, president of the Mason Telephone Company, of Richmond, Va , is in the city with his wife. Mr and Mrs. Thomas will be at the St. Denis for several days

THE MADISON SQUARE LIGHT COMPANY, operating the plant formerly controlled by the East River and Thomson Houston companies, has mortgaged all its rights, privileges and franchises to the State Trust Company for $500,000 to pay off the indebtedness incurred by the acquisition of the East River plant.

MR. THOMAS AHEARN, president of the Ottawa Electric Company, Ottawa, Canada, was in the city last week and reports business as being very satisfactory in his city and vicinity. Mr. Ahearn's company is at present operating 550 arc lamps and 15,000 incandescents and doing a liberal portion of power business.

CHEAP LIGHT.—A bill is before the legislature which provides that city lighting contracts must be sold at auction and must secure to the city prices lower than any now prescribed by law. It further provides that the term of such lighting contracts shall not exceed 15 years, and that the successful bidder shall furnish private lights to the citizens at lower prices than the said bidder had previously been charging, and progressively lower for each year of the term. The bill is to take effect in the cities of New York, Brooklyn, and Buffalo.

W. J RICHARDSON, son of the late "Deacon" Richardson, and for many years secretary of the American Street Railway Association, died at the Presbyterian Hospital, New York, on April 26, after a surgical operation for hemorrhage of the bowels. Mr. Richardson was born at Albany, N. Y., Oct. 22, 1849, and in 1867 entered the street railway field as assistant to his father in the management of the Brooklyn & Jamaica Railway Company. Three years later he became superintendent of the Rockaway Beach Railway & Steamboat line, and in 1872 was made a director of the Atlantic Avenue Railway Company. Owing to his sympathy with the strikers in the late unpleasantness of the Atlantic Company with its employees, Mr. Richardson was dropped from the directorate of that company a few days before his death.

GEN. THOMAS T. ECKERT, president of the Western Union Telegraph Company, celebrated the seventieth anniversary of his birth on April 28, and the employees in the Western Union Building, at 195 Broadway, took advantage of the day to present a testimonial of their regard for Gen. Eckert personally, as well as their appreciation of his services as the president of the company. When he reached his office at the usual hour he was met by a delegation of more than thirty of the officers. They represented every department, and each one wore a bright flower on his coat. All personally congratulated the General on having passed his seventieth year in health and strength. Superintendent W. J Dealy, of the Commercial News Department, then presented Gen. Eckert with the employees' testimonial, consisting of a magnificent floral offering.

THE GENERAL ELECTRIC WINS ITS TAX SUIT.—Justice Leslie W. Russell, of the Supreme Court, handed down a decision last week relieving the General Electric Company from paying city taxes. The property of the Edison Electric Light Company was assessed originally at $140,000 and that of the Edison General Electric Company, which succeeded the former concern, was assessed at $15,000,000, but afterward reduced to $600,000. The General Electric property valuation was placed at $50,000,000 and later reduced to $8,040,800. The three companies (whose properties are held independently of each other, notwithstanding the control by the General Electric of all the interests) protested against paying taxes for 1894 on the ground that their offices and headquarters are in Schenectady County, where they are liable for taxes, if at any place. They took certiorari proceedings before the Supreme Court for the purpose of reviewing the action of the tax commissioners, and the decision handed down by Judge Russell is the result. He holds that the taxing authorities of Schenectady County alone have the right to assess and tax the value of the personal property.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD.
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, April 29, 1894.

FIVE CENT FARES to all parts of the city were adopted by the Bridgeport Conn.) Traction Company on April 22.

BOSTON'S NEW POSTAL TROLLEY CARS are expected to be ready for service in a very few days. Second Assistant Postmaster Neilson expresses the opinion that the use of the cars will very greatly improve the local service.

THE QUESTION OF ELECTRICALLY DRIVING TEXTILE MACHINERY is being seriously investigated in New England. Mr. Sidney B. Paine, of Boston, read a paper on the subject last week at the annual meeting of the New England Cotton Manufacturers' Association, at Providence, R. I.

COMMISSIONER MURPHY has given the West End Company permission to remove its guard wires on all streets where no foreign wires cross the street or are liable to fall on the trolley wire. The commissioner has also perfected plans for the burying of the West End Company's feed wires as far as Adams street.

MR. HENRY F. KELLOGG, well and favorably known to the electrical fraternity, and who for some years past has been connected with the Whitney Electrical Instrument Company as its selling agent, is now identified with W. B. Southgate & Co., of Boston. Prominent among this firm's specialties are the Whitney instruments, so that Mr. Kellogg will continue to present to the electrical trade the acknowledged merits of these instruments, and at the same time a good line of other specialties.

THE WAGNER ELECTRIC COMPANY, of St. Louis, Mo., has opened an office at 620 Atlantic avenue, and will enter into active competition for the New England trade. Mr. Chas. E. Bibber will be in charge of the office. In our issue of April 20 it was stated that Messrs. Bibber & White had taken the agency at the above address of the Wagner Company and of the Columbia Incandescent Lamp Company, which was an error, Mr. Bibber representing both companies as general sales agent for the New England territory.

MESSRS. HOWARD C. FORBES AND GEORGE B. GLIDDEN have associated themselves under the firm names of Forbes & Glidden as electrical and chemical engineers, with offices and laboratory in the Hathaway Building, 620 Atlantic avenue, Boston. Mr. Forbes was for a long time connected with the firm of Stone & Webster, and has had considerable experience in designing and supervising electrical installations, and in the line of mechanical engineering as applied to the design and construction of apparatus and machinery to be used in carrying out chemical operations on a large scale. Mr. Glidden is possessed of excellent business qualifications and training. Both are young men of energy and ambition. The firm's announcement emphasizes the fact that the subjects of chemistry and electricity are so closely allied that the combination of the two has many important advantages.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
936 Monadnock Building, Chicago,
April 27, 1895.

GODFREY LUTHY, of the Royal Electric Company, was one of the prominent Chicago visitors of the week.

MR. F. S. TERRY has returned to town after a long absence, and finds Sunbeam lamps in greater demand than ever.

THE CHICAGO EDISON COMPANY is fitting up its old station on Adams street as the general offices of the company. These will include ample space for the display and handling of supplies in which field of work this company expects to take an active part.

THE FARR TELEPHONE CONSTRUCTION & SUPPLY COMPANY has moved to its new store, 340 Dearborn street. This will hereafter be its office and salesroom. It has recently closed two very large contracts for telephones, and does not seem to have any complaint to make concerning dull business.

THE CHICAGO INSULATED WIRE COMPANY seems to be hustling right along. It has just arranged for commodious quarters at 153 Lake street, where it will carry a full line of the many kinds of wire and specialties which it manufactures. One of the recent orders which it has closed was for 200 miles of insulated copper wire.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, April 17, 1895

INDUCTIVE TELEGRAPHY.—Last week the cable between the Isle of Mull and the Scotch mainland broke down, and messages were transmitted inductively on Mr. W. H. Preece's method across the intervening gap of 3½ miles. This is the first time on record that inductive telegraphy has been made use of in the ordinary course of business.

BOILERS AND ENGINE TENDERS.—A bill of a somewhat extraordinary nature is now before Parliament. It is entitled "The Engines and Boilers Act, 1895." It is proposed by this legislation to allow no one who has not got a first or second class certificate, to be granted by the Board of Trade after evidence of a certain number of years' service or after examination, to have charge of any but the smallest size of steam engine or boiler. It is not very evident on the face of the bill or after consideration what justification there is for this piece of grandmotherly legislation with its paraphernalia of examiners, examinations and certificates. It is surmised by some that the main object is to restrict the field from which men in charge of engines, boilers, etc., can be drawn in moments of emergency and in this way to strengthen the power of trade unionism.

ELECTRIC AND NAVAL BOILERS.—Although at first sight it may not appear so, there are several points of similarity between the working of electric power station boilers and boilers in the navy. Electrical engineers on this side of the Atlantic are, therefore, interested in a discussion which has been going on in *The Times* in regard to the use of water tube boilers on men-of-war. The recent action of the Admiralty in fitting two of our new cruisers, viz., H. M. S. "Powerful" and "Terrible," with Belleville boilers has given rise to considerable criticism, and it will be interesting to see how these two vessels, which are each of 25,000 hp, will carry themselves through the series of severe trials to which they will be subjected when their outfit is complete. The advocates of the water tube boiler in the navy put forward precisely the same arguments that the advocates of this boiler in electric power stations advanced, viz., the superiority in raising steam, increased durability and capacity to stand a very much higher rate of forcing.

ALTERNATE CURRENT ELECTRIC SUPPLY.—The Metropolitan Electric Supply Company, although the largest concern of its kind in the United Kingdom, is by no means the most prosperous. Last year it only succeeded in paying a dividend of 2½ per cent. and this year it has only managed to scrape together sufficient net profit to give the shareholders a return of 5 per cent for their money. The company covers a district in London having an area of 4½ square miles, and at present has a lamp connection equivalent to 224,000 eight candle lamps. During the past year the business of the company has been much hampered by an action brought against it in connection with its station at Manchester Square, and it has only been able to avert the complete closing of that generating centre by the substitution of Parsons steam turbines for Willans engines. It is no doubt due to this kind of thing and owing to the fact that the company possesses a most heterogeneous plant laid out in a by no means scientific fashion that this concern, notwithstanding the magnificent area it possesses and the absence of competition throughout the whole of its dominions, is unable, after more than four years' existence, to pay a better dividend than it does.

RAILWAY ELECTRIC LIGHTING.—A very practical paper has just been read before the Institution of Electrical Engineers by Mr. W. Langdon, of the Midland Railway Company, one of our most progressive railway lines. Mr. Langdon's paper is one of the most valuable testimonials the electric light has received for some time past, coming, as it does, from one who has no particular bias in favor of the new illuminant. In almost every case described by him, Mr. Langdon works out an enormous saving as being effected by the use of electric light, and when I add that much of the plant employed by the Midland Company is somewhat out of date, and employed, owing to circumstances beyond the control of the engineers, under somewhat disadvantageous conditions, it is not too much to anticipate that in more recent isolated railway plants, and in future ones, a still greater saving will be made. At Leicester the Midland Railway Company drive their dynamos by gas engines, using Dawson gas. Mr. Langdon is not enthusiastically in favor of this arrangement, but that may be on account of the short experience he has had. Although the Midland Railway Company some two years ago experimented largely with electrically lighted trains, Mr. Langdon was absolutely silent on that point, and this fact, in conjunction with the abandonment by the Midland Company of this system of lighting, may be considered as a conclusive sign that with the conditions which obtain on the Midland line, electric lighting of trains cannot be made a success. The discussion which arose on Mr. Langdon's paper was of an interesting and practical nature. There was a decided consensus of opinion in favor of the abandonment of high pressure series arc lighting for railway stations and goods yards purposes, and the substitution therefor of a three-wire system at a pressure of 220 or 440 volts with four or eight lamps in series across the outer wires One or two speakers, however, insisted, without giving too many reasons, that the future of railway lighting lay with alternating currents.

SODIUM IN ELECTRIC LIGHT CONDUITS.—The committee appointed by the Board of Trade to investigate the alleged deposit of sodium on the mains of the St. Pancras Vestry's electric supply has just published its report. The committee consisted of members appointed by the Royal Society, and by the Institution of Electrical Engineers, so that science and practice were equally represented. The committee is of opinion that the explosions which have occurred were caused by the firing of an explosive mixture of coal gas and air, by sparks caused by means of chemical incrustations found on the insulators. The sparks, the committee think, were caused by the imperfect conductivity of the deposit, or by moisture coming in contact with the metallic sodium or potassium, both of which metals have been found to exist within the incrustations. It is further the opinion of the committee that these metals were produced by the electrolytic decomposition of alkaline salts taken mainly from the soil and conveyed by moisture along the fibres of the wooden bearers on which the insulators rest toward the negative conductor. The chief engineer of the St. Pancras Vestry reported that these incrustations were first noticed some 18 months ago, and that some 60 or 70 per cent. of the insulators which were near enough to the manholes to be examined have been found to be attacked; incrustations in many cases forming again within 24 hours after removal. It is very evident that the main cause of the mischief, apart from the presence of alkaline substance in the soil, is the existence of the wooden bearers, since it has been found that very few of the insulators supported on iron brackets have been attacked. As there has been some suggestion that the insulators themselves have been actually decomposed by the passage of the current, I may say that the committee does not countenance this idea in any way. The glaze on the insulators has, it is true, been attacked in some cases, but this is, no doubt, a secondary action arising from the presence on the glaze of metallic sodium and potassium, and other powerful chemical reagents. Mr. Miller, of the Kensington Company, which uses a somewhat similar system of bare copper mains in culverts, stated before the committee that his company had scarcely suffered at all from the incrustation complaint; an immunity which he attributed to the fact that his company used very high quality double-shed insulators. Mr. Miller also drew attention to the extraordinary "affinity" which the negative main appears to have for moisture, and a most interesting scientific question is raised by this fact. The committee has contented itself with recommending that the wooden bearers in the St. Pancras mains should be immediately removed, and that better quality insulators of a better pattern should be immediately put in.

General News.

NEW INCORPORATIONS.

THE STANDARD TELEPHONE AND ELECTRIC COMPANY, capital stock $50,000, has been incorporated by S. S. Kilvington, E. W. Batchelder, H. C. Dodge, and G. L. Scott.

THE VANCE ELECTRIC COMPANY, New York, capital stock $10,000, has been formed to do general construction work. The promoters are A. S. Vance, Brooklyn; J. H. Cheever and C. C. Guiteau, New York.

NEW YORK, RED BANK & ASBURY PARK ELECTRIC RAILWAY, Red Bank, N. J., capital stock $500,000, has been incorporated by Ivan Prowattain, Philadelphia; Jos. W. Robinson, Red Bank, and others.

THE CRANFORD MUTUAL TELEPHONE COMPANY, Elizabeth, N. J., capital stock $10,000, has been incorporated by Wm. J. Lansley, Henry C.

Thornton, [illegible] Wattman Wilfred C. Allen, Geo. W. Little and James Rodgers.

THE LAKE CHARLES ELECTRIC RAILWAY COMPANY, Lake Charles, La., capital stock $[illegible] has been incorporated by Gustave A. Jahn of New York, as president, R. H. Nason, Lake Charles, vice president, William Stone treasurer, and H. B. Milligan, secretary.

THE WAYNE & CONSHOHOCKEN STREET RAILWAY COMPANY, Chester, Pa., capital stock $30,000, has been formed to construct and operate a street railway. The promoters are Francis Fenimore, St. Davids; Richard C. Johnson and Julius Bailey, of Wayne, Pa.

THE PACKARD ELECTRIC COMPANY, Ltd., recently of Montreal, was obliged on account of the growing demand for its well-known lamp to seek larger quarters, and consequently removed on April 25 to St. Catherines, Ont., where a new factory is being equipped, which will very materially increase the company's already large output.

THE MIDDLETOWN & BLOOMINGBURGH ELECTRIC RAILWAY COMPANY, Middletown, N. Y., capital stock $200,000, has been incorporated by W. B. Rockwell, Scranton, Pa., and Messrs. Wightman, LeBarr, Smith, McIntyre, Royce and Wiggins, of Middletown, for the purpose of operating a surface railway from Middletown to Bloomingburgh.

THE LAFAYETTE MACHINE, ELECTRIC LIGHT AND POWER COMPANY Denver, Col., capital stock $100,000, has been formed to conduct a machine shop for the manufacture and repair of electric fixtures, and to generate electricity for light, heat and power. The promoters are John S. Spencer, Frank D. Taggert and H. J. Mayham, of Denver, Col.

THE GREAT WESTERN ELECTRIC COMPANY, Des Moines, Ia., capital stock $500,000, has been formed to manufacture all kinds of electrical machinery, apparatus, appurtenances and supplies. Warren A. Drake and L. F. Dyrenforth, Riverside; Ralph H. Smith, Evanston; T. C. Sullivan, H. K. Gilman, Chicago, and C. E. Hunn, Des Moines, Ia., are interested parties.

THE WADSWORTH ELECTRIC RAILWAY COMPANY, Wadsworth, O., capital stock $10,000, has been formed to build railways operated by electricity or horse power, and to construct and operate telephone and telegraph lines furnish electricity for light, heat and power, etc. The promoters are F. C. McCauley, W. A. Ault, O. V. Dibble, R. F. Weaver, Frank Mills and W. S. Holloway.

THE ATLANTIC HIGHLANDS, RED BANK & LONG BRANCH ELECTRIC RAILWAY COMPANY, Red Bank, N. J., has been incorporated by D. S. Arnott, Silas Dutcher, W. H. Hazard, S. S. Whitehouse, Benj. Frick, Brooklyn, N. Y.; A. T. Allen, Hoboken, N. J.; Wm. T. Parker, Little Silver, N. J.; Wm. T. Corlies, Chas. B. Parsons, Arthur A. Patterson, Red Bank, and James Steen, Eatontown, N. J.

TELEGRAPH AND TELEPHONE.

WADSWORTH, O.—Steps are being taken to establish a telephone system.

JACKSON, MISS.—The King-Price Telephone Company will extend its lines from this place to Crystal Springs and Brown's Wells.

BUTTE CITY, MONT.—W. McWhite and others have asked for a forty years' franchise to put in a new telephone system.

HANNIBAL, MO.—The new telephone line between this city and Spalding is rapidly approaching completion, and will probably be extended to Rensselaer and Monroe City.

CARTERSVILLE, GA.—The Cartersville Telephone Company has been incorporated by John W. Jones, H. G. Leake and John W. Dodds to conduct an exchange; the capital stock is $5,000.

MERIDIAN, MISS.—The Mississippi Telephone Company is preparing to construct a 67-mile line to Philadelphia, Miss., by way of Hickory, Newton, Decatur and Union Station. The same company expects to connect New Orleans and Jackson, Miss., by telephone between now and autumn.

ELECTRIC LIGHT AND POWER.

CASCADE, IA.—A $7,000 electric light plant is being established.

BARNARD, MO.—Steps are being taken looking to the establishment of an electric light plant.

MARION, VA.—The installation of an electric light plant to be operated by water power is being investigated.

NEW ORLEANS, LA.—An electric plant is to be installed by the St. Charles Hotel Company in its new building.

GLEN COVE, L. I., N. Y.—The Franklin Illuminating Company will establish an electric lighting system at this place.

AUBURN, N. Y.—The erection of a municipal electric plant is contemplated. Address Mayor Lewis for further particulars.

ROPER CITY, N. C.—The erection of a new electric lighting plant is contemplated. Address the clerk of the Council for particulars.

DECATUR, ILL.—It is reported that the Municipal Electric Lighting Company has decided to enlarge their plant in the near future.

NEWTOWN, N. Y.—The installation of an electric lighting system in this town is contemplated. Address the town clerk for particulars.

NEW ORLEANS, LA.—Maurice Kaufman, 407 Kamp street, is in the market for an electric lighting plant with a capacity of 500 15-cp lights.

LANCASTER, WIS.—A franchise has been granted Edward Pollock for the construction and operation of an electric light and power plant.

MONTPELIER, VT.—The City Council has contracted for lighting the streets for the coming year on a basis of 52 arc lights for 300 nights for $4,000.

ENTERPRISE, MISS.—L. B. Bradley, of Enterprise, and S. H. Gelheman, of Springfield, Ill., have obtained a franchise for an electric light plant.

SOUTH MILWAUKEE, WIS.—The South Milwaukee Light and Power Company has increased its capital stock to $20,000. Mr. F. B. Williams is manager.

WEST CHESTER, PA.—The erection of a new electric light plant at this place is contemplated. Address the clerk of the Council for further particulars.

BARDSTOWN, KY.—The construction of an electric lighting plant at this place is contemplated. O. Arnold is interested and can be addressed for particulars.

PHELPS, N. Y.—It is reported that an electric lighting system is to be established here in the near future. The clerk of the Council can furnish detailed information.

MILAN, MO.—The erection of an electric lighting plant at this place is contemplated. A franchise has been applied for, and the clerk of the Council can be addressed.

ELLICOTT CITY, MD.—The Ellicott City Electric Light and Power Company's plant has been sold to Wm. P. Pierpoint for $1,000. Mr. Pierpoint held a mortgage on the property.

HOLYOKE, MASS.—Sealed proposals are being received for the furnishing of electric lighting for the city. R. S. Burns, of the City Council, can be addressed for particulars.

NEW YORK CITY.—A five-story casino and roof garden is to be built on 101st street and Columbus avenue by George W. Eggers, and will be provided with electric light equipment.

SOUTH HAVEN, MICH.—The town authorities will issue $10,000 worth of bonds for the erection of an electric lighting plant. Address the clerk of the Council for further details.

BIRMINGHAM, ALA.—The Consolidated Electric Light Company will build a new plant to cost $200,000. The machinery will include five engines of 2,500 hp each. The contract has been let.

BENTON HARBOR, MICH.—A franchise has been applied for by Peter English to establish an electric lighting plant at this place. The clerk of the City Council can be addressed for detailed information.

HACKETTSTOWN, N. J.—Bids will be received until May 6 for the lighting of the streets of this town with electricity for the coming year. Wallace Taylor, W. C. Merrell and J. N. Niper are the committee in charge.

THE HOBART & WESTERN ELECTRIC RAILWAY COMPANY, Hobart, Ind., capital stock $50,000, has been formed. The promoters are Alfred Morrison, Andrew J. Smith, George Stoker and Seward Lightner.

NEW YORK CITY.—Electric lighting is to be introduced in the nine-story fireproof office building, which is to be built for the Hournay estate, 43 Lispenard street, after plans prepared by Cady, Berg & See, 31 East 17th street.

NORTHFIELD, VT.—The contract for the new electric plant calls for the completion of the day power equipment May 1, and the starting of the street lights by May 15. The cost of the complete plant will be $7,500. Water power will be used.

NEW BRIGHTON, N. Y.—Sealed proposals will be received for the erection and operation of an electric lighting system for lighting the village streets for a term of one year. Joseph F. O'Grady, village clerk, can be addressed for further information.

THE ELECTRIC RAILWAY.

ATLANTA, GA.—A franchise has been asked for by Richard D. Fisher and others to build an electric railway.

READING, PA.—Work will be soon commenced on the construction of the Reading & Womelsdorf Electric Railway.

ENTERPRISE, MISS.—The construction of an electric railway is contemplated by L. D. Bradley, of Springfield, Ill.

COLUMBIA, PA.—Surveys have been commenced by Civil Engineer Edward M. Smith for the proposed electric railway to Mt. Joy.

ATLANTA, GA.—A franchise has been applied for by R. D. Fisher, to construct an electric railway on certain streets of this city.

SANFORD, FLA.—The construction of an electric railway from this place to Orlando is contemplated by J. M. Saunders and A. Williams.

LOWER PROVIDENCE, PA.—The Norristown & Perkiomen Railway Company has applied for a franchise to construct a trolley line through this town.

MEMPHIS, TENN.—Messrs. J. R. Goodwin, E. S. Proudfit and J. W. Allison have applied for a franchise to build a trolley road in this city.

READING, PA.—The Reading & Southwestern Railway Company has applied for a franchise for right of way on certain streets of this city.

MEDIA, PA.—The Delaware County & Philadelphia Railway Company has petitioned for a franchise to extend its line on Washington street.

TROY, N. Y.—Permission has been granted the Troy City Railway Company to convert its line into an electric road from Green Island to Cohoes.

ALEXANDRIA, VA.—The Alexandria & Mt. Vernon Railway Company has applied for permission to begin work on the construction of their line.

REMINGTON, PA.—It is reported that the Peoples' Electric Street Railway Company, of Pittsburgh, will extend its line from Freedom to this place.

BARRINGTON, R. I.—A charter has been applied for by the Barrington & Warren Railway Company, to construct a line between the points named.

PEKIN, ILL.—The construction of an electric railway from this city to Metamora is contemplated. Daniel Birket is interested, and can be addressed.

GRAFTON, W. VA.—Work will be commenced in the near future on the construction of an electric street railway in this town through to Huntytown.

CARTHAGE, N. Y.—The construction of a railway from this place to Copenhagen, a distance of eight miles, is projected. The estimated cost is $100,000.

KINGSBORO, N. Y.—The building of an electric railway from this place to Mountain Lake, a distance of four miles, is projected. Surveys have been made.

SYRACUSE, N. Y.—It is reported that a trolley line is to be built between this city and Liverpool. Address the clerk of the Council of the latter place for particulars.

FLUSHING, L. I., N. Y.—The Newtown Railway Company has applied for a franchise to construct its line over Flushing Bridge, and through certain streets of this town.

GENEVA, N. Y.—The Electric Railway Company has applied for permission to construct its road on West Castle street. President Craig can be addressed for particulars.

BAY SHORE, L. I., N. Y.—It is proposed to build a line from Brentwood to Babylon via Bay Shore and a franchise has been applied for. W. W. Hulse can furnish particulars.

HACKENSACK, N. J.—The Bergen Turnpike Company has applied for right of way for its proposed trolley line through this place. James J. Romeyn can be addressed for particulars.

ATTLEBORO, MASS.—The Interstate Consolidated Street Railway Company has been organized. N. J. Perry is president, and E. R. Price, H. R. Baker and others are among the directors.

ROCHESTER, N. Y.—The Rochester Railway Company has applied for a franchise to extend its line. The general manager of the company can be addressed for detailed information.

YORKVILLE, PA.—A meeting was held recently to consider a petition for the extension of the electric railway through this village on Market street. President R. H. Koch can be addressed.

WASHINGTON, D. C.—The Washington, Alexandria & Mt. Vernon Electric Railway Company has petitioned to complete its line in this city. Ex-Mayor Strauss, of Alexandria, is interested.

TOLEDO, O.—It is reported that a company is being organized for the purpose of constructing an electric road from this city to Sylvania. Address the clerk of the Council for information.

LONGWOOD, FLA.—Address E. W. Hencke concerning an electric railway to be established, requiring three horse-power plants, two of 100 hp each, and one of 300 hp, and costing with road $400,000.

PORT HURON, MICH.—It is reported that an electric railway is to be built from this place to Lexington in the near future. Edgar H. Brennan, of Toledo, is interested, and can furnish detailed information.

PERSONAL NOTES.

MR. CHARLES L. TOLLES, of the Jewell Belting Company, of Hartford, Conn., and Miss Annie Louise Roberts were married at the home of the bride's parents in Hartford, April 24.

MR. L. HORTON, JR., has been appointed superintendent of the Philadelphia, Reading & Pottsville Telegraph Company, vice Mr. E. R. Adams, deceased, with headquarters at Reading, Pa.

MISCELLANEOUS NOTES.

THE GETTYSBURG BATTLEFIELD.—In the litigation over the taking of land from the Gettysburg Electric Railway Company by the government for the purpose of preserving the battlefield, a decision in favor of the railway company has been handed down by Judge Dallas in the United States Circuit Court. The case will probably be carried to the Supreme Court.

AT THE NEW YORK ELECTRICAL SOCIETY'S April meeting, fixed for the 25th inst., Mr. T. L. Willson was to have delivered a lecture on acetylene gas. At the last moment Mr. Willson had to leave for the West, and Mr. Edward Durant filled the gap by repeating before the Society on the 24th inst. his lecture given on the 16th before the Brooklyn Institute on "The Manufacture in the Electric Furnace of Diamonds, Rubies, Aluminum and Acetylene Gas."

THE ELECTRICAL SOCIETY OF CORNELL UNIVERSITY held a meeting on April 22, at which Prof. H. J. Ryan presented an admirable paper on the "Alternating Current Motor." By the aid of lantern slides he showed clearly the conditions necessary for the efficient working of synchronous motors, the ordinary induction motor, and the monocyclic motor. Curves were exhibited, drawn from data obtained by experiments in the Cornell laboratory, showing the effect of a change in resistance upon the relations between speed and torque. The paper will be published in full in the *Proceedings* of the Society, which will appear about the middle of May.

Trade and Industrial Notes.

THE AMERICAN ELECTRIC MANUFACTURING COMPANY has removed its New York office to 39 Cortlandt street.

E. W. WILSON & COMPANY, bankers and brokers, New York, have removed their offices from 96 Broadway to 40-42 Wall street.

THE IMPERIAL ELECTRIC LAMP COMPANY, now at 253 Broadway, New York, will remove its offices and factory on May 1 to 75-79 Fulton street.

ELLIOTT BROTHERS, London, have appointed Jas. G. Biddle, of 525 Drexel Building, Philadelphia, their sole agent in the United States and Canada.

THOMAS H. FOOTE, consulting electrical engineer, has removed his office from 215 West 125th street to the Presbyterian Building, corner Fifth avenue and 20th street, New York.

THE PROCTOR-RAYMOND ELECTRIC COMPANY, Syracuse, N. Y., has gone into receiver's hands. The court appointed E. A. Marsh, of Keeler, Salisbury, Marsh & Ward, to the receivership.

THE H. E. SMITH ELECTRICAL COMPANY, Batavia, N. Y., is making a success of its telephone exchange at Batavia, over 50 subscribers being already enrolled. The company, besides operating the local exchange, is engaged in a general electrical contracting and supply business.

THE C. W. HUNT COMPANY, 45 Broadway, New York, is meeting with flattering success in its line of work. Among other recent installations is a system of overhead trolleys put in the factory of the Ahrens & Ott Manufacturing Co., at Louisville, Ky., for handling the various materials.

THE MIAMISBURG ELECTRIC COMPANY, Miamisburg, Ohio, reports increased sales in its battery department, a large number of Burnley "Cartridge" batteries having been shipped during April for telephone use exclusively. This company expects to put on the market soon a pair of batteries especially adapted for carbon transmitter service.

THE INTERIOR CONDUIT & INSULATION COMPANY, of 527 West Thirty-fourth street, New York, is sending out catalogue and price list No. 24 descriptive of the 1895 Lundell fan motors for direct and alternating current circuits. The line comprises desk, bracket and suspended fans of the "windmill" or "propeller" type, as well as the two-blade type of ceiling fans.

THE JEFFREY MANUFACTURING COMPANY, of Columbus, O., has issued an exceedingly handsome catalogue describing its line of coal mining machinery and equipment, which includes electric chain coal cutters, cutter-bar mining machines, cutter-bar air power mining machines, electric drills, pumps, locomotives, hoists, conveyers, etc., etc. The book is printed on heavy plate paper, and provided with an attractive embossed cover.

EDWARD F. KEATING, 446-454 Water street, New York, reports marked success in placing his new Brownley injector, for which he makes strong claims. The injector is a double-tube machine, has no valves to get out of order, and can be used under both high and low pressures from 15 to 350 pounds. The strongest claim made, however, is that this injector will work hot water with perfect satisfaction. Mr. Keating is distributing copies of a circular containing some very favorable testimonials.

THE ELECTRIC HEAT ALARM COMPANY, of 145 High street, Boston, has contracted, through its agent at St. Paul, to equip the Ryan Hotel, the largest in the city, with its system of automatic fire alarms. This installation, when completed, will be one of the best in the country. The company has just finished a very nice office outfit, comprising factory, hotel, journal bearing and marine systems, for the Continental Commerce Company, 44 Pine street, New York, and 70 Oxford street, London, Eng.

THE NORTHERN PACIFIC RAILWAY COMPANY, in an elaborately gotten up book entitled "Sketches of Wonderland," describes at length the country through which its lines run. The book is replete with well-executed engravings illustrating the principal features of interest, among which may be mentioned Detroit Lake, Pyramid Park, the Yakima Valley, Yellowstone River and Park, Mount Rainier and the cities of Spokane, Tacoma and Seattle. The book is interesting from cover to cover, and as a specimen of advertising, taste, and skill is exceedingly fine.

THE FOREST CITY ELECTRIC WORKS, of Cleveland, Ohio, manufacturers of the well-known roll drop commutator segments for dynamos and motors, has established an office in New York at 126 Liberty street, which will have general oversight of the eastern territory. Mr. John C. Dolph, formerly connected with the Short Electric Railway Company, and for the past two years eastern representative of the Eureka Tempered Copper Company, has been appointed manager of the above district. It is the policy of the company to push vigorously the sale of its products in eastern territory. A large stock of standard street railway and lighting segments will be carried in the New York store-room.

THE HEINE SAFETY BOILER COMPANY, St. Louis, has issued a statement in regard to a recent contract for twelve Heine boilers, aggregating 4,500 hp for the Edison Illuminating Company, St. Louis. Its competitors having claimed that the allowance of heating surface per horse-power in the Heine boilers was insufficient, the following guarantees, with forfeit and bonus, were made to protect the Edison Illuminating Company on the point. The boilers sold them, like all Heine boilers, have from 25 to 30 per cent. less heating surface than competitors claim as requisite for best economy and proper forcing margin in their boilers of equal horse-power rating. The guarantee (with straight grates and plain setting) was an evaporation of 8 lbs. water (from and at 212 degrees F.) per pound Illinois coal having a heat value of 11,500 B. T. U. per pound, and an evaporation of 7 lbs. water per hour per sq. ft. H. S. (equal to 64.2 per cent. of above rating), with less than 1 per cent entrainment of water. The result of tests made by Wm. H. Bryan, M. E., show that a run at 26 per cent above the rating gave 8,385 lbs. water per pound Illinois coal of 11,481 B. T. U. (equal to 70.13 per cent. efficiency), and a capacity test gave 7,258 lbs. water per hour per sq. ft. H. S. (equal to 70.8 per cent. above rating), with 84-100ths of 1 per cent. entrainment.

WARREN WEBSTER & CO., Camden, N. J., specialists in examining steam plants where increased economy in fuel is desired by utilizing waste exhaust steam, report that there is considerable activity in their business, which they claim is due to the better appreciation of their manufactures. Among the recent orders for the Webster "vacuum" feed-water heater and purifier are the following: Estate of John Nesmith, Lowell, Mass., 100 hp; New Orleans Railway and Mill Supply Company, New Orleans, La., 200-hp; The Proctor & Gamble Company, Ivorydale, O., 3,000-hp; Pennsylvania Tin Plate Company, New Kensington, Pa., two 500-hp; Norwich Printing, Dyeing and Finishing Company, Norwich, Conn., 3,000-hp; Water and Light Company, Harrisburg, Pa., 500-hp; J. Horne & Co., Pittsburgh, Pa., 250-hp; A. Hubbard & Co., Norwich, Conn., 300-hp; W. F. Slade & Co., Pascoag, R. I., 500 hp; Nashau River Paper Company, East Pepperill, Mass., 600-hp; Standard Steel Works, Burnham, Pa. (duplicate), 400-hp; Aultman & Taylor Machinery Company, Mansfield, O., 500-hp; F. S. Field & Co., Boonton, N. J., 300-hp; Pulaski Iron Company, Pulaski City, Pa., 300-hp; Russell & Co., Massillon, O., 400-hp; Arbegast & Bastain, Allentown, Pa., 150-hp; Crescent Steel Works, Pittsburgh, Pa., 750-hp; Moro Phillips Chemical Company, Camden, N. J., 450-hp; Crane & Waters, Millbury, Mass., 400-hp. In a number of the above contracts standard makes of feed water heaters were displaced. Numerous orders are also reported for the Webster separators and Williams vacuum system of steam heating.

Business Notice

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

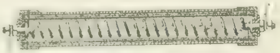
Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 24, 1895.

In charge of Wm A. Rosenbaum, 177 Times Building, New York.

537,8[illegible]. ELECTRIC APPLIANCE FOR ELEVATORS; J. H. Roberts, Grand Rapids, Mich. App filed Oct. 6, 1894. An appliance for elevators having independently mounted switches with conductors, contacts and suitable means for switching the main line and auxiliary conductors, combined with a liquid chamber having a piston at each end, and brake mechanism connected with one of said pistons, the other being exposed to the action of the descending elevator.

[illegible]. ELECTRICAL APPLIANCE FOR ELEVATORS; J. H. Roberts, Grand Rapids, Mich. App. filed Feb. 23, 1895. Substantially the same as the above.



No. 537,876.—Rheostat.

537,857. ELECTRIC MOTOR CAR; William Robinson, Boston, Mass. App. filed Jan. 16, 1890. The combination, with the car axles, of a motor having one end directly supported by one of the said axles and the other end flexibly supported by an independent bar, the said bar being in turn supported partly by the motor journal boxes and partly, directly or indirectly, by another car axle, independently of the truck frame and of the ordinary axle boxes.

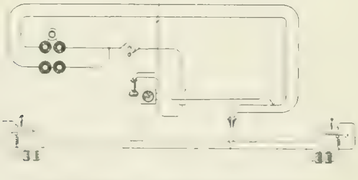
537,860. ELECTRIC GUEST CALL; F. O. Smith, La Crosse, Wis. App. filed June 2, 1894. The combination of a clock, an electric bell and a battery having its poles electrically connected with the clock, a series of insulated wires with exposed ends projecting to form a series of contact points around the clock mechanism, a circuit closing finger attached to the hour arbor of the clock adapted to form electrical contact with the said contact points, and a keyboard and removable room indicating checks adapted to be hung upon said keys.

537,876. RHEOSTAT; G. H. Whittingham, Baltimore, Md. App filed Dec. 11, 1893. The combination of a heat radiating casing, a resistance wire within the casing, and loose sand packed within the casing and separating the resistance wire from the casing.

537,907. ROSETTE OR CEILING CUT-OUT; E. A. Snow, Syracuse, N. Y. App. filed Sept. 21, 1894. The combination of oppositely arranged fastening and circuit-connecting members, each being provided with an arm extending outwardly, and a second arm having one extremity extending laterally from the first arm, and provided with a contact face; each arm having its outer extremity provided with an engaging shoulder extending from the face, for engaging another face.

537,920. COUPLING FOR ELECTRICAL CONNECTIONS; J. M. Faulkner, Philadelphia, Pa. App. filed Aug. 9, 1894. A coupling made in longitudinal sections internally formed to rigidly grip the wire, and having fastening means, one of the sections having an internal depression containing mercury engaging the conductors.

537,932. METHOD OF AN APPARATUS FOR PROTECTING ELECTRIC CIRCUITS; J. M. Oram, Dallas, Tex. App. filed Jan. 15, 1895. The combination, in an automatic variable signal transmitter, of a movable carrier, a shifting device controlling the movements of the carrier, a circuit closing device carried upon the carrier, and a series of points forming a plan for actuating the circuit closer, with means for arbitrarily changing the plan.



No. 537,967.—Telephone System.

537,967. TELEPHONE SYSTEM; Wm. Coonan, Jersey City, N. J. App. filed Aug. 4, 1892. The combination of a subscriber's line, an artificial resistance, and a bell magnet therein at the subscriber's station, a switch arranged to cut the resistance out and leave the line closed, a central office testing apparatus, consisting of two electro-magnets of different resistances connected in parallel, an operator's switching apparatus, and means whereby the subscriber's line may be connected in series with one of the magnets.

537,989. STORAGE BATTERY; M. Moskowitz, Newark, N. J. App. filed May 7, 1894. A battery having a single cell, bearings in the cell, a bearing bar, and elements on the bar; the elements being wound spirally to permit free action of expansion and contraction, and having their free ends rigidly connected with the cell.

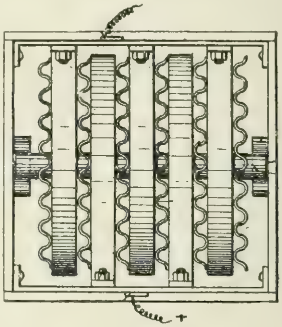
537,994. CONTROLLING MECHANISM FOR ELECTRIC MOTORS; C. H. Richardson, Philadelphia, Pa. App. filed June 9, 1894. The combination of a motor, conductors connecting the armature of the motor with the supply circuit, a speed regulating resistance in the supply circuit, a supplementary resistance and switch mechanism therefor, by the adjustment of which regulating resistance the armature is short-circuited and the supplementary resistance is thrown in to prevent an overflow of current. By a reverse movement of the supplementary resistance switch the opposite result is obtained.

538,005. ELECTRIC RAILWAY; C. C. G. Wolpers, Brooklyn, N. Y. App. filed Oct. 2, 1894. A trolley consisting of a vertical arm having a receiving groove and bores connecting with the respective ends of said groove, insulated plugs, a covering plate removably attached to the arm, a wire-receiving arm removably secured to the lower end of the vertical arm, a contact wheel journaled on the horizontal arm, and an insulating spool and a contact bushing interposed between the wheel and the arm.

538,020. INSULATED CONDUCTOR; W. M. Habirshaw, New York, N. Y. App. filed Oct. 16, 1894. The combination of a conducting core with an insulating coating or covering composed of continuous layers of soft vulcanized rubber and cut-sheet alternately applied.

538,023. ELECTRIC ARC LAMP; F. M. Lewis, London, Eng. App. filed Oct. 12, 1894. The combination of a single solenoid and plunger, a rocking beam, and a differential train for the purpose of enabling the striking and feeding movements to take place independently of each other.

538,024. ELECTRIC BRAKE; E. D. Lewis, Savonia, N. Y. App. filed Dec. 7, 1894. The combination of a brake, a spring for normally holding the brake set, means for varying the tension of the spring, an electro-magnet disposed to normally act in opposition to the spring to release the brakes and hold them out of action until the circuit is interrupted, and means for varying or changing the relative position of the electro-magnet.



No. 537,989.—Storage Battery.

538,083. SEPARABLE TERMINAL FOR CONDUCTORS. D. N. Osyor, Columbus, Ohio App filed Nov. 28, 1893. The combination of stationary terminals insulated from each other, and having recesses, a portable conductor section having insulated terminals, with two pairs of contacts in opposition to each other, one of the said pairs of terminals being detachably fitted to the other and having devices adapted to bear against the other during the rocking movement.

538,090. ELECTRIC CUT-OUT; H. A. Wagner and F. Schwedtmann, St. Louis, Mo. App. filed Jan. 5, 1895. The combination of an outer shell, a removable core fitting closely therein, a helix around such core, a fusible wire in such helix a contact ring around the core near its upper end, a contact plug in the lower end of the core, and a contact ring and plug of the shell adapted to make contact with those of the core when it is in place.

538,097. COMMUTATOR BRUSH; L. Boudreaux, Paris, France. App. filed Oct. 28, 1892. A brush formed of superposed folds of metallic sheet foil compressed into a compact body.

538,104. ELECTRIC MOTOR FOR RAILWAY CARS; C. E. Emery, Brooklyn, N. Y. App. filed April 19, 1894. A motor adapted for use under a car by arranging the field magnets horizontally and the armature axle at the same elevation as the car axle, with an intermediate idle gear for transmitting motion from a pinion on the armature shaft to a spur gear on the car axle, the three gears being supported by suitable framing, journals and bearings in a continuously fixed relation one to the other.

538,127. ELECTRIC DOOR OPENER; J. Schneider, Long Island City, N. Y. App. filed May 7, 1894. The combination of a casing, a magnet, an armature lever, a rock-lever pivoted in the casing and adapted when moved in one direction to be held stationary by the armature lever, and when moved in the other direction to be out of position to be engaged by the armature lever, and a catch mounted to swing and adapted by a bolt on the door.

538,136. WORKING OF RAILWAY POINTS AND SIGNALS BY ELECTRICITY; I. A. Timmis, London, Eng. App. filed June 9, 1894. The combination of points provided with a locking bar, a locking bolt, two electric motors for operating the points, the home branch and distant signals, each provided with an electro-magnet for operating it; connections placing the magnets of the branch or the main line signals in circuit, and interlocking switches having electrical connections to send current to the motors and to the magnets of the home and distant signals in rotation.

538,224. AUTOMATIC CUT-OUT SYSTEM; L. L. Borradaile, Philadelphia, Pa. App. filed Feb. 5, 1895. An automatic cut-out comprising a hollow trolley wire supported upon a bracket having a passage in communication with the trolley wire, and pneumatic contact devices on the bracket.

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THE ACETYLENE SCARE.

In referring to this new rival of the electric light in our issue of Feb. 16, we stated, in reference to the estimated cost of its production, that until the figures given are substantiated they need not worry the managers of electric light stations or those who install and manufacture electric lighting apparatus. The figure at that time was about $15 per ton of the calcium carbide from which this gas is produced. It now appears that the lowest price at which the material may be purchased is 8 cents per pound in 20-ton lots, the price in one-ton lots being 12 cents, which figures are equivalent to $160 and $240 per ton respectively. In addition there is a considerable expense for the water-tight drums in which the carbide must be packed for shipment. As the margin between these actual figures and the theoretical price is so very great, those interested in electric lighting may again sleep in peace.

GALVANOMETER CONSTRUCTION.

In another column we print an article from the pen of Prof. Fisher describing the construction of a simple type of galvanometer. A large number of these instruments was made at Lehigh University, and gave results that, as will be seen from the comparison with commercial instruments, were remarkable when we consider that all of the work was done by students almost entirely unskilled in the processes of construction. Working drawings, as well as full and explicit instructions, are given in the article, and the opportunity thus presented to the amateur who desires to construct a galvanometer is an unusually favorable one, as it rarely happens that the necessary directions for making apparatus of scientific accuracy are placed within his reach. Most of the parts of the instrument can be easily made by the amateur; in the lack of a lathe, such parts as require its use could be made by almost any instrument maker or machinist from the drawings, and the mirrors could be purchased from a commercial maker of instruments if preferred.

THE BUFFALO-NIAGARA FRANCHISE.

After unusually protracted consideration, the committee of Buffalo municipal officials having in charge the matter of fixing the terms of a franchise under which the Niagara Power Company would be permitted to do business in Buffalo, has rendered its report, a résumé of which we print elsewhere. The three principal points in the report are those concerning the supply of power for municipal purposes, the terms under which power is to be supplied to private users, and the provision in regard to the Niagara Company providing additional and equal facilities with respect to poles and conduits to accommodate two other prospective competing companies. The provisions concerning the sale of power for municipal purposes and the free use of poles and conduits for municipal lines include compensation for the franchise, and therefore are to be considered only in this connection. The provision requiring the Niagara Company to provide pole and conduit facilities for each of two other companies equal to those necessary for its own needs, was doubtless designed to avoid a similar experience to that of New York City with respect to its subways. While the requirement is an onerous one, yet the Niagara Company would seem to be in a position to have little or no fear of any prospective rival profiting by the terms of this section. After all of the talk in regard to the municipal authorities fixing limiting prices at which power should be sold, it is gratifying to learn that they have left this matter to be settled between the buyer and seller, the only restriction being the very fair one that there shall be no discrimination between users. The report has not as yet been acted upon by the City Council, but it is not believed that its provisions will be materially changed upon final adoption. It is quite possible, however, that the Niagara Company will require some changes, as thus far only one party to a proposed contract has had a voice in the preparation of its terms.

PREVENTION OF ELECTROLYSIS BY TROLLEY CURRENTS.

In another column Mr. Stuart-Smith gives some very strong reasons in favor of the method proposed by him for the prevention of electrolysis and consequent corrosion of underground piping by trolley currents. This method consists, as will be seen from the article, in connecting the track to underground piping at frequent intervals, and commencing at a point distant from the power house where the pipes first become positive to the track. A hasty reading of his article led us into error in regard to some points of the proposed method which, as remarked by Mr. Smith, would relieve the piping through a metallic connection of the current flowing into it, instead of the reverse, as stated by us. It should here be remarked that all of the various methods that have been proposed for the protection of piping rest upon an assumption that the difference of potential at a given point between the piping and the track is a constant, which necessarily cannot always be the case, depending as it does upon the relative position of the cars on the line, and the position of a single car relative to a given point on the line. As a consequence of these considerations, there are probably some points of a line where the potential changes sign at intervals, and to meet this case the method of Mr. Smith seems to be particularly applicable, especially if the system of connections proposed were carried to the farthest point where such a change might be expected. In this case the surgings of current would take place through local metallic circuits instead of otherwise causing electrolysis when the piping becomes positive.

SIZE OF STEAM UNITS IN CITIES.

Some data recently published as to the size of steam units in Paris and Berlin are interesting as bearing on the subject of the electrical transmission of power. Within the walls of the former city the aggregate horse power of the stationary steam engines in use exceeds 55,000, and the average horse power is only slightly above 17, there being over 3,200 engines in use. In Berlin and suburbs the aggregate horse power is in the neighborhood of 58,000, the average horse power of the engines being 38. The largest average size of engines in any of the manufacturing districts of Prussia is less than 100 horse power, and averages of above 50 are confined in general to mining, iron working or other heavy manufacturing districts, the units in cities being small. We regret there are no corresponding data at hand for American cities, but there is no reason to believe that the conditions in these with respect to the size of units are materially different. We have before referred to the absurdity of estimating the charges for electrical power on the cost of steam power generated in exceedingly large quantities, and the above figures bear us out if, indeed, any specific evidence were needed in such a palpable case. While the central lighting and power stations and perhaps a few of the largest industries in a city will be customers for electrical power in large quantities, the most profitable portion of the business will be in the supply of power in small quantities, and for this a rate that should be entirely satisfactory to users would be nearer $75 than $30, the figure usually referred to in discussions on the subject.

THE ANNUAL REPORT OF THE GENERAL ELECTRIC COMPANY.

We print in our financial department the third annual report of the General Electric Company, which enables some idea, though not a very satisfactory one, to be formed of the condition of that company on Jan. 1 of the present year. The most favorable features of the report are the showings of business done during the year, the decrease in expenses, and the great reduction of the floating debt. As will be seen by reference to the balance sheet, the sales amounted to over twelve and one-half millions, and the total receipts, including royalties, sundry profits and returns from securities owned, aggregate over thirteen millions. The gross profit on this business was $1,811,747.60, against which there are charges of $932,521 for old losses, depreciation of inventories, cost of patents and franchises acquired, and sundry losses—the latter amounting to $38,798. As the two former items are due to special circumstances, and the third would not customarily come out of the profits of business, the amount of profits that would ordinarily go toward paying dividends is $1,308,365, or sufficient to pay about 3¾ per cent. on the $34,712,000 of capital stock. The unfunded debt of the company, which was $599,505 at the end of 1893, has been reduced to $90,021, and the liabilities for paper endorsements and discounts, which were $2,022,454 last year, have been entirely discharged. While the showing is undoubtedly favorable thus far, and reflects credit particularly on those in charge of the manufacturing and commercial departments, there are some unfavorable features to be considered. The shrinkage of assets has increased from $12,454,967 to $14,794,716. The two items of notes and accounts receivable ($6,550,499) and stocks and bonds ($5,079,012) are so indefinite as to offer little assurance as to their real value, while the figures given for the plants and inventories are largely fictitious in the absence of any purchaser for the former, and in view of the rapidly changing value of the latter, both in price and marketability. Perhaps the most unfavorable feature is the valuation of patents, which is placed at the same figure as in 1893, $8,159,265, notwithstanding the loss during the last year of three of the most important patents held—those on the incandescent lamp, the feeder-and-main principle and the Thomson arc regulator. The conclusion we believe an examination of the report will lead to is that a company which can, under adverse circumstances make the showing the General Electric Company has in volume of legitimate business and in manufacturing profits, deserves to be placed on some other basis than one which the most herculean efforts would not seem to be able to make secure. As we remarked before, the result of the year is extremely creditable to the technical and commercial employees of the company, but it is not creditable to those controlling its financial management that no steps are taken in the direction of a reorganization which would make such a good showing count on the side of a real prosperity.

Hydraulic Power Conduit at Buffalo.

The conduit for the wires of the Niagara Falls Hydraulic Power & Manufacturing Company is nearly completed on the north side of Falls street, Buffalo. This company owns the power canal and is a competitor of the Niagara Falls Power Company. The canal is large enough to supply turbines up to a total of 100,000 hp. The power conduit consists of an iron pipe eight inches in diameter which has within it several ducts for the conductors to pass through. The conduit is placed three feet below the surface of the street.

The widening of the power canal of the Niagara Falls Hydraulic Power & Manufacturing Company is progressing finely. A large strip on the east side of the canal near the Erie avenue bridge is now being removed.

Accumulator Traction in Paris.

At the April meeting of the Société Internationale des Electriciens, M. Sarcia gave some information in regard to results obtained with the three storage battery lines established in Paris since 1892. In 1892 the mileage was 145,000 miles, and the expense per car mile 20.6 cents; in 1893 the total mileage was 502,860 miles, and the cost 16.7 cents per car mile. Among recent improvements made to facilitate the handling of the storage batteries, the latter, instead of being placed under the seats as formerly, are now contained in a box which is suspended underneath the car between the two axles. It is hoped by this means to reduce the expense to 14 cents per car mile.

The Buffalo-Niagara Transmission Line.

A Buffalo newspaper reports that the Niagara Falls Power Company has made a proposition to the New York Central Railway Company to furnish power for the electric cars it is proposed to run on the line of the latter company between Niagara and Buffalo, in return for the use of an unoccupied strip of land along the tracks for the installation of electrical transmission conductors.

The Buffalo Niagara Franchise.

The report of the committee of Buffalo municipal officials appointed to consider the terms under which a franchise would be granted to the Niagara Power Company for the right to do business in Buffalo, was submitted on April 26, and we give below a resume of the various sections of which there are 16 in all. The report will not be considered by the Council until May 20.

Section 1 requires that plans and specifications of all proposed pole lines and conduits shall be filed with the Board of Public Works, as well as specifications relating to material, methods of insulation, etc., and that work cannot be proceeded with until authority has been granted by the Council after approval by such board.

In section 2 it is required that all poles erected and all conduits laid shall be of sufficient size and capacity and of such construction as to afford facilities for at least two other companies, each requiring facilities as great as the company receiving the grant, which additional space may be used by the city for any public purpose without charge. Any other companies not exceeding two, upon receiving substantially similar grants from the Council, and on making compensation for the use of such poles or conduits, may use the same for similar purposes to the extent of the space and facilities not used by the city; the compensation to be fixed by arbitrators should the companies concerned not agree as to the amount. The poles and conduits shall also be of sufficient additional capacity for four wires each of the Fire Alarm Telegraph and Police Signal System, for which there shall be no charge.

In section 3 it is provided that all work shall be under the immediate direction and supervision of the Board of Public Works and such inspectors as it may appoint, and the same authority may at the expense of the company at any time do all the work necessary to restore to a proper condition any street left in a state dangerous to life and property.

The fourth section stipulates that in case the company fails to use all necessary measures to avoid danger to life and property the Board of Works may furnish the material and do the work necessary to that end at the expense of the company. The fifth section requires that the company shall at its own expense make any changes in conduits or lines necessary in carrying out any public improvement by the Board of Works. Section 6 requires the company to put its overhead lines underground whenever demanded by the city authorities. Section 7 permits the use of poles and conduits of any electrical company having a similar franchise to the one in question upon just compensation. Sections 8, 9 and 10 are of the most interest, as they relate to the terms of sale of power. In section 8 it is provided that the company shall, during the entire period on the grant, supply electricity to such extent as the capacity of its plant and its facilities for increasing the same will permit, to all persons and corporations desiring the same in Buffalo City and situate along any of its lines of transmission or within five blocks thereof, upon their complying with such general rules and regulations not inconsistent herewith as it may make with respect thereto; and shall not charge therefor a greater price than it shall charge other consumers in Buffalo for the same or a less quantity of electricity supplied the same or a greater distance from a distributing station, and shall not charge any consumer a greater price than it shall have previously charged him, or a greater price than it shall charge consumers at other points further from its Niagara Falls power house for the same or a less quantity of electricity supplied the same or greater distance from a distributing station. Whenever said company shall have received bona fide applications for power aggregating 1,000 hp within a radius of a mile from any point in any part of the city, where it has not constructed a line of transmission, and the applicants shall have tendered the said company contracts for the use of power, aggregating said amount, for at least one year, accompanied by a bond, which contracts shall conform to said company's general rule and regulations not inconsistent therewith, then and in such case the Common Council may order and direct the company within six months thereafter to extend its line of transmission and furnish electricity to such applicants so far as the capacity of its plant and its facilities for increasing the same will permit.

Section 9 provides that the company shall agree to supply the city with electric power for its water works or other public purposes at a rate not exceeding $20 per horse-power per annum, 24 hours a day, and for lighting the public streets, avenues, alleys and places of the city at a rate not exceeding $50 per annum for each electric light of 2,000 cp, or to supply such electricity at the city line to any contractor for lighting the city at a rate that will enable such contractor to contract for lighting the city with lights of said candle power at a rate not exceeding $50 per annum for each such light; provided, however, that where the city shall require power at points not on a line where the company is supplying electricity to others, it shall pay the extra cost of transmission.

Section 10 requires that the company shall be prepared to supply 10,000 hp to consumers within the city on or before the 31st day of December, 1895, and 10,000 additional horse power within each successive year thereafter for four years, so far as the demand therefor may require the same.

Section 11 makes the term of the grant 25 years, at the expiration of which time the city may purchase all parts of the plant within the city limits at a price agreed upon by three appraisers, one to be appointed by the company, one by the mayor and the third by the two thus appointed. In case the city shall not give the company one year's written notice before the expiration of the grant of its election to purchase the plant, the grant shall be renewed at the request of the company for the same term of years or such longer time as the Council may authorize.

Section 12 specifies that the grant is not transferable or assignable without the consent of the Council, and that the company shall not consolidate or merge with any other company or corporation, or enter into agreement to prevent competition, or the reduction of the price of electricity, without such consent.

Section 13 requires a bond of $250,000, and provides that the company shall pay all expenses incurred by the city in supervising any work done under this grant.

Section 14 is in regard to obtaining consents for tearing up pavements whose maintenance or repair is at the charge of private citizens. Section 15 specifies penalties for the violation of any provisions of the grant, and section 16 requires a written acceptance of all its terms before it shall become operative.

The National Electric Light Association.

A meeting of the officers and executive committee of the National Electric Light Association was held in New York, on May 4, to discuss matters in connection with the time and place of holding the next annual convention. All of the officers of the association and all but one member of the executive committee were present, as follows: President C. H. Wilmerding, Vice-Presidents Frederick Nicholls and E. F. Peck, Secretary and Treasurer Geo. F. Porter, Master of Transportation C. O. Baker, Jr., and Messrs. John A. Seely, E. H. Davis, A. J. De Camp, C. R. Huntly, W. W. Carnes, W. R. Gardener, G. A. Redman and J. J. Burleight, of the executive committee. In addition to the above, several representatives of electrical commercial interests and of the electrical press were present by invitation, in order that an expression of opinion might be obtained from them in regard to the questions discussed.

An extended discussion took place on the subject of annual meetings, and the sense of those present seemed to be in favor of a proposition made to the effect that, hereafter, meetings should be held alternately in New York and Chicago, and at the entire expense of the association. Some opposition was manifested in regard to holding exhibitions in connection with the meetings, but most of those present who spoke on the subject declared themselves in favor of having such exhibitions as part of all future meetings.

It was proposed that the next meeting be held at New York, in May, 1896, and that an extensive electrical exhibition in the Grand Central Palace be organized in connection with it. This proposition seemed to meet with favor, and after some discussion the following named gentlemen were appointed a committee with authority to decide upon the date and place of the next meeting, and whether an exhibition shall be held in connection with it: Messrs. Wilmerding, Nicholls, Peck, Huntley, Seely, De Camp and Porter.

Electric Traction in the Isle of Man.

The electric railway to the top of Snaefell, Isle of Man, is being rapidly pushed on, and it is anticipated that the line will be completed in time for the coming season.

Effects of Competition.

A firm in Germany sells incandescent lamps at a little less than 14 cents each.

The Governing of Steam Engines.

Mr. G. L. Addenbrooke, in the London *Electrician*, gives an account of some experiments on the engines of an electrical plant in India for which he was the consulting engineer.

The plant consisted of three 40-kw dynamos, coupled direct to Belliss compound engines; the boiler pressure was 120 pounds, and the speed was to be under 525 revolutions full load; the dynamos were fully compounded. The compounding having been adjusted on the first set, and trials of this and the second set having established the characteristics and working of the plant, advantage was taken of the trial run of the third set to make the experiments on the governing and control of the engine, after the plant had run for about four hours at full load, viz., 100 volts, 100 amperes and 500 revolutions. The experiments were as follows:

1. The whole current was suddenly switched off, leaving no load on the engine. The speed at once went up to something over 600 (the tachometer was not calibrated further), but within a second it was reduced to 575, and after two more oscillations of rapidly-decreasing amplitude, and taking only a few seconds, the engine settled down to run steadily at a speed of not more than 1 per cent. difference from the full-load rate. This was repeated, and the current then switched on.

2. The governor (of the throttle-valve type) was kept full open, and the speed run up to 575 revolutions, when the dynamo gave 403 amperes at 118 volts. The engine was then doing 18 per cent. more than its proper load, or about 80 hp. It still ran quietly, and the governor seemed to have proper control over it.

3. An attempt was next made to ascertain the sensitiveness of the governor to slight differences of adjustment, which are obtained by means of a small hand-wheel working on a screw; this alters the tension of a spring, the latter balancing the thrust of the governors, the action of which opens or closes a sensitive throttle-valve arranged in the main steam pipe.

In the first pace, the load was reduced to a quarter, and when everything was running steadily, a complete turn of the governor adjusting wheel was made. The result was to reduce the revolutions about 12, and to bring down the voltage 3 per cent. Under the same circumstances, a half turn made about five revolutions difference in speed. The difference made by one eighth inch of a turn was not sufficiently decided to be observed, but a one-fourth inch turn was; and it was clear that the voltage could easily be regulated within less than 1 per cent. or a one-third inch turn, by means of the governor. In the next place, the full load was put on, and the above experiments repeated, to see if the governor was as sensitive at full as at one-quarter load. Under these circumstances a whole turn of the governor adjustment wheel reduced the revolutions by 14, and the voltage in two trials, both up and down, was increased and decreased by 3 per cent., in accordance with the direction in which the turn was taken.

4. The plant running full load, by rotating the adjusting wheel the speed was lowered 20 and 30 per cent. while the engine was running, and afterwards brought up again to the normal.

Of course, in trials like these, involving small differences, slight alterations of pressure in the boiler, the cooling and heating of resistances, and other matters, a very high degree of percentage accuracy is only attainable by extreme care and careful preparation. But the above results are sufficiently accurate for all practical purposes, and the observations left the impression that, if possible, even better could have been done after the engine had had two or three weeks' constant work, and all the working parts had become properly polished.

It is worthy of note that the engine, which indicated some 65 hp during the trials, was placed on a platform, and was not bolted down—simply standing on its own extended bed-plate.

Mr. Addenbrooke concludes that the makers have certainly used great care and skill in working out their engine, with the most excellent results. His account of these trials, he states, is not to eulogize the engine beyond expressing a high opinion of it, nor does he suppose that they are unique in their method of governing. The object has been to show that engines can be made to govern, and with provision for altering the adjustment of the governor or the speed of the engine, over the full range required for central station or similar electric work; and that the governor can also be made sensitive enough to enable sufficiently accurate increments or decrements of voltage to be provided for by adjustment of the governor, and thus that it is thoroughly practical to provide the voltage required in the omnibus bars and in the circuits by adjustment of the engine, leaving the switchboard attendant to his proper duty of observing the voltage in the feeders and at the feeding points or transformer stations, which he is then in a better position to keep at the requisite pressure than if he had to look after the adjustment of exciting resistances also.

Electrical Engineers.

What to do with mothers' sons, says the London *Electrician*, is becoming a more and more important problem every day in the households of the United Kingdom. A profession that has few prizes and many blanks, especially when the prizes themselves have no very great attraction, does not attract the best men. It may be that it contains openings for hundreds, if not thousands, of units, but few of these units come in prominence because of talent. The electrical engineering professsion is such a one. It employs many men, most of whom are mere items, and will remain items to the end. These items are intensely ignorant of the why and wherefore of their everyday work. Their only view is bounded by the wall of as much pay as possible and as little work as possible. Their ignorance compels them to wait for assistance at the rise of every little difficulty. We should prefer to see more men ready to grapple with the difficulty and capable of stepping into a higher position when the chance offers. When the standard of knowledge in any profession is of a high order, wages and salaries also average higher in amount, because the universal law of supply and demand acts in this direction. The most recent development in the electrical industry seems to warrant the conclusion that in future the number of prizes will be greater, and this will lead to greater competition for such prizes and inevitably to a higher standard of knowledge in certain ranks of the profession. Hitherto putting aside the question of consulting engineers, with which we are not now dealing, the best positions open to general competition have been those of municipal electrical engineers. The renumeration, except in a few cases, has however been too low, but this may probably have arisen from the youth of the profession. No one in the earliest days could adequately grasp the value of the work to be done, and municipalities were cautious in offering too much. As time went on, it became clear that to successfully manage a central station demanded capacities of a much higher order than were originally thought necessary. In more than one case success has been taken as obtained automatically, but the illness or departure of the successful organizer has opened the eyes of those who controlled the management. It is an open secret that some companies have found the loss of a man of far greater importance than they ever suspected. We, however, have no intention of dilating further upon the settled conviction of business men, that the proper course to pursue is to employ those who know their business, and to pay them well for their work. Experience is only gained by age, and experience is worth paying for.

What Next?

The latest sensation which the public is expected to swallow is a story now being circulated by the daily press to the effect that there lives near Abilene, Tex., a young woman whose hair might become of practical use should electrocution be adopted by her State. The story has it that this remarkable hair sweeps the floor as the owner walks, and gives forth crackling sounds along with a strange, weird light at night. If it stopped at this uncanny manifestation all would be well, but we are assured that a person touching a strand of the hair receives a terrific shock, and that a young physician who investigated the matter is nearly dead, as the result of his temerity and skepticism.

The girl, it is said, discovered her peculiar power recently, when, in bending over to caress a kitten, her hair fell about it and killed it instantly.

Farragut and Sumter.

At the recent meeting in Washington of the Telegraphic Historical Society, Mr. Henry A. Reid related that he received the news of the firing on Fort Sumter in the Poughkeepsie office, while Commodore Farragut, who was visiting friends in that city, stood beside him and read the message as it was written down. When the message was concluded Farragut remarked: "That means I must go to Norfolk at once. I have many friends there, but if duty requires I will blow the city to h——l."

An Electrical Ferry Service.

BERGEN, Norway, enjoys the distinction of having the first electrical ferry service in the world conducted as a business enterprise. Primitive rowboats had for a long time been adequate for the increasing traffic between the different sections of the city, and after a consideration of steam, petroleum and electric boats it was finally decided that the latter possessed the greatest merit for the use proposed.

The ferry plant consists of eight boats, a charging station and a boat harbor. Work was begun last May, and by August the ferry was started.

Fig. 1 gives a view of one of the boats, and their construction is shown in Figs 2 and 3, the details of which were determined by the requirements of the ferry service. The dimensions of the boats are as follows:

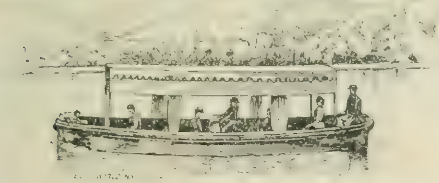


FIG. 1.—ELECTRICAL FERRY BOAT.

Extreme length	26 feet 3 inches.
" breadth	6 " 7 "
Draft (about	2 " 7 "
Number of passengers	18
Displacement	6 tons.

The boats are built symmetrically fore and aft and provided with a screw and rudder at either end in order that turning when leaving the landing places may be avoided, that they may be more easily steered and for other reasons. The screws are on a common shaft, direct coupled to the motor.

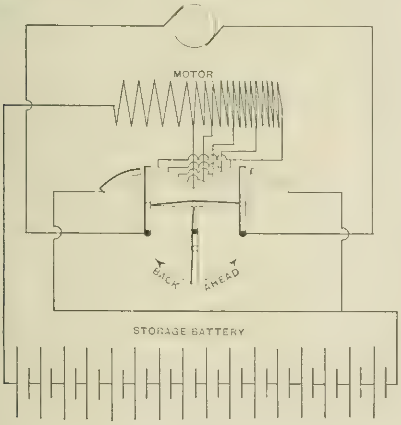
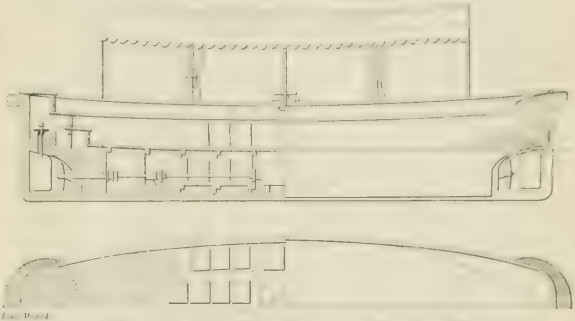


FIG. 4.—DIAGRAM OF CONTROLLER CONNECTIONS.

A series-wound motor is used, weighing about 660 pounds, and rated at 3 hp; it is placed in the middle of the boat under the flooring. Its construction is such that the insulation cannot be injured by any bilge water which may collect. The radically fastened carbon brushes work without sparking or heating of the commutator, whether the armature is turning forward or backward.

The storage batteries are placed partly under the flooring and partly under the seats, as can be seen in Figs. 2 and 3. The plates are of the Hager type, and those of each battery weigh about 3,080 pounds, and have a capacity of about 20,000 watt-hours. The battery consists of 32 cells in series, and weighs altogether 5,280 pounds.

In order to control the speed, a special switch (Fig. 4) is provided, which operates by cutting different parts of the field coils of the motor in and out, and so causes the boat to go ahead, astern, slow and faster by regular gradations. In the middle of the boat, over the motor, there is a cylinder, about four inches in diameter, through which pass the conductors to the motor and the accumulators, and the connections to the steering apparatus. On the head end of this cylinder are two wheels, each 16 inches in diameter, placed one above the other, the upper of which works the rudder, while the lower controls the movements of the regulating switch.



FIGS. 2 AND 3.—ELEVATION AND PLAN OF BOAT.

The average speed, with a power of 2,300 watts, is about five miles an hour. As the distances between the landing places (Fig. 5) are not great, this comparatively low speed has been found ample, and owing to the crowded condition of the harbor, it is even necessary in order to avoid accidents.

The bearings of the motor and the shaft are self-lubricating while running, so that the man at the wheel, who operates the boat alone, can give his individual attention to steering it. The boats are run under five minutes' headway and from 7 o'clock in the morning to 9.30 at night in the winter, while in summer the daily service is lengthened. Each boat runs about 37½ miles a day. Up to this time about 1,800 passengers, on the average, have been carried by the ferry each day. After the day's work is over, the boats return to the charging station, where the accumulators are charged during the night, and the necessary cleaning done and repairs made. The charging station is fitted with a compound portable steam engine, a dynamo of 30 hp and a suitable switchboard.

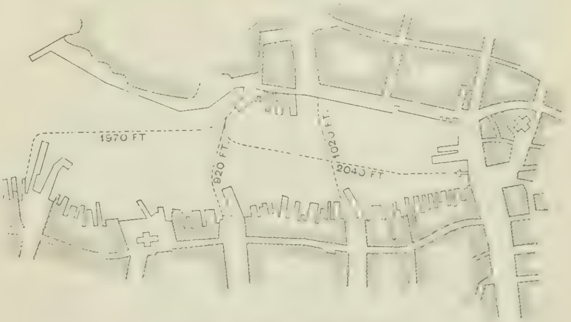


FIG. 5.—MAP OF ROUTES.

The total cost of the plant was as follows:

Eight boats, including duplicate parts	$11,900
Charging station, boat harbor and landing places	9,520
Total amount	$21,420

During eight months of uninterrupted operation the plant has proved excellent in every respect.

The above description is borrowed from an article in the *Electrotechnische Zeitschrift*, written by Mr. J. Trumpy, of the Bergens Elektriske Faergeselskab, who designed the boats and plant.

Galvanometer Construction at Lehigh University.

BY EDWIN C. FISHER.

During the fall of 1894 a piece of work well worthy of note was undertaken by the Junior Students of the Department of Electrical Engineering at Lehigh University. The work consisted in the construction of a set of galvanometers for use in the laboratory, and derives its interest from two sources: First, in that a body of students, almost entirely unskilled in construction work, built up a set of instruments which for accuracy, sensibility and finish stand very close to instruments put forth by our best manufacturers. Second, in that this set of instruments shows to a certain extent the amazing results which may be obtained by the new method for astaticizing galvanometer needles, as advanced by Mr. F. L. O. Wadsworth, in the November issue of the *Philosophical Magazine* for 1894. Covering, as this set of instruments does, such a wide range, the results are particularly valuable.

To meet the varying work of a laboratory, the instruments were designed of resistances ranging from 160 ohms to 5,000, giving instruments suitable for most of the general work which students meet. Also, they were designed so as to produce instruments which should be both serviceable, reliable, and at the same time highly sensitive. How nearly these requirements were met can best be ascertained by a careful consideration of the details of one of the instruments given later.

Fig. 1 shows the general appearance of the instruments after completion. All the different designs are here shown (though not all the instruments, as there were three or four of some of the types) with both front and back of each type where possible. Figs. 2 and 3 show to somewhat better advantage two of the most satisfactory of the designs, Fig. 2 showing the high resistance potential instrument, with the cups on and off; Fig. 3 gives a similar view of the two-coil instrument.

The table near the end of this article gives results of the tests made upon completion. The first three instruments, *a* 1, 2, 3, are by one of our best American instrument makers and merely inserted for comparison and reference. Instrument *a* 1 was an excellent example of fine work, being of the *best* construction mechanically and electrically. Its sensibility, as given, needs no comment (the controlling magnet not used). The remainder of the list gives the details of the instruments constructed. As will be seen, there are three instruments of about 5,000 ohms, two of 4,000, nine of 400, and one of 160. The magnetic systems of all are astatic, vary in weight from .4 to .6 gm. and in number of needles from 68 to 12. All sensibilities given in this table are for the instruments under the earth's influence only, and *not* using a controlling magnet.

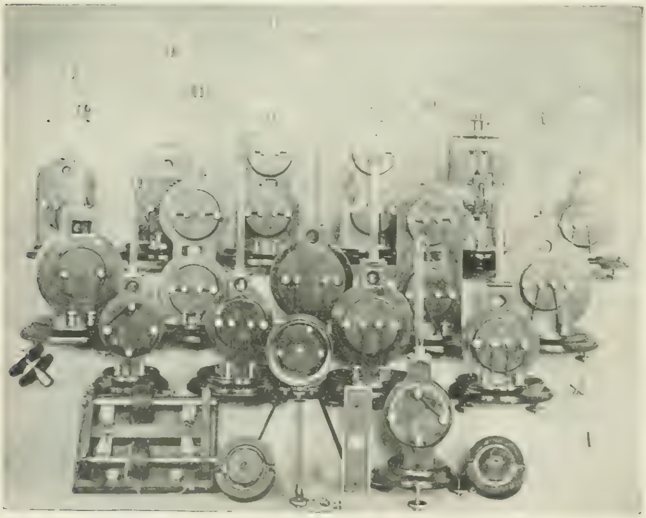
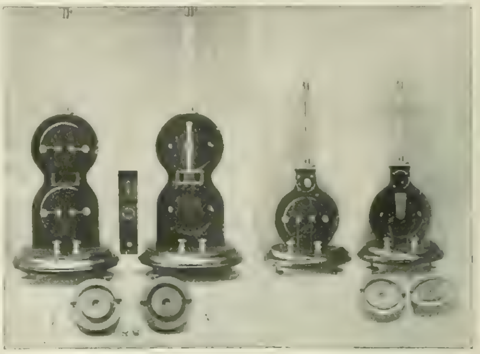


Fig. 1.

The most sensitive instrument (*b* 1), it will be noticed, has a sensibility of 12×10^{-11}, which is about *two-thirds* the current necessary for the instrument (*a* 1) of standard manufacture. When one stops to consider that *b* 1 is nearly 800 ohms *less in resistance* than *a* 1, and uses *silk* instead of *quartz* for its suspension, certainly the result is well worth notice. This, without doubt, was due primarily to the method of magnetizing the needles. Indeed, when properly made the needles would become so nearly astatic that the earth's influence *was entirely null*, and only the torsion in the silk suspension fibre affected the position in which the needles rested.



Figs. 2 and 3.

The instrument *a* 1 is not an old one, being out of the manufacturer's hands less than six months, but its magnetic system was probably built up after the old methods; were it to be reconstructed and remagnetized according to the newer method its sensibility would probably be most surprisingly lowered. (The sensibility given for this instrument is that given by the manufacturer's test.)

Instrument *b* 1 was first tested with a magnetic system having but 14 needles, giving a sensibility of 62×10^{-11}. This system was then reconstructed, using a better grade of steel and 68 needles, which change reduced the "figure of merit" to *less than one-fifth*. Thus *b* 2 and *b* 3 would probably give equally good results were they treated in the same way. The remainder of the instruments, it will be seen, give sensibilities which are quite remarkable, and yet were they to be reconstructed, using the better steel, and greater number of needles, one could predict sensibilities one-fourth or one fifth the present, at least. Especially would the effect be great, as these instruments have so small a number of needles (12).

The construction of all the instruments can best be shown by carrying through in detail the construction of one certain instrument, as all were built upon the same principles; the woodwork of all was the same, except in design and dimensions; the coils of all were graded and of the dimensions given by Mr. Edwin F. Northrup in The Electrical World of November and December, 1893; the needles of all were astatic, built up similarly, and all magnetized by the method previously stated; the metal parts of all were the same. For this purpose, that instrument which has been most nearly perfected, *i. e.*, *b* 1, is taken.

The wooden framework of this instrument is shown in detail in Fig. 4. Here it will be seen that the frame consists of two parts: the base, and the upright section which is firmly attached to it. This upright part is composed of three pieces firmly glued together, the object being to prevent any change in the instrument due to warping, and also to form by the thin "separator" (middle piece, 3-32 inch thick) a rest or stop for the coils. This middle strip is almost entire, being cut away only enough to allow the needles to swing freely. The coils are thus kept always at the distance apart of 3-32 inch. An upright thus made, and of well seasoned material, should warp very little, if at all. The distance between coils might be made less, but would hardly be advisable unless metal were used.

The cups for receiving the coils are as shown, and are not quite deep enough to allow the coils to sink below the flush surface. In this way the wire always touches the separating strip of wood, and is as near the needle as is allowable, producing the maximum magnetic effect under the circumstances. The cups are held to the woodwork by four threaded brass rods (not shown) which pass through the "separator" and have thumbscrews at their ends. The terminals of each coil are taken to two small binding posts on the exterior of the cup, these posts being finally properly connected to each other and to the main binding posts of the instrument. The drawing shows arrangements for the damper and for a window to allow access of light to and from the mirror. This window is closed by a piece of plate glass held in place by screws. A piece of sheet rubber between the glass and the wood prevents air entering due to any poor fit or uneven woodwork.

Fig. 5 shows such metal parts as are necessary.

The leveling screws need no comment and are placed as ordinarily upon such instruments.

The suspension tube is clearly shown, having two points worth mention. The "head" is so arranged that an *indefinite* length of silk fibre may be taken up, yet always maintaining the central position. Also should this rolling of the fibre produce torsion it may be immediately removed by turning the "head" upon the glass tube, rendered possible by the strip of chamois interposed between the brass cap and the glass tube. This chamois is shellaced to the glass, but *not* to the cap, and keeps the "head" perfectly tight, true, and vertical, yet free to move (though snugly) about a vertical axis. The lower end of the tube may be held in the "base" either by chamois, which answers admirably, or by sealing wax or plaster of paris. Naturally, an instrument of so great delicacy would be positively worthless were it not for this "torsion head" which allows the perfect removal of any torsion which may be in the fibre.

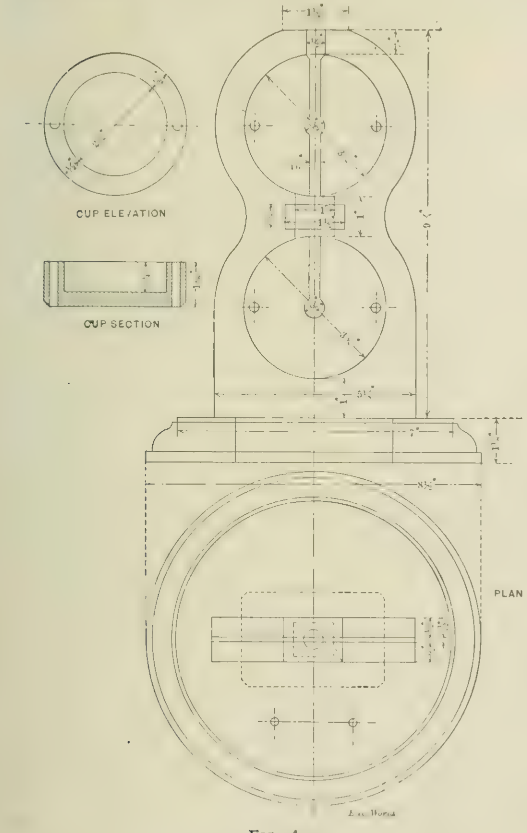


FIG. 4.

Between the metal base and the wooden framework a piece of felt is interposed. This is in the form of a circular disc (cut away at the centre to allow passage for the suspending fibre) of about 1¼ inch diameter. This felt answers two purposes: it serves to prevent air currents passing through and disturbing the action of the needles, as the wood and metal could not otherwise be made to fit perfectly; also it serves as a means for adjusting the suspension tube into a perfect alignment with the rest of the instrument (the position of the tube being changed by tightening or loosening the screws holding the tube base to the frame; the felt being elastic gives much play)

The most important part of the instrument is its "astaticized needle system" or magnets. This instrument was first constructed with its magnets of the dimensions as in Fig. 5, but using 14 needles, instead of the 68 shown. At first only two mica discs for needles were used, one at the top and the other at the bottom, the needles being placed on the one side only. With this arrangement the sensibility was 62×10^{-11}. Reconstructing this system, using a mica disc on either side of the glass fibre at the top and at the bottom (*i. e.*, four discs in all) it was possible to use 68 needles, with which the sensibility obtained was 12×10^{-11}. In this last case, the needles were made of No. 8 guitar string, tempered glass hard. This steel is not the best that may be obtained by any means, so that even this remarkably low sensibility might easily be lowered still further.

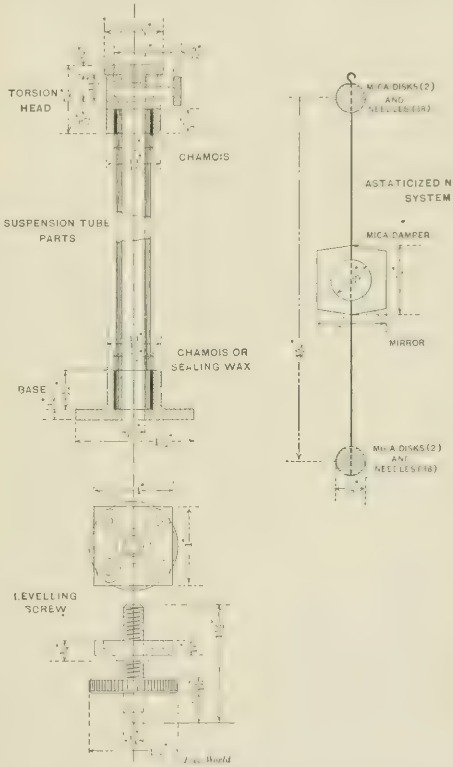


FIG. 5.

Glass was used to hold the discs, mirrors and damper together; quite inferior to quartz, yet answering fairly well. The small hook at the upper end, for attachment to the suspending fibre, was of No. 38 B. & S. copper wire firmly held with sealing wax. Shellac was used for holding needles and discs in place.

The mirrors used were of "home manufacture," and hence not of the efficiency which might have been wished. They were made by depositing from solutions metallic silver upon thoroughly cleaned microscopic "cover glasses." Great care and close inspection had to be exercised in choosing the mirrors to be used, yet the final result was quite satisfactory. The mirrors were perfectly plain, being suited from their size to either telescopic or reflected light methods of reading.

After the needle system had been properly assembled, and thoroughly dried, it was placed in the "astaticizer" or magnetizer. No description of this is necessary, as it is built entirely after the suggestions of Mr. Wadsworth. The detailed drawing of the instrument used in this instance is shown in Fig. 6. Also Fig. 1 gives a fairly clear idea of its construction. In this case a current of five amperes was used, passing through the two coils in series each of 350 turns of No. 18 B. & S. (*i. e.*, 3,500 ampere turns). In Fig. 6 *B B* are screws by means of which the pole pieces may be loosened and their positions changed, suiting them for needles of quite various lengths. *A A* are set screws for holding the bars in place after adjustment by the front screws. The frame of the instrument was of cherry and the metal parts of the best Swedish iron.

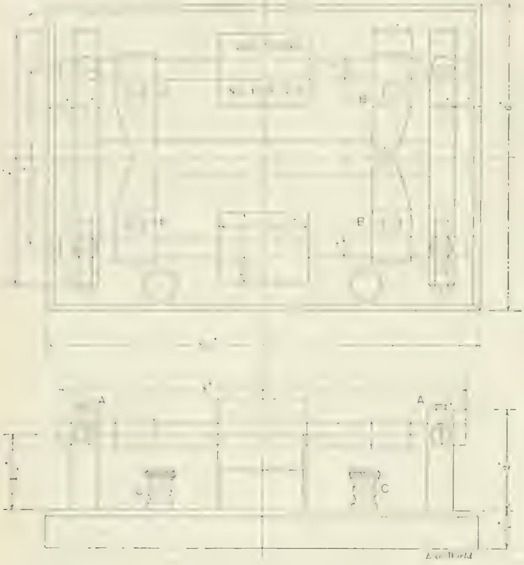


FIG. 6.

GALVANOMETER DATA.

Instrument.	Resistance at 15° C.	No. of coils.	Needles. Kind.	Number Total.	Wt. in mg of suspended parts.	Suspension.	Sensitivity. ["Figure of merit" in Amperes.]
a—1...	5,891.7	4	Astatic	22	254	Quartz.	119×10^{-11}
a—2...	1,991.0	2	Bell.	1	......	Silk.	$5,370\times10^{-11}$
a—3...	98.9	2	do.	1		do.	$30,180\times10^{-11}$
b—1...	5,123.3	4	Astatic.	14	440	Silk.	62×10^{-11}
*do. ...	do.	4	do.	68	578	do.	12×10^{-11}
b—2...	4,983.0	4	do.	18	47	do.	39×10^{-11}
b—3...	4,779.1	4	do.	14	492	do.	57×10^{-11}
c—1...	4,014.4	4	Astatic.	14	486	Silk.	89×10^{-11}
c—2	4,068.0	4	do.	14	50[illegible]	do.	107×10^{-11}
d—1...	392.9	2	Astatic.	12	608	Silk.	398x10
d—2	391.6	2	do.	12	422	do.	453x10
d—3	394.8	2	do.	12	468	do.	560x10
d—4...	400.9	2	do.	12	490	do.	560x10
d—5...	390.7	2	do.	12	498	do.	594x10
d—6	395.5	2	do.	12	506	do.	599x10
d—7	384.4	2	do.	14	480	do.	685x10
d—8...	404.2	2	do.	12	522	do.	705x10
d—9...	398.3	2	do.	12	432	do.	748x10
e—1...	158.1	2	Astatic.	12	630	Silk.	$1,055\times10^{-11}$

The same instrument, with new suspension; differing as shown.
* Manufacturer's statement.

Next in importance to the needle system are the coils. In this instrument each of the four coils were "graded" to secure the maximum electromagnetic effect, being wound after the following specification:

No. 40 B. & S.	590 ft.	= 590 ohms.
No. 36	904	= 374 "
No. 34	1,300	= 397
Total		1,361 "
Total resistance of instrument		5,204 ohms.

These coils were wound on specially made cast iron cores or spools, so arranged that one flange could be removed and the coil slipped off. Before winding, the spool was lined with paraffine paper. The No. 40 wire was used first and the No. 34 last. In fact, as before mentioned, these coils were wound after the method of Mr. Northrup, excepting that shellac was used instead of paraffine on the wire. The paraffine paper lining to the spool allows the coil to be readily removed upon gently heating it. Upon completion, the coils were mounted in the cups, and cemented in place with paraffine, leaving the winding exposed, and thus brought as nearly as possible to the needle system.

As to finish the instruments were thoroughly coated internally with shellac to increase insulation and also to keep the moisture from warping the frame. Externally they were finished off and polished with a hard oil finish, or with a varnish, after thorough smoothing down with pumice.

Such a set of instruments certainly cannot fail to be of interest, possessing as they do many original features in construction, combining many excellent principles already put forth by others, and illustrating what may be done with the recently propounded method of needle magnetization, even where those who undertake the work are not over highly skilled at it.

Grooved Rails for Electric Railways.

Some investigations, says the London *Engineer*, have recently been made to ascertain the most desirable shape for the groove to be used in the guard rails for curves on street railways, especially those operated electrically, the fundamental idea being that these grooves should be laid out corresponding to the lines of wear, so as to present from the start the largest possible wearing surface to the action of the wheels, in order to prolong the life of the rail. Two pair of wheels were carefully turned out of hard wood to an accurate scale of three inches to one foot, and with their axles—on which they were turned—secured to a strong frame representing the car truck, so that they could revolve freely but without any play. The frame was rigidly fastened in the centre to a stiff board extending at right angles with the truck, to what would be the centre of the curve. A pin accurately turned and fitting snugly in holes in the board, and holes in a wooden stand screwed to the floor, formed the centre proper. A large piece of drawing paper was stretched on a board, and on it were laid rail blanks without any groove, formed out of potters' clay, following the curves described by the wheels when allowed to move, guided by the board from the centre of the curve to whatever radius it was set. The wheels were then set upon the rail blanks and weighted until their flanges sank into the clay to their full depth, at which point the whole apparatus was arranged to be exactly level. The wheels having previously been varnished, were thoroughly oiled, so that the clay would not stick to them. The first pair of wheels was then revolved from the axle by hand, and thus the truck moved along the potters' clay, the flanges cutting their own grooves into it. The length of arc available having been traversed, the truck was lifted away, and if a perfect impression had been obtained short pieces were cut out of the various parts of the arcs of both the inner and outer rail, and particularly of those parts which had been traversed by the front wheels only or the hind wheels only, and those that had been passed over by both wheels, as comparison of them would show whether or not the truck stood exactly square with the radial line. These pieces were cut out so that the cut would also sever the paper underneath, and extending a short distance inside and outside, forming a strip on and by which the cut-out pieces could be slid away upon another board, and put away to dry and harden without handling the piece itself while yet soft, thereby avoiding possible distortion, except on the very ends, by the cutting knife. As this latter was unavoidable, the pieces, after being thoroughly hardened, were sawed in half, so as to get at the central undistorted section, and the sawed surface ground smooth on a piece of slate so as to present sharp lines. The shrinkage of the clay in drying could well be neglected, as actual measurement on a test piece showed that it would amount to little more than 1-64 inch in the full-size width of the groove.

Southwest London Polytechnic.

The new Southwest London Polytechnic, Manresa Road, Chelsea, is now rapidly approaching completion, and will, it is expected, be ready for opening at the commencement of the autumn.

Prevention of Electrolysis by Trolley Currents.

BY W. STUART SMITH

In an editorial comment in your issue of April 13, on my recent paper on the electrical condition of underground conductors within the influence of electric roads, it is stated that "The plan advocated by Mr. Smith to connect the rails to underground piping and employ the piping system as part of the underground circuit will not, we believe, meet with the approval of many, and we fear that the saving in copper entailed by such a method would have little weight in inducing gas and water companies to accord the necessary permission."

In this editorial you have credited me with advocating a plan which I have not for a moment thought of. You no doubt arrived at this conclusion from a somewhat hasty reading of my paper, and I am sure that a more careful reading of the latter part of the concluding section will show you that the plan I advocated was exactly the contrary of that with which you credit me.

In order to prevent electrolysis it is, of course, desirable that no current at all be allowed to enter the pipes, but this is impossible because as long as the rails are used for the return, some current will leak to the pipes wherever the track is +.

This current will all flow in the pipe systems, toward the power house, with a constantly increasing volume, and finally the potential relations between pipes and track will reverse, and the pipes becoming + to the track, the current will begin to leave them and electrolysis will begin to take place unless the return can be through metallic paths.

As soon as this condition obtains, my plan is to begin wiring pipes and track together, not for the purpose of making the pipes act as portion of the return circuit, but, on the contrary, to prevent such use in the greatest possible degree by taking the current, which is unavoidably present in the pipes, out of them at the *earliest possible* moment.

I prefer to begin wiring the track and pipes together at the farthest possible point from the power house where the pipes definitely become + to the track, and wire at every street crossing within the region where pipes are +; by so doing, the current which leaks to the pipes along the lower reaches of the road and spreads out so as to flow in the pipes for long distances on both sides will, on its return to the neighborhood of the track where the pipes are +, immediately find metallic paths by which it can return to the track, and thus prevent these numerous branch currents from finally accumulating as a current of large volume in one section, as would be the case if an attempt was made to rewire the pipes by heavy wiring near the power house only. My plan distributes the return from the pipes and thus minimizes danger of corrosion at resisting joints. Briefly, in order to prevent, as much as possible, the use of the pipes as a portion of the return conductor, the resistance between the track and pipes should be made as great as possible where the track is + to pipes, and small where the pipes are + to the track—in the first case to prevent the current getting into the pipes, and in the second to take out as soon as possible such current as does get in.

Now, with regard to the system of auxiliary conductors mentioned in the latter part of the editorial above indicated, whatever may be the value of such conductors when frequently connected with the rail and used as part of the regular return circuit, their value when specially led out and connected to pipes only is open to some question. By wiring track and pipes together as I have above stated, one or two No. 0 wires at the street crossings will be found adequate to so far remove the current from the pipes as to entirely neutralize the potential relation between pipes and track, and absolutely prevent any passage of current through the soil. By so doing the conductivity via the pipe systems as a whole will be somewhat increased, with the result of inducing slightly more leakage to pipes in those regions where the track is +; but this will also be the case if auxiliary conductors are used and only exemplifies the fact that good in one direction is apt to be accompanied by evil in another. In this case the good is of very large amount and the evil of little moment. If, however, auxiliary conductors connected to pipes only are used, it will be extremely difficult, and probably utterly impossible, to so proportion them as to prevent passage of current in one direction or the other between pipes and track. If the auxiliary conductor was so large and so frequently connected to the pipes that right up to the power house the track would be + to the pipes, there would certainly be no passage of current from pipes to track, and corrosion from that cause could not take place; but there would be leakage from track to pipes over the entire road instead of only a portion, as is the case when no wires are present, and as would be the case if my plan was followed. Also, the very greatly decreased potential of the pipe systems which would result from such large auxiliary conductors, would cause a greater potential difference between track and pipes along all portions of the road, thus inducing much greater leakage to pipes everywhere than would be the case with my plan.

Such auxiliary conductor, therefore, would have the effect of promoting exactly that use of the pipes as portions of the return conductor which the editorial condemns. If the auxiliary conductor was much smaller than that necessary to so far reduce the pipe potential that there would be no tendency for passage of current from pipe to track, the danger region would be contracted, but there would still be a portion where corrosion would take place, and the remedy would only be partial. The plan I propose is far simpler than the auxiliary conductor method; it takes but a few yards of wire to entirely rewire the potential difference between pipes and track throughout the region where pipes are +, it reduces to a minimum amount the use of pipes as return conductor—in fact it accomplishes the desired purpose. The auxiliary conductor requires a large amount of copper, which is expensive; it necessitates a large amount of digging in order to lay it; in order to be entirely effective in preventing passage of current from pipes to rail, it must be very large and greatly reduce the potential of the pipes, thereby increasing leakage to pipes and augmenting their use as portions of the return circuit; if smaller than this it still leaves a region where corrosion can take place. My plan is simple, cheap, and effective; the auxiliary conductor is expensive and does not achieve the desired end.

When the passage of current from pipes to track has been prevented, there still remain two sources of possible danger, the remedy for which is entirely outside the hands of the railway companies. These are the drop of potential over joints with consequent possible corrosion, and the potential difference between pipe systems which is the direct result of such drop over joints. The remedy is to have the ends of the pipes and the inside of the bells clean metal when making pipe joints. It is the general practice to have them coated with asphaltum.

The Spring Valley Water Company, of San Francisco, is now, on my advice, making all new joints with clean metal.

In wiring pipes and track it is, of course, necessary to wire both or all systems, otherwise the ones not so wired will be in a dangerous condition.

With regard to the auxiliary conductors, it would be much better for the railway companies if the copper they would require for this purpose were put in as supplementary to the rails, thus increasing the conductivity of the circuit and reducing the conductivity relatively to the pipe systems. The total leakage to pipes would thereby be reduced, and the total amount of corrosion correspondingly lessened.

To this extent such an augmenting of the rail return would be a benefit to the pipe companies, but there is a further consideration that furnishes another example of the companionship of good and evil. Increasing the conductivity of the rail circuit would cause a very considerable reduction of the rail potential, and if there was, from any cause, considerable leakage to pipes on the lower reaches of the road, it would result in the danger region, or region where pipes were + to track, being considerably expanded, and while thus the total corrosion would be less in amount, it would really represent a greater ultimate danger by being distributed over a larger territory. If my plan of neutralizing the danger was in all cases followed out, however, there would be a direct benefit to pipe systems in a good rail conductivity, because the volume of current in the pipes would be less and the danger caused by resisting joints be thereby reduced.

Electrical Fakes.

With reference to electrical fakirs in general, and one in particular, the *Worcester Spy* very sensibly says that when a man claims to get out of any mechanical device more than he puts into it, it is time to suspect either his sanity or his honesty. A correspondent of an electrical contemporary calls attention to a stock-selling speculation loudly advertised in a Boston daily paper, which has a very queer look about it. The promoters say that "the voltage distributor is a machine that multiplies electric horse power without materially increasing the cost of the original source of production." Any Worcester capitalist contemplating investing in any such scheme had better in the first place consult with a junior member of the electrical course at the Polytechnic Institute.

Electrodynamic Machinery.—XXXV.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

215. As has already been pointed out (Par. 12), all self-exciting continuous-current generators may be wound in one of three ways, namely:

(1.) Series-wound.
(2.) Shunt-wound.
(3.) Compound-wound.

216. Fig. 158 represents diagrammatically the connections between the field and armature of a series-wound generator. It will be observed that the current in the main circuit passes through the field magnet windings. The M. M. F. of the field coils increases directly with the current strength through the circuit. So long as the iron in the magnetic circuit of the machine is far from being saturated, the flux through the armature increases with the M. M. F. approximately in direct proportion, and the E. M. F. of the armature, consequently, increases nearly in proportion to the current strength. As soon as the iron in the circuit approaches saturation, the flux increases more slowly, and finally, the E. M. F. of the armature is scarcely increased by any increase in the current strength through the circuit.

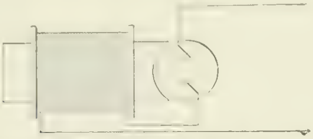


FIG. 158.—DIAGRAM OF SERIES WINDING.

217. Fig. 159 represents diagrammatically the connections between the field and armature of a shunt-wound generator. Here the field magnets are wound with fine wire and the windings are connected in parallel with the external circuit, instead of being connected in series with it. Consequently, if the pressure at the brushes be considered as uniform, the current strength passing through the magnet coils must, by Ohm's law, be uniform independent of the current strength in the main circuit. Thus, if the pressure at the brushes be assumed constant, at, say 100 volts, and the resistance of the magnet coils be 50 ohms, then the current strength through the magnet coils will be two amperes independently of the strength of current supplied to the main circuit.

218 Practically, however, owing to the drop of pressure in the armature as the load increases, and also on account of the shifting of the brushes that may be necessary with the increase of load, the pressure at the brushes diminishes, and the current strength through the field magnets diminishes in the same proportion. The tendency in a shunt-wound machine is, therefore, to diminish its M. M. F., and its resulting E. M. F., as the load on the generator increases. In order to maintain a constant pressure at the brushes under all variations of load, it is necessary to adjust the strength of current passing through the field magnets, so that the M. M. F. at full load shall be slightly in excess of the M. M. F. at light load. This is usually accomplished by the insertion of a rheostat in the field magnet circuit, so that some or all of this resistance can be cut out by hand at full load, thereby increasing the current strength through the magnet coils.

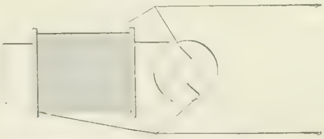


FIG. 159.—DIAGRAM OF SHUNT WINDING.

219 If, for example, the full load activity of the machine be 10 kw at 100 volts pressure, the full load current strength will be 100 amperes. Assuming the resistance of the armature to be 0.05 ohm, the drop of pressure in the armature at full load will be 100 x 0.05 = 5 volts, and the additional drop of pressure, owing to the shifting of the brushes in order to avoid sparking, may be two volts more, making a total drop in pressure of seven volts. The effect of this drop would be to reduce the current strength in the field magnet coils from two amperes to $\frac{93}{50}$ = 1.86 amperes, thus reducing the flux through the armature and the E. M. F., so that a balance between the E M. F. and M. M. F. might be found at, say, 90 volts, if no means were adopted to regulate the current strength through the field coils. In other words, the pressure at the brushes would vary by 10 volts between light and full load.

220. Fig. 160 represents the connections between the field and armature of a compound-wound generator. Here the principal M. M. F. furnished by the magnet coils is that due to the shunt coil, composed of many turns of fine wire, an auxiliary series coil, of comparatively few turns of coarse wire, being also employed in the main circuit. As the load increases, the M. M. F generated by the shunt winding tends to diminish as above described, but the M. M. F. due to the series coil increases. By suitably proportioning these two opposite influences, the M. M. F. may be automatically so controlled that the pressure at the brushes shall remain constant, either at the brushes of the generator, or at the terminals of the motor or other translating device, which may be situated at a considerable distance from the generator. In order to effect this latter result, the M. M. F. of the series coil must compensate not only for the drop in the armature, but also for the drop in the conductors leading from the generator to the motor, so that these external conductors may be regarded electrically as forming an extension of the armature winding, and, in this sense, the generator delivers a constant pressure at its final terminals on the motor. Such a machine is said to be *overcompounded.*

221. Series-wound generators are almost invariably employed for series arc lighting, since it would be very difficult to supply the required M. M. F. for their magnets by a shunt winding, considering that the pressure at the brushes varies between such wide limits, and even if such shunt winding could be supplied it would necessarily be formed of a very long and of fine wire, and consequently would become troublesome and expensive. Series arc lighting generators are sometimes constructed for as many as 200 lights, representing about 10,000 volts at the generator terminals at full load, and a shunt winding for such a pressure would be very expensive.

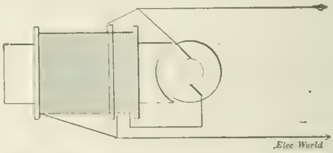


FIG. 160.—DIAGRAM OF COMPOUND WINDING.

222. Shunt-wound generators are usually employed for supplying incandescent lighting from central station, and their pressure is varied by hand regulation.

Compound-wound generators are usually employed for supplying motors from central stations, and also for incandescent lights and motors in isolated plants.

223. In the design and use of generators it is important to know how the E M. F. generated in the armature at a given speed varies with the current passing through the field magnets. We have seen that the E M. F. in the armature, in C. G. S. units, so long as the brushes remained unaltered in position, is equal to the product of the number of turns on the armature, the number of useful webers passing through the armature from each pole, half the number of poles, and the number of revolutions per second. Consequently, the E. M. F. of such an armature, running at a constant speed, depends directly upon the flux through its magnetic circuit or circuits. If we vary the current strength through the field magnets, and, consequently, the M. M. F., we can observe the pressure in volts, which the machine will deliver at its brushes at light load. A series of such observations, plotted in a curve, gives what is called the *characteristic curve* of the generator. In the case of a self-exciting, series-wound generator, it is only possible to vary the M. M. F. by varying the load, and, consequently, by including in the pressure at the brushes the drop taking place in the armature. The curve obtained from a series-wound machine under such circumstances, is called an *external characteristic*, and the *internal characteristic* may be determined from it by correcting for the drop in the armature.

224. Fig. 161 represents the internal and external characteristics of a particular series-wound generator intended to supply a maximum of 70 amperes at 50 volts terminal pressure or 3,500 watts.

The pressure at terminals, when the load was varied so as to produce the required variations of current strength through the magnets, followed the broken line *A B C*, which is, therefore, the external characteristic of the machine. If we add to the ordinates of this line from point to point, the drop of pressure in the armature at the corresponding current strength, the full line 0 *D E F*, is obtained, which is, therefore, the internal characteristic of the generator or the curve of its E. M. F. in relation to the exciting current in its field coils.

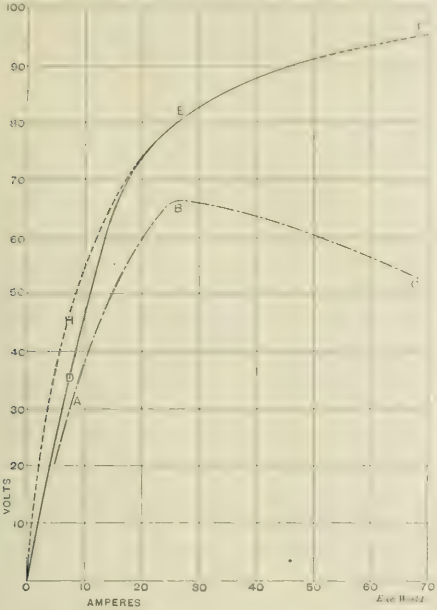


FIG. 161.—CURVE OF E. M. F. DEVELOPED IN THE ARMATURE OF A SERIES-WOUND DYNAMO, WITH REFERENCE TO CURRENT STRENGTH IN A CIRCUIT.

The useful E. M. F. developed by the armature may be expressed by the formula,

$$E = \frac{I}{x + y\,I}$$

so that, if two observations are secured, the whole curve may be deduced to a very fair degree of accuracy. For example, in Fig. 161, the E. M. F. at 20 amperes = 74 volts, and at 70 amperes, 95 volts. From these observations we may take the two equations,

$$74 = \frac{20}{x + 20\,y} \text{ and } 95 = \frac{70}{x + 70\,y}.$$

From these two equations we obtain $x = 0.0836$ and $y = 0.00933$, so that the E. M. F. at any current strength through the field magnets is

$$E = \frac{I}{0.0836 + 0.00933\,I}$$

The dotted curve 0 *H E F*, which is lying close to the full curve 0 *D E F*, represents the locus of this equation. It will be observed that the dotted line practically coincides with the full line representing the observations, except within the first 20 amperes of magnetizing current strength.

225. Fig. 162 represents the characteristic curve of a shunt-wound generator, of 200-kw capacity. Here the current strength through the field magnets was not observed, but the pressure acting on the field coils was noted. Assuming, as would probably be very nearly true, that the resistance of the field magnet coils would be constant throughout the observations, the exciting current strength would be proportional to the pressure acting on the coils; with 40 volts on the magnets, the E. M. F. at the brushes with the external circuit broken was 71 volts, and increased, as shown by the full line *A B C*, to 185 volts, with 140 volts on the magnets. Here also the E. M. F., *E*, may be expressed by the Frölich equation, $E = \frac{e}{x + y\,e}$, the e being the pressure on the field magnets; taking the two observations, $120 = \frac{70}{x + 70\,y}$, and $174 = \frac{120}{x + 120\,y}$, we find $x = 0.43$ and $y = 0.0022$, from which the general equation becomes,

$$E = \frac{e}{0.43 + 0.0022\,e} \text{ volts.}$$

The locus of this equation is represented by the dotted line, which practically coincides with the full line *A B C* of observation.

226. When, therefore, two reliable observations have been made of the E. M. F. generated by an armature, at observed exciting current strengths or pressures situated not too closely together, it is possible to construct the characteristic curve throughout to a degree of accuracy sufficient for all practical purposes.

The Frölich equation, by which this is possible, is a consequence of the fact that the reluctance of the air paths in the magnetic circuit of a generator is constant, while the reluctivity of the iron in the circuit is everywhere capable of being expressed by the formula $= a + b\,\mathfrak{H}$ (Par. 51) and, consequently, the total apparent reluctance of the armature takes the form $x + y\,\mathfrak{M}$, and the useful flux passing through the armature $\phi = \frac{\mathfrak{M}}{x + y\,\mathfrak{M}}$, $\mathfrak{M}$, being the magnetomotive force in gilberts in ampere-turns, in amperes or in volts supplied to the coils.

227. When the characteristic curves of a shunt machine have been obtained, it is a simple matter to determine what the series winding must be in order to properly compound it, for either the drop in the armature or the drop in any given external circuit as well. Thus, suppose that it be required to determine the series winding for the machine whose characteristic curve is represented in Fig. 162. If the E. M. F. required at the terminals of the machine be 120 volts at all loads, and if the drop in the armature due to its resistance at full load, as well as the resistance of its series coil and also due to any shifting of the brushes that may be necessary, amounts in all to 10 volts, then the full load current must supply the M. M. F. necessary to carry the E. M. F. from 120 to 130 volts, equivalent to raising the pressure by eight volts from 70 to 78 volts on the shunt winding. The increase in current strength from the shunt winding represented by these eight volts multiplied by the number of turns in the shunt winding, gives the M. M. F. required, and the full load current must pass through a sufficient number of turns to supply this M. M. F. in its series coil.

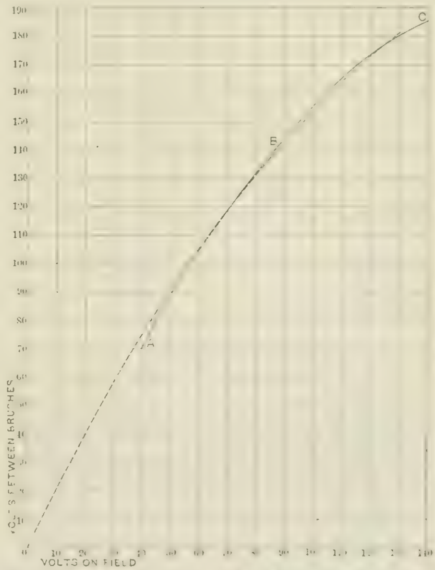


FIG. 162.—CHARACTERISTIC CURVE OF SHUNT-WOUND DYNAMO.

(To be continued.)

Electric Traction in Brazil.

The *Jornal do Brazil* states that work has been commenced on the Santa Theresa Electric Railway at Laderia de Santo Antonio.

Rope Driving—XV.

BY J. J. FLATHER.

For a head or jack shaft carrying heavier pulleys, the weight acting on the bearings may be taken equal to four times the bare weight of shaft, in which case, other conditions remaining the same, we obtain

$$F = \frac{4}{\pi}\sqrt{\left[\frac{4}{4}(3.36\,d^2)\,L + \sin 30° \cdot \frac{1}{4}\left(\frac{3}{2}\,d^3 N\right)\right]^2 + \left[1 \cdot \left(\frac{3}{2}\,d^3 N\right)\right]^2}$$

Since, however, the extra weight of pulleys on a jack shaft is liable to produce a greater bending moment, it is customary to assume a larger shaft to transmit a given horse power; therefore, instead of using $\frac{d^3 N}{100}$ as the working horse power transmissible by the shaft, it is better to use under these conditions $\text{HP} = \frac{d^3 N}{125}$.

From this value of the power transmitted we obtain

$$F = \frac{4}{\pi}\sqrt{\left[\frac{4}{4}(3.36\,d^2)\,L + \sin 30° \cdot \frac{1}{4}\left(\frac{3}{2} \cdot .8\,d^3 N\right)\right]^2 + \left[1.2\left(\frac{3}{2} \cdot .8\,d^3 N\right)\right]^2}$$

$$= \sqrt{[0.8\,d^2 L + 0.0114\,d^3 N]^2 + [0.11\,d^3 N]^2}$$

The ratio of power absorbed by friction to the horse power which the shaft is capable of safely transmitting will now become

$$\frac{HP_f}{HP} = \frac{0.08\,d\,N\,F}{0.008\,d^3 N} = \frac{0.10\,F}{d^2} \text{ per cent.},$$

from which Table XIV. has been determined. In calculating the values given in this table it has been assumed that the belt speeds are the same as those previously considered, namely, 2,640 feet per minute for main belts to head shaft, and one-fourth of this, or 660 feet per minute, from head shaft to auxiliary shafting; this may be low in many cases, but, as already pointed out, the force, F, will decrease under the assumed conditions as the belt speed increases, so that for higher speeds we may expect the friction loss obtained by the above formula to be somewhat less than the actual.

TABLE XIV.—POWER ABSORBED BY FRICTION IN JACK OR HEAD SHAFTS.

Diameter of Shaft in Inches.	Revolutions per Minute.	Percentage of Loss when Length in Feet	
		50	100
2	100	4.8	8.5
	250	7.2	10.1
	400	10.0	12.5
2½	100	5.1	8.7
	250	8.3	11.0
	400	12.2	14.3
3	100	5.5	9
	250	9.5	12
	400	14.2	16.1
3½	100	5.8	9.1
	250	11.5	12.9
	400	16.6	17.8
4	100	6.3	9.5
	250	12.1	14.2
	400	18.4	20.5

In the foregoing discussion it has been assumed that the shaft transmits its allowable maximum power, that is, for line shafting the power transmitted $= \frac{d^3 N}{100}$, and for head shafts the power transmitted $= \frac{d^3 N}{125}$.

As a general thing the actual average power transmitted by a shaft is seldom more than about three-fourths of its assumed working capacity, and since the weight and speed remain practically constant, the percentage of loss under conditions approximating those we have assumed will be somewhat greater than that given in the table. But while the power transmitted is diminished 25 per cent., the percentage of increase in friction loss will vary between wide limits, depending upon the speed of rotation and length of shaft; thus for a 3″ head shaft 100 feet long, delivering three-fourths of its allowable capacity at 100 revolutions per minute, the loss increases from 9.0 to 11.5 per cent., which represents an increase of 28 per cent.; at 250 revolutions the loss is now 14.0 per cent., corresponding to an increase of 14.3 per cent., while at 400 revolutions the loss is 17.8 per cent.—a gain of only 10.6 per cent.

For these determinations it is supposed that the shafting is properly supported, with hangers sufficiently close to each other to prevent undue deflection under working conditions, and that the shaft is in line, having good bearings and well lubricated. Departures from these assumptions will further increase the friction loss, but, on the other hand, this loss will be decreased if lighter or fewer pulleys are used throughout the length of the shaft, or if the machines be belted directly from the shaft below. Where shafting is employed, there will generally be an additional loss due to the friction of the auxiliary shafting and countershafts, which is extremely variable.

It is outside the province of the present article to discuss the losses in these secondary shafts; the losses which we have been here considering are those which exist in main line shafting, jack and head shafts receiving their power presumably by leather belting or ropes, with either of which, for similar drives, there should be no appreciable difference in the total weights of pulleys and shafting and the friction involved. The diameter of grooved shaft pulleys will be larger and the rim will be thicker, but for the same horse power transmitted the width will be less and the weight not materially increased. In any case, the total weight of grooved pulleys, compared with that of belt pulleys used in the same system is usually very small, and any individual differences may be neglected when taken as a whole. In those cases where ropes are used exclusively, as, for instance, in dynamo rooms and other power stations, the pulleys are frequently heavier and the shafting is generally fitted with a number of friction clutches, thus materially increasing the weight on the bearings; in cotton mills, also, where the ropes are geared direct from the engine to the various floors of the mill, there is frequently a heavy stress on the shaft, especially on the upper floors, due to the weight of the ropes; under such conditions the receiving shafts should be considered as head shafts.

In work of this nature the velocity of the ropes is usually much greater, both from the engine to the first shaft and from the latter to the machine or secondary shaft. Assuming a speed of rope double that used for the previous tables and letting the weight of pulleys, ropes, clutches and couplings equal four times the weight of shaft, it can be shown that the formula for the friction load will be reduced to

$$F = \sqrt{[0.8\,d^2 L \times 0.0057\,d^3 N]^2 + (0.033\,d^3 N)^2}$$

From this formula Table XV. has been calculated, and may be considered to represent the percentage of loss in the first shaft when working under full load; with lighter loads the percentage will be greater.

TABLE XV.—POWER ABSORBED BY HEAD SHAFTS CARRYING HIGH SPEED ROPES.

Diameter of Shaft in Inches	Revolutions per Minute.	Percentage of Loss when Length of Shaft in Feet =	
		50	100
2½	100	4.2	8.1
	250	4.8	8.6
	400	5.6	9.2
3	100	4.3	8.2
	250	5.2	8.7
	400	6.0	9.5
3½	100	4.3	8.3
	250	5.3	8.8
	400	6.2	9.6
4	100	4.4	8.3
	250	5.6	9.1
	400	7.1	10.1

Line of action of resultant of tensions in main drive = 30°.
Velocity of ropes from engine, 5,280 feet per minute.
Ropes from shaft are horizontal and run at an average of 2,640 feet per minute.
All ropes drive from one side of the shaft toward the engine.
Weight on bearings four times weight of bare shaft.

It must be noted that with any other arrangement of shafts the friction loss will vary; in the present case the ropes from the engine to the jack shaft make an angle of 25° with the horizontal, and the ropes from the jack shaft back to the machine or secondary shaft are horizontal, as in Fig. 41.

When rope wells are used, each successively higher shaft will have an increased friction percentage, since the belt pull becomes more nearly vertical and the resultant load on each shaft is thereby increased.

It is worthy of remark that in long lines of shafting with high rim velocity the influence of belt pull on the bearings is very slight compared to the weight of shaft and pulleys, so that the loss in friction is but little more than that due to weight alone. We see in this an additional argument for high rotative speeds in shafting, for while the percentage of loss increases, say from 8.1 to 9.2 in a 3-inch shaft running at 100 and 400 revolutions per minute, respectively, the power transmitted by the shaft, as calculated from $HP = \frac{d^3 N}{125}$ increases from $21\frac{1}{2}$ for 100 revolutions per minute to about 87 HP for 400 revolutions per minute, so that while the friction percentage increases in the ratio $\frac{9.2}{8.1} = 1.14$ to 1, the power transmitted increases in the ratio of the number of revolutions per minute, or 4 to 1. With higher belt velocities and increased rotative speeds in our factory shafting, the friction loss, instead of being from 30 to 50 per cent. of the total power transmitted, ought not to exceed one-half of these percentages. For with higher speeds narrower and lighter pulleys could be used, the belts could be run slacker, and lighter shafting could be employed.

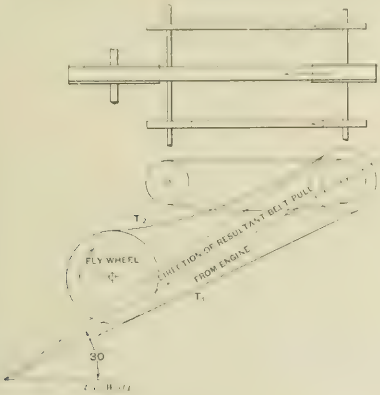


FIG. 41.

Although it has been previously considered in a general way that the friction due to the shafting may be taken as about 10 per cent. of the full power transmitted to the shaft, yet in the light of further investigation it will be seen that, owing to the various conditions under which the shafting is run, no general value for friction loss can be assigned.

While the friction absorbed by large engines is reasonably less for rope-geared fly-wheels when compared with engines using flat belts, driving in a similar manner, there seems to be no good reason for supposing that the friction in ordinary mill shafting should be appreciably different when rope-driven.

On account of the larger diameter of pulleys used with rope driving, the velocity of the rope may be, and usually is, greater than that in a belt used in the same place, and for this reason the pull on the shaft due to the tensions in the rope may be less; but with long lines of rope-driven mill shafting the main drives only are of rope, and any difference in pull on the bearings which might exist in favor of the rope-driven main shaft must necessarily be small when compared with the total friction load due to the pull of the numerous cross or machine belts which, running at a greatly reduced speed, produce by far the greater effect on the shaft. With short lines of shafting, however, there will generally be a small saving in favor of a rope-driven plant. Under these conditions the effect of the ropes to and from the first motion shaft is usually in excess of that due to the belts which may be used to transmit power from the main or jack shaft to secondary shafts or machines, and, therefore, since the rope pull is less than would be produced by belts used in the same place, we may expect the friction to be less. When ropes are used entirely, as in electric and other power stations, we should expect the friction loss to be somewhat less, assuming that the ropes are run at a higher speed than would be used for belts in the same place.

(To be continued.)

An Electrical Cat.

To the Editor of The Electrical World:

SIR: I am the possessor of a pet cat, and to-day after having held her in my arms, I went to put her down, and instead of dropping her outright, I let her fore-paws slip off my left arm, still holding her with a grip of my right hand at her flanks just above or in front of her hips. This brought her into a position, with head down and paws extended, and as I relaxed my grip, preparing to drop her, my middle finger pressed on some muscle or organ, which gave me a slight shock, quite similar to that received from a person charged by friction of the feet on a carpet.

I was naturally surprised, and repeated the operation six times with the same result each time.

This afternoon I related my experiment to a professor at the Buffalo Electrical Engineering School, who advised me to write you and have you disseminate the facts, that some of the readers of your valuable journal might experiment and investigate further.

I am of the opinion that the cat may possess, on a small scale, an organ of the nature of the Electric Torpedo and Gymnotus mentioned in text-books.

I. H. BALCOM.

BUFFALO, N. Y.

The Power Factor of a Synchronous Motor.

To the Editor of The Electrical World:

SIR:—In a recent article* entitled "The Action of a Single-Phase Synchronous Motor," giving the results of an extended series of experiments conducted by Prof. Ryan and myself, reference was made to the work of other investigators in this direction, beginning with the first operation of the synchronous motor by Wilde in 1868, and the first discussion of its theory by Hopkinson in 1884.

In the experimental treatment of the synchronous motor, as given by us, analytical discussion was excluded. Our investigation showed the condition of operation under which it is possible to obtain the minimum current and maximum power factor, a relation obtained by Mr. Mordey and called attention to by him in 1893. It is of interest to note that this relation was theoretically deduced by Prof. Blondel the year before and given by him in "La Lumière Electrique," Vol. 45, p. 423, in his extensive memoir on the synchronizing of alternators. No bibliography on the theory of the synchronous motor would be complete without reference to this article, and I must thank Prof. Blondel for calling my attention to the bearing it has upon the relation shown by Mr. Mordey. I take pleasure in calling the attention of your readers to the elaborate theoretical treatment by Prof. Blondel, for from it many conclusions concerning the action of a synchronous motor may be readily deduced, and it should take an important place in the literature of the subject. Yours very truly,

FREDERICK BEDELL.

ITHACA, N. Y.

Maxwell and Joubert.

To the Editor of The Electrical World:

SIR:—I read with much interest Mons. Andre Blondel's biographical sketch of Prof. Jules Francois Joubert in the last issue of your esteemed journal. This sketch contains a statement which I cannot pass without a comment. It is this: "*It is to Professor Joubert that the honor belongs of having found the law of simple alternating currents, represented by the two well-known formulas*

$$I = \frac{E_0}{\sqrt{R^2 + \left(\frac{2\pi L}{T}\right)^2}} \sin 2\pi \left(\frac{t}{T} - \phi\right)$$

$$\text{and } \tan\phi = \frac{2\pi}{T}\frac{L}{R}$$

which define the apparent resistance effect, called impedance to-day, and the lag in phase. It would only be just to give definitely to these formulas the name of Joubert's law."

In his great essay on "A Dynamical Theory of the Electromagnetic Field," published in 1864, Maxwell not only gave these formulæ, but he also showed how the self induction and the resistance, and therefore the impedance of a primary circuit is modified by the presence of a closed secondary. In fact, the whole theory of the ideal modern transformer and alternator was given in this essay. (See pages 546 and 547, vol I, of Maxwell's scientific papers.) I do not see how this can be reconciled with Mons. Blondel's statement that "*Maxwell had approached the question in two or three notes, but without results,* . . . . . ." Professor Joubert's reputation rests on big things and needs no bolstering up by these little trifles, which are as light as air.

M. I. PUPIN.

NEW YORK, N. Y.

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*Reprinted in a slightly condensed form in THE ELECTRICAL WORLD of April 6.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

BY CARL HERING.

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors, or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 927 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French, or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Force Experienced by Iron-embedded Armature Conductors.—The Lond. "Elec.," April 19, contains a short paper by Mr. Sayers in which he shows that in iron-embedded conductors the driving force is borne directly by the iron instead of by the conductors, as in the case of smooth core machines. Taking the case of an armature in which the thickness of each projection is equal to the space between them, he shows that, when the induction in the iron is 16,000 and the field in which the conductors are immersed is 50 while in a smooth core armature it would be 8,025—then the force on the embedded conductor is 165 times greater in the latter than in the former. The lines of force in the case of the embedded conductor must travel across the solid at a very much greater rate than the peripheral velocity of the armature, in this case about 164 times as great, and traveling in a direction opposite to that of the rotation of the armature; a curious point is, that the arrangement constitutes a kind of speed gear whereby the relative velocities of the conductors and fields in which they are immersed is enormously greater than the actual velocity of the periphery of the armature and that the forces experienced by the iron must be due to the reaction of the lines of force which are being propelled at a high rate of speed in the opposite direction to the conductors. In another example he takes a larger magnetic induction in which he finds that the force is only 16 times as great; if the induction be taken less the force on the conductors will be a still smaller fraction of the total.

Armature Reaction.—The leading editorial in the Lond. "Elec.," April 19, on "Recent Papers on Dynamo Design" compares the recent American paper by Prof. Ryan and Mr. Thompson with the recent English paper of Mr. Sayers; the problem which these two devices are intended to solve is claimed to be precisely the same in both but the solutions are different; in principle that of Ryan and Thompson does not appear nearly as radical a remedy so far as armature reaction is concerned; the editorial claims that sparking at the brushes is a thing of the past and that it is now not worth while striving to attain greater fixity of position of the brushes at the cost of any complication; inventors it is stated are apt to recommend panaceas for evils which do not practically exist; it may still be asked, however, at what cost this perfection is secured (referring to the usual forms of dynamos and not to these devices); a long air gap is a necessity which signifies a large expenditure of copper and a long magnetic circuit; the real aim of the devices described in these papers is to show how it may be possible to use armatures with projections and with short air gaps thereby lessening the copper and iron required; it does not think that the claim that the output of the armature may be greatly increased, is well founded as it believes that in the ordinary armatures the limits fixed by heating and sparking are reached at nearly the same output. If both devices are equally efficient it gives preference to that of Sayers.

Deductions from Dynamo Characteristics. — In a short article in "L'Eclairage Elec.," March 30, it is shown how certain deductions may be made from the characteristics. Assume that the curves are given, whose ordinates are the volts at the terminals and the abscissas are the exciting currents, the machine being separately excited; a separate curve is given for each of several constant currents in the armature; if a line be drawn through the origin making an angle with the horizontal axis whose tangent is equal to the resistance of the shunt magnets then the ordinates for the points of intersection of this line with these curves represents the difference of potential which must be applied to the magnet terminals in order to give the excitation corresponding to those abscissas; the points of intersection are those for which there will be an equilibrium between the difference of potential at the terminals of the armature and that applied to the magnets to obtain the required excitation; (the explanation is not as clear as might be desired). He also gives a formula, which is not very simple, for calculating what the speed must be to obtain a somewhat different voltage at a certain fixed current.

Non-synchronous Polyphase Motors.—The "Bull. l'Ass'n Ing. El. Montefiore," vol. 6, No. 1, 2, 3, contains a long presidential address by Mr. de Bast in which he gives a summary of a number of papers on the theory of such motors, which have recently appeared in Europe and discusses them from the standpoint of the engineer, giving in as simple form as possible the characteristic equations concerning the action of these machines; it is chiefly of a mathematical character.

LIGHTS AND LIGHTING.

Silvered Bulbs.—The table from which the abstract in the Digest, Jan. 20, was taken, showing the saving of power in the use of silvered bulbs, is reprinted in the "Elek. Anz.," April 14.

Holophane Globes.—A brief illustrated description of the principles involved in these globes (which have been fully described in these columns) is given in the Lond. "Elec.," April 19.

Price of Incandescent Lamps.—According to the "Elek. Anz.," April 18, the agreement among German manufacturers to sell lamps at a uniform price has not been adhered to; one firm sells lamps at 13¾ cts. each.

Illumination of Streets and Public Places.—The "Eng. Mag." for May contains an article by Mr. F. Pope in which he discusses briefly oil and gas lighting, giving costs of each and then more in detail, electric lighting; he describes briefly the tower system used in Elgin, Ill., and gives as his opinion that the most satisfactory plant for arc lamps under ordinary conditions is to suspend them from a mast-arm placed at the corners of streets. From the analysis of a large volume of trustworthy statistics he concludes that for a plant of about 100 arcs operated by steam power and doing no commercial lighting, the actual cost per lamp cannot at present prices be brought below $100 per year for all-night lighting of 4,000 hours or $65 for 2,200 hours; figures frequently appearing in the newspapers giving materially lower prices in order to induce municipalities to construct their own plants are therefore wholly untrustworthy. In conclusion he describes the series incandescent system which he thinks will ultimately be adopted in general for public lighting in all except possibly the largest cities and towns; such lamps should not be less than 20 or more than 32 cp to combine economy and good distribution; they should be located at intervals of 250 to 300 feet which may be reduced to 125 feet in the central districts and increased in the suburbs; a fair contract price for supplying and operating 25-cp lamps for street lighting would be $20 to $24 per year when burned until midnight; with cheap water power they have been supplied for $16; a 25-cp lamp will in practice give two or three times as much effective light as the average gas lamp. The choice of the system for public lighting depends upon the particular conditions, in the majority of cases a series incandescent system will be the best, but for brilliant lighting the arc light is better; nevertheless the kerosene lamp in skillful hands will give results which suffer but little in comparison.

POWER AND HEAT.

Transmission Plant at Goule.—A brief description of this plant in Switzerland is given in "L'Ind. Elec.," April 10. The power from a waterfall is transmitted electrically for lighting and power purposes, to a number of different cities and towns; it is said to be of special interest on account of the great extent of the area over which it is distributed. The simple alternating current is used; there are three turbines of 500-hp each which are directly connected with three alternators, generating currents of 5,500 volts and 63 amperes at a frequency of 50; separate systems of leads are used for the motors and for the lights, the motors being run at 240 volts and the lamps at about half that on a three-wire system; the motors used are non-synchronous, single phase, alternating current motors made by the Oerlikon Company; the starting apparatus is said to be very simple (but is not described) and it is said that they have given perfect satisfaction and that this installation has demonstrated that the problem of the alternating current motor has been solved; at present there are connected about 10 motors varying from 1 to 15-hp.

Thermopile.—In an illustrated article by Mr. Cox in the "Elec. Eng.," May 1, he describes at some length the principles of his "thermoelectric generator" (a true thermopile), and gives illustrations of the apparatus. He claims that the fatal defect of thermopiles as formerly used was the lack of stability; they deteriorated rapidly; his apparatus is intended to overcome this defect. The oxidation at the junction which was said to be a serious defect in the other forms, is claimed to be overcome by having no real junction point, which is here formed of a "graduated alloy; that is the two alloys composing the element are graduated or shaded one into the other so that there is no real point of junction;"

the fusion point of the alloy is over 1,000 degrees less than that of the cross connection or solid alloy; further than this he does not describe the alloy or its constituent parts. The complete element is encased in cement which is afterward vitrified thus preserving it from oxidation, the whole pile forming a hard, stone cylinder; the elements are arranged as usual in thermopiles, forming a hollow cylinder; around the outside is a water jacket; the apparatus is said to have been in use for three years without showing signs of deterioration. The average gas consumption is 2.5 cubic feet per hour for an output in the external circuit of 45 watts; with seven feet per hour the Commercial Cable Company operated its entire lines for several weeks with these generators, from the New York office, representing a saving at that station of eight to one in favor of the generator over its present system; their entire system will be equipped with these; a 55-volt five-ampere coal burning generator is shown which with coal at $4.50 per ton generates current at 0.2 cent. per lamp hour (the candle-power is not given). He adds that he has discovered that it required a "particular form or kind of heat" there being a great difference in the output with various forms and kinds of fuel, the output being increased 300 per cent. by "simply using the proper heat."

TRACTION.

Accumulator Traction.—According to a recent paper by Mr. Sarcia read before the International Society of Electricians in Paris the following improvements are to be made in the accumulator system used in Paris: the charge was formerly at a constant potential but the very large charging current at the start injured the plates; the voltage formerly was 255 for 108 cells, it will now be made 220 during the first period of about an hour and a half and 255 during the remainder, the total charge lasting four hours. The batteries were formerly placed under the seats which resulted in frequent accidents owing to the upsetting of the sulphuric acid and the change of the cells involved considerable time; the batteries will now be placed between the two separate trucks, being put in place by hydraulic process in the pit below the car. The weight of the car and the batteries is 12 tons the accumulators weighing 2.5 tons; the positive plates will contain a core of antimonous (10 per cent.) lead; the coal consumption for the last year was 9.2 pounds per car mile.

Accumulator Traction in Vienna.—The "Elek. Echo" for April concludes its lengthy description of this proposed installation, including illustrations of the car and detailed estimates of the cost.

Jungfrau Railway.—The "Elek. Anz.," April 18, gives a few details regarding the water power station for this unique mountain railway, the plans of which station have been completed. There will be two power stations on the White Luetschine, an upper and a lower one both for high pressure falls; the total power will be 4,400 hp; at one station there will be four dynamos of 470 hp each, coupled directly with turbines with horizontal axes; a 35 hp turbine is used for the exciters (from which fact it appears that alternating currents may be used but there is no statement to this effect); in the other station there will be four direct coupled dynamos of 1,000-hp each.

Mountain Climbing Railways.—In the continuation of Mr. Scott's article in the Lond. "Elec. Eng.," April 19, he gives a brief description of nine different roads in Switzerland some of which use electricity as the motive power.

Surface Conductor System.—According to a note in the Lond. "Elec.," April 19, the Claret-Wuilleumier system (which has been used in Lyons and which was described in the Digest, Oct. 15 and 22), is to be used in a line from Paris to a suburb for a distance of a little over four miles of double track road.

Budapest Conduit Road.—The "Rev. Industrielle" abstracts a description from the "Ann. des Ponts et Chaussees;" illustrations are given of the motor, truck, conduit and collecting shoe; (the latter illustrations are not usually given in the description of this road, but it is unfortunately not very clear.)

High Speed Traction.—According to the "Elek. Anz.," April 18, the Western Railway Company of France has ordered two electric locomotives from the Heilmann syndicate which are to be delivered in June; the locomotives each weigh 110 tons and can draw a load of 200 tons at a speed of 62 miles per hour.

Electric Railways in Italy.—According to an official report which is abstracted in the "Zeit. fuer Elek.," April 15, there were on Jan. 1, in Italy four electric roads having a total length of about 7.5 miles.

Will the Electric Motor Supersede the Steam Locomotive?—An article with this title by Mr. Wetzler is published in "Scribner's Mag." for May. He discusses the growth of electric railways stating that at present there are over 850 electric railways in the United States having 9,000 miles of track, 23,000 cars, and representing an investment of over $4,000,000, while in 1887 there were only 13 roads with scarcely 100 cars; he believes there are no less than 500 miles of electric road running parallel to steam roads and 1,000 miles running or in the course of construction; he shows how they gradually developed by a process of linking, thereby gradually paralleling steam roads which resulted in several instances in the abandonment of local passenger trains on those steam roads. In discussing the influence on railways to be built in the future, the question arises whether the electric roads can be operated more economically, in which lies the gist of the whole matter; the apparatus necessary would be forthcoming at once from any of the leading manufacturers. He points out the advantages which electricity offers over steam, all of which are already well understood, referring more particularly to the more economical steam plant and the smaller capacity of a central station over a large number of separate generators in the form of steam locomotives; the difference he estimates at 25 per cent. for say a 20,000-hp plant for 40 trains; the simplicity of the rotary motion as compared with the reciprocating motion is pointed out; the electric locomotives on the London underground railway ran 60,000 miles without one cent for repairs; the absence of reciprocating motion means less wear, steeper grades, lighter roadbeds and bridges; furthermore the traction is obtained by a paying load if motor cars are used; the possible speeds are far beyond that at which the public would care to travel. He compares locomotives with motor cars, mentioning accumulator traction which on account of the great weight he says may be left out of consideration; after referring briefly to the Heilmann locomotive and that for the Baltimore tunnel, he concludes that it is fairly certain that the best method to be adopted is the overhead trolley system with voltages of about 1,000; regarding the voltage he states that the number of power stations and the weight of the copper will increase directly as the square of the relative decrease in the number of volts, quoting figures of Mr. Sprague for a 90-mile road with a speed of 90 miles an hour with two car units every ten minutes, in which case the weight of the copper would be only two-thirds that of the telephone conductors between New York and Boston; the table given shows the voltages for 1, 2, 3 and 4 power stations under these conditions, varying from 3,600 volts for the first to 900 for the last, for the two-wire system, and one-half of this for the three-wire system. Discussing the question why railway managers do not immediately replace steam by electricity, he mentions the inertia of the managers toward improvements which entail the abandonment of existing apparatus and discusses the economical operation of electric roads, showing that with a large number of trains at short intervals there is no question that electricity will prove more economical, but for a few trains over a long line it would not give sufficient returns on the capital invested; there is therefore a point midway between the present steam and electric systems where the two meet on a basis of equality; the greater the number of trips the greater the economy of electric traction, the governing factor is therefore the nature of the traffic; the successful introduction of electricity on steam roads will probably require a change in the methods of handling the passengers and freight, the single car or small train at frequent intervals taking the place of the long train. In conclusion he believes that steam railways will be eventually operated electrically; he adds that cheap transportation is the more important element, speed being secondary in most cases; according to Prout the passenger traffic on the steam roads of the United States pays 2.14 cents per mile while trolley roads carry passengers from five to 20 miles for five cents and make it pay.

Electric Street Railway Test.—No. 9 of the "Technograph" (1895) (an annual published by the Engineering Societies of the University of Illinois), contains an article by Messrs. Trego and Goldschmidt which gives a full account of efficiency tests made by them of the street railway connecting the towns of Urbana and Champaign in the State of Illinois. The railway is a single track, single trolley road of six and a half miles total length; the electrical equipment is Westinghouse throughout; seven single motor cars are operated. Several preliminary tests made in the winter of 1894 were followed in the spring of the same year by a general test of the entire plant, lasting 11 hours; the following are some of the results obtained: Water evaporated per pound of coal 4.9 pounds; cost of coal per pound of water evaporated 0.0184 cents, per passenger carried 6.46 cent, per engine hp hour 0.854 cent, per generator hp hour 1.213 cents, per motor hp hour 1.3 cents; boiler efficiency *low;* station efficiency 69.4 per cent.; line efficiency 94.6 per cent.; commercial efficiency 47.1 per cent. The article is quite long and contains nine large plates giving the data of the road and tests.

Transportation for the Paris Exhibition.—The "St. Ry. Gaz." gives a brief description of what is being done, from which it appears that electric traction will not form an important part; it is stated that the project for the underground electric road in Paris appears to have been abandoned partly because the time for completing it was insufficient.

Locomotive.—An illustration and a brief description of the one used at La Beraudiere, France, for mining purposes, is given in the "Elec. Eng.," May 1.

Successor of the Railway.—The article from the "Pop. Sc. Mo." abstracted briefly in the Digest, April 13, is reprinted in part in the "St. Ry. Gaz.," April 27.

Chicago.—A well illustrated description of the plant for the elevated railway is published in the "St. Ry. Gaz.," April 27.

A well illustrated description of the California avenue power station is published in the "West. El.," May 4.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electric Lighting of Trains.—The Lond. "Elec. Eng.," April 19, publishes the first part of a serial by Mr. Weekes in which he enumerates the requirements, classifies the systems, and proceeds to describe examples of these various systems and their variations, from which he intends to draw conclusions. In the present portion he begins with the systems in which accumulators placed on each car are charged by a dynamo in the baggage car driven from the axle; as an instance of this system he gives a description with good illustrations of the system of Mr. Lewis (American), the description being taken from a recent paper by Mr. Leonard read at the Society of Railway Superintendents. Comment is reserved until the other descriptions are given. The subject of train lighting is also discussed editorially in that journal.

[illegible]—In a communication to the Lond. "Elec. Engineer," April 19, Mr. Langdon gives some explanations and the data from which deductions were made in the previous issue (see Digest last week) and gives in addition some further tabular data regarding several of the stations.

[illegible]—A paper of a general character by Mr. L'Hoest is published with the discussion in the "Bull. l'Ass'n Ing. El. Montefiore," vol. 6, Nos. 1, 2, 3.

[illegible]—A description with illustrations of a plant in a large brewery in Zipt, is published in the "Zeit. fuer Elek.," April 15; it includes a small trolley road for freight purposes in connection with which a table is given containing experimental data regarding the load, power and speed.

Charging for Current.—In a brief article on the management of central stations in "L'Energie Elec.," April 16, methods of charging are briefly discussed and an illustrated description of the cut-out of Mr. Sageret is given; 300 of these instruments are in use at Rouen; by means of an additional fine wire leading to the station this interrupter enables the current to be cut off from any consumer at any fixed time by the attendant at the station.

Electricity in Relation to Fire Risks.—In Lond. "Lightning," April 18, Mr. Clirehugh discusses briefly the reasons why insurance companies have not reduced the premiums for electrical installations; the chief reason is probably that electric lighting has become so common that it will soon be in most of the buildings and therefore to reduce the rate would signify a lowering of the rates all around; the second is that the companies are afraid of electricity, which is due greatly to careless workmanship; he states that there is more unsafe work being done now than ever before.

Stage Lighting.—The apparatus of Siemens & Halske for varying the brightness of the lights in different groups for stage lighting, is briefly described and illustrated in the "Zeit. f. Beleucht," April 15.

Central Station Statistics in Switzerland.—A long table giving briefly some data for each station, taken apparently from an official publication, is reprinted in the "Zeit. f. Beleucht," April 15.

Electrical Industry in London.—The Lond. "Elec. Eng.," April 19, translates an article by Mr. Semenza from "L'Elettricista" for November in which he gives his views (from the standpoint of an Italian) of the electrical industries in London.

Budapest.—A description of some length without illustrations, of the station at Budapest is given by Mr. de Fodor in the "Zeit. fuer Elek.," April 1 and 15, and is to be continued.

Edinburgh.—A description of this station which has just been opened, is published in Lond. "Lightning," April 18.

Sunderland.—An illustrated description of this alternating current station is published in Lond. "Lightning," April 11.

Aberdeen.—The accounts of this station for the past year are published in the Lond. "Elec. Eng.," April 19.

Multiphase Plants.—The "Elec. Eng.," May 1, gives a brief description of the two-phased 300-kw plant at Fitchburg and a small three-phased plant for mining purposes in the tropics.

Effective Electric Lighting.—Mr. Maycock's article mentioned in the Digest, April 27, is being reprinted in the "Elec. Rev." beginning with the issue of May 1.

Portable Plant.—An illustration of the 28-arc light plant used for the Buffalo Bill show is published in the "Elec. Rev.," May 1.

Electricity at the Atlanta Exposition.—A short article on this subject by Mr. Atkinson is published in the "West.. El.," May 4.

WIRES, WIRING AND CONDUITS.

Underground Mains.—The Kingdon system is described and illustrated in the Lond. "Elec. Rev.," April 19. The object is to avoid the risk of explosions by the accumulation of explosive gases in the conduits; each main is laid in a channel iron shaped like the letter U inverted, the iron therefore protecting the cable against mechanical injury from above; the size of the iron is such as to approximately fit the cable; the bottom of this channel iron is closed by means of a strip of wood or iron forced into it. For alternating currents both cables are laid in the one channel iron or a concentric cable is used. The cost of this system is said to be no greater than that of armoring the cables with steel ribbons and the ease with which the channel can be removed for the purpose of making joints is an additional advantage.

St. Pancras Explosion.—The Lond. "Elec. Rev.," April 19, comments unfavorably and at some length on the recent Board of Trade report regarding this explosion; it expresses great disappointment at the nature of the report.

ELECTRO-PHYSICS AND MAGNETISM.

Mechanical Equivalent of Light.—In a short paper by Mr. Ravenshear in the Lond. "Elec. Rev.," April 19, he calls attention to the want of constancy in the energy equivalent of light and claims that from a theoretical point of view a candle power has no fixed mechanical equivalent, giving an attempt to show this by means of a simple geometrical diagram; in this he takes a system of three co-ordinates, making one proportional to the mass of each vibrating atom in a luminous body, the other represents the squares of the number of vibrations per second executed by successive atoms, and the third, the squares of the amplitudes; the whole volume of the solid drawn on this system of co-ordinates therefore represents the energy of vibration of the whole body. Making the usual assumption that a physical candle power is proportional to the mean of the squares of the amplitudes, the candle power will in this diagram be the mean height of the prism corresponding to the visible spectrum; if the condition is imposed that the luminous energy has to bear a constant proportion to the candle power, the supposition must be made that the law of displacement of the atoms is identical with Hooke's law and that unless this extremely unlikely assumption holds good, the physical candle power of the source of light is not proportional to the luminous energy; if the candle power is not in a constant ratio to the luminous radiation it has not a fixed mechanical equivalent. He concludes that all such quantities as the ratio of the candle power to the luminous energy, or that of the luminous energy to the total energy, or that of the candle power to the total energy, by any of which the efficiency of a source of light might be measured, have none of them constant values even for the same source of light at different intensities; Merritt examined the first and second, Thompson used the second and Ebert seems to have used the third with his luminous lamp; there is no wonder therefore that the results are discordant.

Earth Currents.—"L'Eclairage Elec.," March 30, contains an article by Mr. Palmieri giving the results of his observations on Mt. Vesuvius. Those who have made observations with earth currents have usually run the wires horizontally and none of them, to his knowledge, have taken into account the vertical inclination of the wires; in the present tests the wires were run from the foot and near the top of the mountain and covered a period of six years. From his results he draws the following conclusions which he considers are demonstrated by the facts observed; in inclined wires the earth currents flow from the lower to the upper end whatever be the inclination; this supposes that the experiments were made beyond the volcanic regions or in the present case, when the volcano is not in action; if the volcano is in action the intensity of the currents diminishes or increases according as the activity of the eruption increases or diminishes; the variations depend on the activity of the volcano; researches with earth currents, not in volcanic regions, should be made with perfectly level wires and also with those inclined.

Photographs of Sparks.—"L'Energie Elec.," April 16, describes a simple process for photographing sparks from influence machines and gives two good reproductions, one of a positive and the other of a negative discharge showing distinct characteristics; they were made by Mr. Farman; the method is as follows: a sensitive plate is placed on a horizontal copper disc somewhat smaller than the plate and separated from it by a sheet of black paper the size of the copper disc, to avoid reflection from it; one knob of the machine is placed over the sensitive plate and in contact with it while the other is connected with the copper disc; the spark therefore travels readily from the centre of the sensitive plate and is photograped by its own light; the pole over the sensitive plate should terminate in a point; excellent results are said to be obtained with this simple apparatus.

Law of the Dissipation of Energy in Dielectrics.—A translation from the Italian, in abstract, of a paper by Mr. Arno is given in the Lond. "Elec. Rev.," April 19; he refers to electric fields of feeble intensity and gives the numerical constants which he determined empirically. In conclusion he draws an analogy between the law of the magnetic hysteresis and the law of the phenomenon which he has been studying, and which analogy, he says, confirms the idea that phenomenon is due to an electrostatic hysteresis of dielectric bodies.

Force Acting at the Surface of Separation of Two Dielectrics.—A translation of the recent paper by Mr. Pellat, mentioned in the Digest, Dec. 8, is published in the Lond. "Elec. Rev.," April 19.

Behavior of Certain Bodies in the Presence of Electromagnetic Oscillations.—A note by Prof. Minchin forming part of the discussion of Mr. Appleyard's paper on "Dielectrics" (see Digest, Oct. 27), is published in the Lond. "Proc. Phys. Soc." for January.

Dynamical Theory of the Electric and Luminiferous Medium.—"L'Eclairage Elec.," April 6, contains the first part of an article by Prof. Poincare on the theory of Larmor (Proc. Roy. Soc., vol. 54, p. 439). He gives a summary of the reflections which suggested themselves to him by the reading of that paper, and which he says often lead him to differ from that writer.

The Potential of an Electrified Surface.—An Academy paper by Mr. Andrade, of a mathematical nature, is reprinted in "L'Eclairage Elec.," March 30.

Mechanical Actions of Electromagnetic Origin.—An article by Mr. Weber from the "Wied. Ann.," vol. 54, p. 30, is abstracted in "L'Eclairage Elec.," April 6.

Electromagnetic Induction in Plane, Cylindrical and Spherical Current Sheets.—A paper by Mr. Bryan (see Digest, Sept. 15), is published in the Lond. "Proc. Phys. Soc." for January.

Coefficient of Induction of Multiple Conductors.—"L'Eclairage Elec.," April 6, contains an article by Mr. Guye in which he shows how the coefficient of induction can be calculated for the general case of multiple conductors.

Supposed Magnetic Fatigue.—The Lond. "Elec.," April 19, contains a short paper by Messrs. Campbell and Lovell in which they give the results of their tests. Prof. Ewing showed in a recent paper (see Digest) that there was no perceptible change in the magnetic qualities of good wrought iron when subjected to many reversals of small magnetizing fields; the present authors show that the same is true with strong magnetizing fields as also with cast iron. One series of tests was made with a laminating wrought iron ring the magnetizing force being carried up to about 80 and the method being like that used by Ewing; the tests were made at the beginning and end of about three weeks during which interval of time the alternating current was flowing through the coils; the curves plotted on the same sheet were found to be practically coincident; with the cast iron there was a large amount of hysteresis but the hysteresis loss remained absolutely unchanged; the ring was also tested as a transformer, the results leaving no doubt that it behaved in exactly the same manner under oft repeated reversals as before.

Magnetism of Nickel.—A paper by Mr. Nagaoka on "Distribution of the Magnetization in a Wire of Nickel Under the Simultaneous Action of Longitudinal and Torsional Strains" from the "Weid. Ann.," vol. 53, p. 481, is abstracted with some curves in "L'Eclairage Elec.," March 30; a mention of this paper with the conclusions was given in the Digest, Feb. 9.

Effect of Magnetization on Length.—A paper by Mr. Nagaoka on "Variation of the Length of Elipsoids of Iron, Nickel and Cobalt Under the Influences of Magnetization" from the "Weid. Ann.," vol. 53, p. 487, is abstracted with a number of illustrations in "L'Eclairage Elec.," March 3.

Design and Winding of Alternating Current Electromagnets.—The complete paper of Prof. Thompson and Mr. Walker, abstracted in the Digest, June 2, 1894, is published in the Lond. "Proc. Phys. Soc." for January.

Experiments on Electromagnets.—In the "Technograph" for 1895 (an annual published by the Engineering Societies of the University of Illinois), Mr. Esty gives some experimental data on a standard solenoid brake magnet of the type used on electric cranes, hoists, etc. The object of the investigation was to render the design of this type of magnet (having an air gap in the magnetic circuit) less a matter of trial and guesswork; accordingly a large number of observations were made to determine the relation between ampere turns, magnetic induction, leakage, length of air gap, and the pull in pounds. Detail sketches of the magnet and connections, tables of results and a number of curves plotted therefrom including the and $\mathcal{H}$ curve for the iron, are given. A ballistic galvanometer enclosed in a thick cylinder of iron, as a magnetic screen, was connected by a special switch to the several exploring coils around the magnetic circuit, thus giving the respective inductions; calibrated spring dynamo meters were used to measure the corresponding pulls; currents ranging from .25 to 4 amperes were sent through the magnet windings and data observed for eighteen different air gaps from 0 to 5 inches. The diameter of one magnet core was two inches; the greatest pull recorded was 1,270 pounds with no air gap and a magnetizing force of 26,825 ampere turns, the pull under working conditions being about 300 pounds with an air gap of three-eighth inch and about 18,000 ampere turns. A group of curves for various air gaps showing the relation between the pull in pounds and the $\mathcal{B}$ in the air gap shows that for small air gaps pull (in pounds) $= \frac{\mathcal{B}^2}{11,740,000}$ or $\mathcal{B} = 3,426 \sqrt{\text{pull}}$, the curves approximating to rectangular hyperbolæ. Another curve shows how the coefficient of leakage varies with the air gap, the calculated and experimental values of the former agreeing fairlywell. It was found that varying the ratio $\frac{\text{length of fixed cores,}}{\text{length of movable cores,}}$ made practically no difference in the results. To the designer of similar types of electromagnet, the data given will be of great service for predicting the pull to be obtained under varying conditions of magnetizing force, magnetic induction and length of air gap. The article is quite long and contains numerous tables and curves.

ELECTRO-CHEMISTRY AND BATTERIES

Metallurgy of Copper.—In an article by Dr. Cohen and Mr. Lenz in the "Zeit. f. Electrochem," April 20, they discuss the subject of the electrolysis of copper from cuprous chloride without the use of a diaphragm. They give a brief review of experiments in this direction with special reference to the method of Hoepfner in which a diaphragm is necessary. (The advantage in using cuprous chloride solution is that the same current will deposit twice as much copper as in the ordinary copper sulphate solution or any other cupric solution thus representing a great economy in power; besides this there is the advantage that the chloride solution at the same time extracts all other valuable metals in the ore and it is much more soluble, thus requiring smaller apparatus.) They show that the reason for the failure of the Hoepfner method was due to the use of this diaphragm and they describe experiments made by themselves which show that the cupric solution which is formed in the process sinks to the bottom of the vats where it can be drawn off with a siphon; in the presence of the cupric solution the deposit of copper is again partially dissolved; the copper electrode in this system extends only half way down to the bottom of the vats while the annode of carbon extends to the bottom; the results are said to have been excellent, the weight of the copper deposit being 1.91 times as great as that in sulphate solutions; the current density affects the result but slightly; the degree of concentration, however, has a very important influence; they give figures showing the results of experiments to determine the best concentration; with the apparatus which is described and illustrated the action was continuous, the cuprous solution flowing in at the top and the cupric flowing out at the bottom.

Electrometallurgy of Zinc.—According to the "Zeit. fuer Elek.," April 15, an installation was started in Duisburg in which the zinc was extracted directly from the ore by being heated in an electric furnace; no further information is given. The electrolytic process of Nahusen is referred to, which has been used for several years in another installation, but it is only for obtaining small quantities as the cost of the installation is greater than that of the ordinary process, although the zinc obtained is very much more pure.

Electrolysis.—Dr. Keith in a communication to the Lond. "Elec. Rev.," April 19, continues the discussion of his recent paper; it is largely personal; he adheres to his definition and use of the word "electrolysis."

The Hermite Process of Disinfection.—According to a paper by Messrs. Roscoe and Lund, before the Chemical Society of London, there is no complete sterilization produced by electrolyzed sea water although it deodorizes, and the method is therefore not adapted for disinfection purposes; if the liquid contains less than 0.5 gram of chlorine in a liter it rapidly loses all this in contact with the solid material encountered; if the percentage of chlorine is greater it will remain nearly constant.

Disinfection of Sewers.—A report to the city of Bombay abstracted briefly in the Lond. "Elec.," April 19, states that it would not be possible to introduce the system of electrolyzed sea water (the Hermite system) for disinfection on a large scale in that city, except at a heavy initial outlay; the report looks upon the introduction of the system as an experiment and doubts whether it is worth the expenditure.

Cost of Operating a Chlorine and Soda Installation.—The "Zeit. f. Electrochem." contains a paper by Mr. Haeussermann in which he gives in detail and discusses, an estimate of the cost of operating a plant for producing daily 11,000 pounds of sodium-hydrate and the corresponding amount of chloride of calcium, from the electrolysis of a solution of salt; the figures are not based entirely on results obtained in practice. Eight hundred and thirty-two electrical hp will be required; the cost of the whole installation is given as $144,000; the following are the costs per day in dollars: power 110, salt 29, coal 22, lime 27, packing 51, labor 44, repairs 42, amortization 55; total 380; to this should be added all the necessary general expenses which he estimates at 25 per cent. of the total operating expenses.

Chlorine and Soda.—An illustrated description of the Kellner apparaus is published in the "Zeit. f. Electrochem.," April 20; there is a layer of mercury which by means of a bell-shaped cover is shifted alternately into the apartment where electrolysis takes place and into the other apartment where the amalgam is decomposed; the mercury itself remains at rest.

Electrochemical Industry.—"L'Elec.," April 20, contains a short article by Mr. Andreoli in which he points out quite a number of errors in the recent paper of Mr. Lucion (see Digest, March 16); it appears that in a number of cases the latter referred to installations which have long ago been abandoned and processes which do not exist, besides making other mistakes; any one who has read that paper should not fail to read these corrections of Mr. Andreoli. He adds a few remarks regarding the bleaching of sugar by means of ozone, which in a recent paper by Mr. Buse was said to be done in an installation in Lancaster; such an installation does not and never did exist; there are a number of reasons why sugar will never be bleached by ozone chiefly because there is no need of using ozone of which great quantities would be required; ozone would be too expensive.

Dry Pile.—A new pile by Mr. Renault is briefly described in "L'Elec.," April 20; it is made of a vessel of carbon in the bottom of which is placed chromic acid mixed with silica gelatine which absorbs 60 times its volume of water; above this is a disc of porous earthenware on which is a spiral of zinc surrounded by silica gelatine; it is said to have great capacity in a very small volume.

Thermochemical Carbon Cell.—The paper of Mr. Korda abstracted in the Digest last week, is given apparently in full in "L'Ind. Elec.," April 10, "L'Eclairage Elec.," March 30, and "L'Elec ," April 13.

Solubility of Sulphate of Lead.—The Lond. "Elec. Rev.," April 19, quotes an experiment by Mr. Burman confirming the conclusions of Gladstone and Hibbert that sulphate of lead is about equally insoluble in dilute sulphuric acid and in dilute acid mixed with sodium sulphate

Limits of Electrolysis.—The Lond. "Elec. Rev.," April 19, gives a brief abstract of the recent paper of Mr. LeBlanc abstracted in the Digest, Dec. 29.

Chemical Analysis by Means of Lighting Currents.—An apparatus for using lighting currents for chemical analysis is described and illustrated in the "Zeit. f. Electrochem.," April 20.

Electro-Chemistry.—The electro-chemical journals occasionally contain articles which are of interest to chemists only and not to the electrical engineer; such articles will therefore not be noticed in the Digest.

Action of Electric Currents on Fused Sulphurets.—A translation of Mr. Garnier's paper (abstracted in the Digest, March 9 and 23), is given in the "West. El.," May 4.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Scale Photometer.—The "Zeit f. Beleucht," April 15 contains an article by Mr Delman in which he discusses the eye as used in photometric measurement and gives an illustrated description of the Zoellner scale photometer which is based on the proposition of Crookes; it consists of a Crookes radiometer made of four vanes of mica blackened on one side and suspended in a vacuum tube on a strong cocoon thread;

light falling on this radiometer will tend to turn it in proportion to the intensity of the light; the deflection is measured on a circular scale; the instrument is mounted so that it can be turned on a vertical axis. The instrument was described in 1879 but has not come into extended use; it is believed, however, that as the measurements of lights of different colors is becoming important, the instrument will now come into use; it may be used to advantage by photographers to determine the degree of light with which they are printing plates, the instrument being placed in the same light and the readings taken directly; experiments in this direction gave very favorable results; the temperature has quite a marked influence on the deflection and it is therefore necessary to use a thermometer in connection with it.

Aperiodic Galvanometer.—A new instrument devised by Messrs. Chauvin and Arnoux is described and illustrated in "L'Ind. Elec.," April 10. It appears to consist of a small d'Arsonval galvanometer (like the Weston instrument) except that the movable coil is circular and about the size of an ordinary finger ring; it is said not to change its constant as the magnetomotive force developed in the coil is very small, being only about two ampere turns for a deflection over the whole scale. They are made in the form of voltmeters and amperemeters; in the latter the instrument is shunted with a conveniently arranged resistance separate from the instrument and which may therefore be changed to increase the range.

Sensitive Galvanometer.—A Physical Society paper by Mr. Weiss is abstracted briefly in "L'Eclairage Elec.," April 6. Instead of using very short magnetic needles which are difficult to magnetize and which exercise a demagnetizing action on each other, he makes an astatic system of two long vertical magnets fastened on a piece of mica; such system is always astatic whatever be the intensity of magnetization of each of the magnets ; the magnets are long with respect to the distance apart; each pair of ends is at the centre of cylindrical coils like in the Thomson galvanometer; by properly reducing the dimensions, a galvanometer is obtained whose construction is very simple, and which is claimed to have a greater sensitiveness than any other known form.

Effect of an Alternating E. M. F. on the Capillary Electrometer.—An Academy Paper by Mr. Brunhes is given briefly in "L'Ind. Elec.," April 10; he describes some experiments.

Absolute Electrometers.—A Physical Society paper by Messrs. Abrahams and Lemoine briefly describing an instrument for measuring 40,000 to 100,000 volts, is published in "L'Eclairage Elec.," April 6.

The Hookham Alternate Current Meter.—The Lond. "Elec.," April 19, publishes a well illustrated description; it consists of a Ferraris motor controlled by an electric brake.

Cinemograph.—An electrical instrument with this name, intended for registeirng velocities, that is, the distance passed over in a unit of time by a moving body, made by Richard Bros., is described at some length and well illustrated in "L'Elec.," April 20.

Influence Machine.—A new form devised by Mr. Lebiez is described and well illustrated in "L'Elec.," April 13; the construction is said to be extremely simple and cheap; the principle is the same as that of the replenisher of Thomson and its output is equal to that of the well-known Wimshurst machines.

Resistance Wire for Strong Currents.—A translation of Mr. Strecker's paper which was abstracted in the Digest, Nov. 3, is published in the Lond. "Elec. Rev.," April 19; he points out the error in the recent conclusion of Messrs. Herzog and Feldmann in which they attempted to show that copper and iron are better adapted for rheostats than high resistance wires.

Measuring the Insulation Resistance of Leads While in Use.—A short paper by Mr. de Bast published in the "Bull. l'Ass. Ing. El. Montefiore," vol. 6, Nos. 1, 2, 3, describes the following method the equations for which are deduced in the paper. A voltmeter is used for measuring the total insulation resistance of a network of wires of a three-wire system while in use; let the resistance of the voltmeter be r; connect it between one of the outside wires and the earth and let the reading be a; connect it in the same way between the other outside wire and the earth and let the reading be b; connect it between the two outside wires and let the reading be c; then the insulation resistance of the whole circuit will be equal to

$$r\left(\frac{C}{a+b}-1\right).$$

Photographic Testing of Projector Reflectors.—A number of illustrations from the recent article of Mr. Tchikoleff, mentioned in the Digest Feb. 16, together with a brief description, are reproduced in the Lond "Elec. Eng.," April 19.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Code Telegrams.—A writer who is quoted in the Lond. "Elec Eng.," April 19, criticises very unfavorably the recently proposed international code showing that a number of English words exist in it which differ in only one letter; he states that the vocabulary reflects but little credit on those who prepared it and argues that such an ill-selected vocabulary should not be forced on the mercantile communities of Europe.

Submarine Cable.—A discussion of the proposition for a cable from Tamatave to the island of Maurice is published in "L'Elec.," April 13.

Indicators and Regulators.—"L'Industrie," April 14, in a report on the Antwerp exposition contains an illustrated description of indicators of water levels, regulators for clocks and microphone.

Longest Telephone Wire Span.—According to the "Elek. Anz.," April 14, a telephone wire was recently stretched across the Walensee, Switzerland, the length of the span of which is 7,900 feet which is doubtless the longest span in the world; one support lies 1,180 feet above the lake; the wire is 2 mm in diameter (about a No. 12 B. & S.).

Submarine Cables.—In a continuation of Capt. Trott's article in the "Elec. Eng.," May 1, he explains some of the methods of repairing broken cables; he states that the steamship Minia made 120 repairs during the last 10 years without a single failure although some were at the enormous depth of 2,597 fathoms, a record which is claimed to be without a parallel.

Telephone Competition.—The "West. El.," May 4, publishes a number of extracts from daily papers concerning telephone competition.

MISCELLANEOUS.

Therapeutic Action of High Frequency Currents.—An abstract of an Academy paper of Messrs. Apostoli and Berlioz is given in "L'Ind. Elec.," April 10. During the past year they treated a large number of patients with high frequency alternating currents generated in the body itself by induction, as originally suggested by d'Arsonval, who termed the process auto-conduction (described in the Digest, Aug. 5 and 12, 1893; March 17 and April 28, 1894); the patients were surrounded by a large solenoid and treated every day for 15 to 20 minutes, the treatment being as nearly uniform as possible. In conclusion they claim that their numerous results confirm the physiological action discovered by d'Arsonval; these currents have a powerful influence on the nutritive action and therefore constitute a means of medical treatment of the first order in a large number of functional diseases due to improper nutrition. In "L'Elec.," April 13, the results are given more in detail, those in which the treatment was successful as well as those in which it was not; the total number of treatments on which these conclusions were based amounted to 2,446.

Artificial Indiarubber.—According to the "Rev. Scientifique" (no date given) Mr. LeBrocquy makes artificial rubber with a mixture of glue, glycerine and molasses.

Insulating Material.—According to the "Zeit. f. Beleucht.," April 15, Mr. Gentzsch makes a new insulating material from mineral substances like ozokerite, asphalt or amber, which are heated to 400 degrees C. until all steam, gases or oils cease to be evolved; what remains has the consistency of butter and can be used either alone or mixed with other materials.

Calcium Carbide.—According to the "Elek. Anz.," April 14, the Aluminium Company at Neuhausen, Switzerland, has begun the manufacture of this material and sells it at 5.5 cts. per pound; (this is from 1-9 to 1-5 of the price at which it is quoted in New York city.)

Lightning.—According to the "Zeit. fuer Elek.," April 15, a photograph of a stroke of lightning which occured in Prague in May last year showed six distinct bolts originating from one cloud and extending in different directions striking four houses, a cupola and telephone wires; a peculiar phenomena was noticed, the photograph showed very distinctly the shadow of the cupola on the dark sky. (It is not quite clear how the same photograph can show the lightning and at the same time the shadow of the cupola on the sky unless the lightning was between the camera and the cupola which, though possible, seems hardly likely; there ought to have been six shadows.)

Educational.—The Lond. "Elec. Eng.," April 19, publishes the answers and solutions to the questions in electric lighting and power transmission, in the preliminary examination of the City and Guilds of London Institute.

Patent Decision.—The "Eng. Mag." for May contains an article b Mr. Benjamin on "The Meaning of the Recent United States Patent Decision," referring to the Bate case, in which he points out that the law in this case defeats its own object; the persons that were aimed at were the foreigners and its principal effect has been to limit the life of American patents of American inventors; the statute referred to, he claims, does not serve any beneficial purpose.

A Complete Telephone System.

We illustrate herewith some of the telephone apparatus of the Western Telephone Construction Company, Monadnock Block, Chicago, Ill. This company, which has been furnishing telephone apparatus for the last three years, is the oldest manufacturer in the United States in competition with the Bell Company, and owns or controls many patents relating to details of construction. Fig. 1 shows the new "Western Giant" long distance and exchange telephone, with granular carbon microphone transmitters. Granular carbon held between carbon discs forms the electrodes of the microphone. The discs are held in a cast brass shell fitted with a thread-like projection which passes through the box, and to which is screwed the mouthpiece, so that it can be used as an agitator, thus keeping the granules in a free state. This instrument is constructed with a view to avoiding the great care usually required by microphone telephones, and does not, therefore, need the constant tinkering incident to the usual types. The carbon granules and their arrangement are such as to prevent "packing" and injury in other ways. A switchboard form of transmitter is shown in Fig. 2.

The receiver is of the double pole type with double compound bar magnets, and the highest guarantees as to its efficiency are offered by the makers. The telephone hook is also guaranteed free of patents and to be both mechanically and electrically efficient in every respect. The magneto call bells and generators, the latter shown in Fig. 3, are manufactured by the company, and not constructed, as is usual, from parts purchased elsewhere. All the connections are soldered, and no contacts are made through hinges; the microphone circuit-changing contacts are platinum-pointed, and all contacts are strong, firm and direct, the usual rubbing contact being avoided. The best magnet steel to be purchased is used in their construction, and the armatures and bells are wound for the best efficiency.

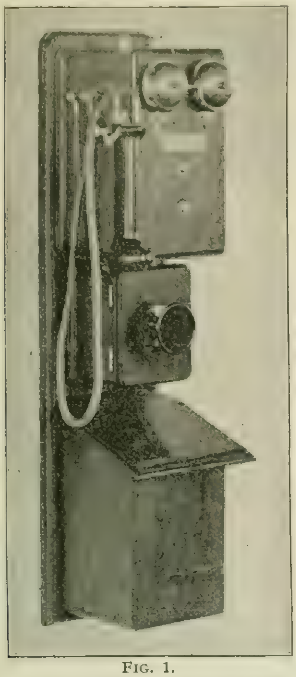


FIG. 1.

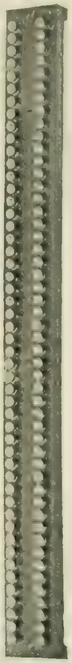
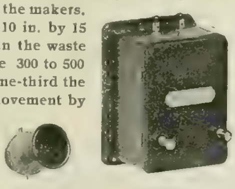


FIG. 4.

The switchboards are claimed to be free of infringing devices, and to contain a number of features patented by the makers. The 100 connection board requires but 10 in. by 15 in. by 4 in. space, and can be placed in the waste space of an ordinary writing desk. The 300 to 500 connection board can be operated with one-third the usual number of operators; the same movement by the operator which places the plug in the jack, restores the drop. It is claimed that this board gives no chance for induction, while sections can be added indefinitely. It is equipped for both metallic circuit and single line systems; can readily be changed from one to the other. Fig. 4 illustrates one of the details of the exchange system, being a new type of cable lightning arrester and distributing board.


FIGS. 2 AND 3.

A New Insulating Compound.

A patent was issued last week to J. W. Kidwell, of Washington, D. C., for a new insulating compound, consisting of a titanic mineral such as rutile, brookite and other similar materials found in the phoshpate ore of Nelson county, Va. These materials are usually found together in the ore referred to and they are conveniently so used, but either may be employed exclusively in forming the compound.

To produce 100 pounds of compound, 75 to 85 pounds of the titanic minerals are used and from 10 to 20 pounds of asphaltum and about five pounds of rice hulls, the latter furnishing the necessary silicious material, upon which the insulating properties of the compound very largely depends.

The mineral is ground to a fine powder and mixed with the asphaltum by heat and stirring, the rice hulls being added after the mixing is completed. The inventor states that a thickness of one-eighth of an inch of this insulating material has resisted a pressure of 24,000 volts.

A New Electrical Enterprise.

A new and vigorous firm is about to enter the electrical field, Messrs. Thos. E. Adams, E. J. Bagnall, L. H. Rogers, C. W. Phipps, S. E. Cox and George Arnold, for many years identified with the Brush Company, having withdrawn from that concern, and formed what will be known as the Adams-Bagnall Company.

Mr. Adams is well known as the designer of the Brush-Adams arc lamp, which has been so widely used ever since it came out five years ago, and the merits of which are due in great measure to the fact that Mr. Adams obtained, by personal interviews with trimmers and repairers, a thorough knowledge of the defects and disadvantages embodied in arc lamps generally, and then bent his energies to the avoidance of those defects in the construction of his lamp.

Mr. Bagnall was with the Brush Company for eight years, occupying a number of prominent positions. During the past seven years he has been engaged in engineering work in St. Louis, and was consulting engineer for the Lindell Railway Company, whose road was built and equipped under his supervision.

Mr. Rogers is so widely known as to make any comment here practically superfluous. He has been with the Brush and General Electric companies for six years, and has scored many and signal successes in electrical business circles.

Mr. Phipps has been closely identified with the Brush Company since a short time subsequent to its original organization, and he has been repeatedly intrusted with most important missions to foreign countries. He is a man of extended experience in the handling of large forces o men and the general supervision of factory work.

Mr. Cox made hosts of friends throughout the country during his able management of the Swan Incandescent Lamp Company's affairs, and his fine executive ability and judgment in this line of work make him exceedingly valuable to the new organization.

Mr. Arnold has successfully filled several positions of responsibility with the Brush Company, his last work being in the drafting department, of which he was in full charge.

Associated with the above named gentlemen are a number of the most influential capitalists in Cleveland, among them being Mr. Charles G. Hickox, who is president of the new company, and Mr. Geo. W. Howe, vice-president and treasurer. The other offices are filled as follows: General manager, L. H. Rogers; secretary, S. E. Cox, and superintendent, C. W. Phipps. The building formerly occupied by the Hackney Bicycle Company, at No. 47 East Prospect street, has been leased for a factory.

Nothing very definite can be stated at this time concerning the company's policy beyond the fact that arc and incandescent lamps and probably street railway motors will be manufactured.

The Manufacture of Carbon for Electrical Purposes.

An American patent was issued last week to Messrs. C. P. Shrewsbury and J. L. Dobell, of Modbury, England, on improvements in the manufacture from carbonaceous materials of plates, slabs, pencils and other articles for electrical and other purposes.

The invention consists in the production of a compound which, when subjected to the different processes of treatment, can be given different properties; according to one process a carbon insulator is produced and by another a material equal or superior in conductivity to graphite, but costing considerably less.

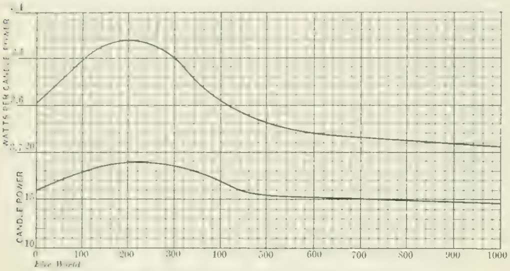
The compound consists of anthracite coal, bituminous coal and pitch or tar, or both; the articles which are formed from this mixture are submitted to pressure, and gradual baking concludes the process. The anthracite coal and bituminous coal are first reduced to a fine state of division and then placed in a suitable mixing machine in the proportions by weight of anthracite coal 10 parts and bituminous coal four parts; after having been thoroughly mixed a considerable quantity of tar or pitch, or both, is added, such quantity being varied according to the caking quality of the bituminous coal and the degree of pressure to be employed in forming the material into the required shape. If the bituminous coal be of good caking quality, about seven parts by weight of the above may be added and a light pressure not exceeding 20 pounds to the square inch applied. As the pressure is increased the amount of tar, etc., is less.

When the material is moulded under pressure not exceeding 20 pounds per square inch, it is not sufficiently condensed to retain its form during the baking process if removed from the moulds previous to being placed in the oven; it is therefore baked in the moulds, after which it is removed, and, if required to have a high electrical resistance, the article is ready for use; if, on the contrary, it is required to have a low resistance, another baking at a higher temperature is necessary.

If it is desired to produce a plate or other article to be employed as an electrical insulator, the maximum temperature must not exceed 1,450 degrees F.; if it is to possess a high electrical resistance the temperature must be above 1,450 degrees, and must not exceed about 1,500 degrees. If required for Laclanche or Bunsen batteries, the temperature must be above 1,000 degrees F. In all cases the oven is allowed to remain at the maximum temperature for a period of about four hours. If the articles are required to be of low electrical resistance, such as that of carbon plates employed for electrolysis, or are to be subjected to a high temperature, the oven temperature should be raised to from about 1,600 to 1,800 degrees F. After the articles are removed from the moulds they are placed in tiers in an oven with ashes between and surrounding them, and the temperature gradually raised to 2,500 degrees and maintained at the maximum temperature about four hours, after which the oven is allowed to gradually cool. If, however, the material in the moulds be subjected to a pressure of 300 pounds or upward per square inch, the moulded articles before being placed in the oven may be removed from the moulds and placed in a drying chamber or dried by exposure to a dry atmosphere, after which, if the article is to be of low electrical resistance, the baking may be effected by one operation.

Recent Tests of Packard Lamps.

The accompanying curves and tables of tests made on April 30, of Packard lamps, show clearly the peculiar properties of this lamp, and justify the New York & Ohio Company in claiming an increase in candle-power and efficiency for the first few hundred hours, followed by a remarkable maintenance of both. An analysis of the curves shows that the candle-power gradually increases up to about 225 hours, when the maximum of nearly 19 candle-power is reached, giving an increase of nearly 20 per cent. in light. Beyond 300 hours there is a gradual decrease in candle power, but this is so gradual that the 450th hour is almost reached before the lamps have fallen back to the initial candle-power, and the drop beyond that point is so very gradual as to be practically imperceptible. This maintenance of candle-power means, of course, a longer commercial life.



Curves Obtained from Lamp Tests.

The maximum efficiency is reached at about 200 hours, when the lamps show an increase of 2-10 of a watt, and the falling off in efficiency, like that in candle-power, is so gradual that not until 400 hours burning do the lamps drop back to their initial efficiency, and even at 1,000 hours the tests show only a drop of 1-10 of a watt in efficiency. These lamp tests show an unusually efficient filament treatment, and it is said that the carbon is so dense that it stands continuous use without showing any signs of deterioration, which gives the lamps another desirable feature, as the bulbs do not, even after 1,000 hours, show any appreciable blackening.

TESTS OF PACKARD 16 CP LAMPS.
50 lamps, 98 volts, direct current.
Average measurements.

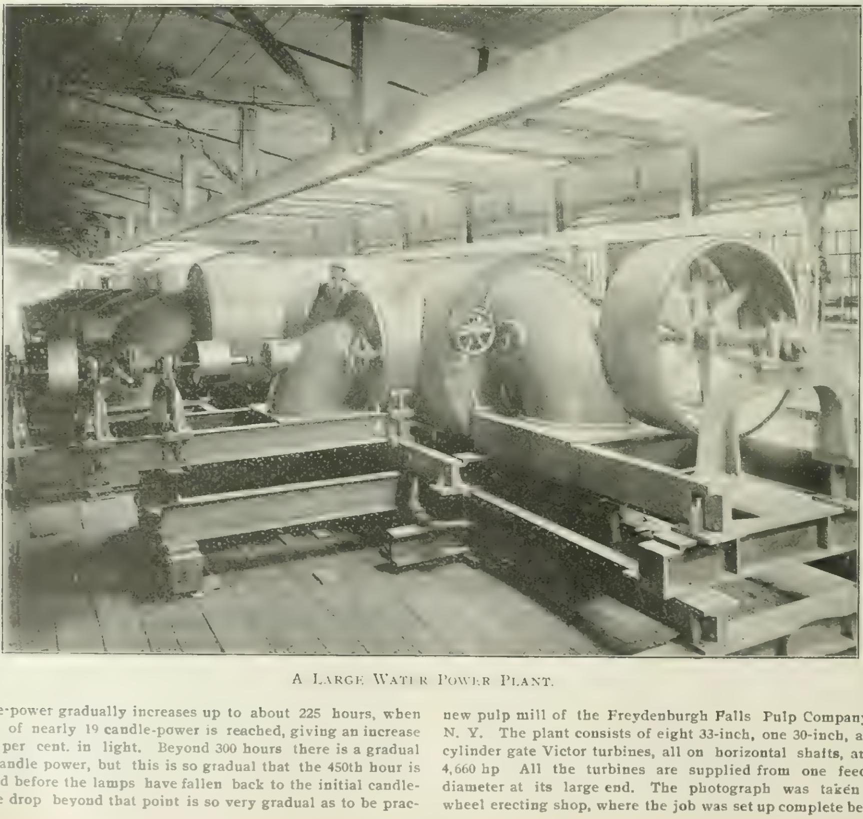
	Volts.	Current.	Watts.	Watts per cp.
Initial	98.2	.583 Amp.	57 25	3.59
End of 100 hours	97.4	.577 "	56.23	3.51
" 200 "	96.9	.578 "	55.33	3.46
" 300 "	96.8	.578 "	55.93	3.49
" 400 "	97.8	.585 "	57.21	3.58
" 500 "	99.0	.585 "	58.21	3.63
" 600 "	99.0	.589 "	58 31	3.64
" 800 "	99.3	.590 "	58.58	3.66
" 1000 "	100.1	.591 "	59.16	3.69

Increase of candle power at 98 volts.

Initial	16	cp.
End of 100 hours	17.9	"
" 200 "	18 7	"
" 300 "	18.7	"
" 400 "	16.9	"
" 500 "	15.5	"
" 600 "	15.5	"
" 800 "	15.2	"
" 1000 "	14 5	"

A Large Water Power Plant.

We illustrate a very large turbine water wheel plant recently built by the Stilwell-Pierce & Smith-Vaile Company, of Dayton, O., for driving the new pulp mill of the Freydenburgh Falls Pulp Company, Plattsburgh, N. Y. The plant consists of eight 33-inch, one 30-inch, and one 15-inch cylinder gate Victor turbines, all on horizontal shafts, and aggregating 4,660 hp All the turbines are supplied from one feeder 13 feet in diameter at its large end. The photograph was taken in the water wheel erecting shop, where the job was set up complete before shipment.



A Large Water Power Plant.

The Tracy Oil Filter.

It is a well-known fact that users of lubricating oil can almost invariably realize a very material saving by the process of filtration and re-usage, and numerous devices have been produced with a view to accomplishing the filtration and purification of oil after it has passed through the journals. One of the most carefully designed filters is that manufactured by the Phœnix Automatic Filter Company, of Racine, Wis., which is shown in the accompanying illustration.

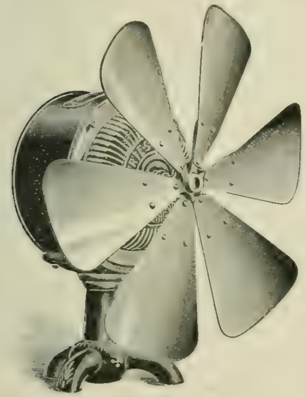
After long and exhaustive experiments which demonstrated the unfitness of mineral wool, bone-dust, charcoal, felt, etc., as filtering mediums, owing to their so quickly becoming saturated, the Phœnix Company determined upon the method now used in its "Tracy" filters, consisting of passing the oil from a storage chamber to an accumulating compartment by means of "clarifying discs," on the capillary principle employed in an ordinary oil lamp for drawing oil up to the burner. This process is analogous to distillation, and the results have been so satisfactory that the manufacturers claim for the Tracy filters the absolute purification of lubricating oils passed through them. Additional points claimed are self-cleaning and automatic regulation.

OIL FILTER.

The Ries-Scott Alternating Current Motor.

Upon the withdrawal from business recently of the Ries Electric Specialty Company, of Baltimore, Rossiter, MacGovern & Co., of 141 Liberty street, New York, purchased the Ries Company's entire stock of Ries-Scott alternating current fan motors, one of which we illustrate in the accompanying engraving. These motors are substantially built and of handsome design and finish. The armature and field cores are of unique construction, the laminæ constituting a series of very short magnetic circuits, which are almost closed.

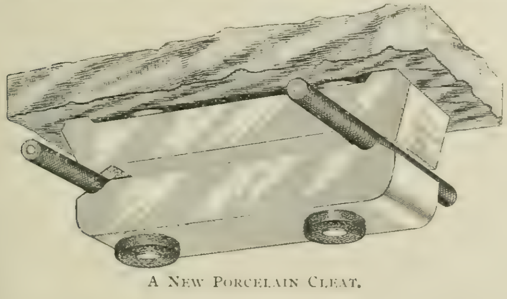
The machine is provided with regulating and reversing devices and these are placed on the side opposite from the fan so as to allow manipulation of them with impunity while the fan is running. The motor is effectually cased in and protected from dust and damage, and still accessible by the removal of two screws. They are made for 50 and 100 volt circuits, and a periodicity of 133 or thereabout.



RIES-SCOTT FAN MOTOR.

A New Porcelain Cleat.

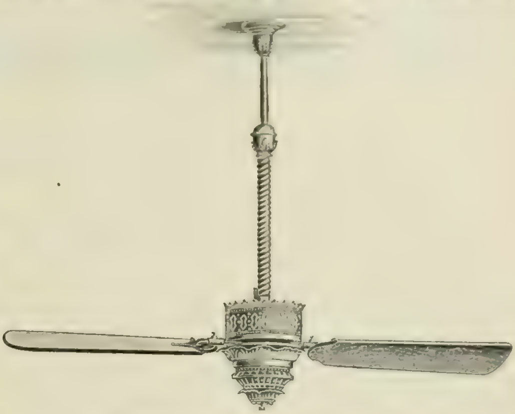
The cleat shown in the accompanying cut is being put on the market by the Thompson-Brown Electric Company of 97 High street, Boston, and will be known to the trade as the "T. B." cleat. It is made applicable to either single or double wire installation, and admits any size wire from No. 14 up. The claims made for this cleat are that it grips the wire firmly, does not at all injure the insulation, obviates the danger of the wire slipping down on the screw and causing liability to short circuit, and is moisture proof. The cleat conforms to all requirements of the underwriters, and is manufactured of the best glazed porcelain, thoroughly vitrified.



A NEW PORCELAIN CLEAT.

A New Alternating Current Ceiling Fan.

A new addition to the list of alternating current fan motors is the ceiling fan herewith illustrated, which is the product of the Emerson Electric Company, of St. Louis, manufacturers of the well-known Meston fan motors. The new ceiling fan is operated by a direct driving slow speed fan motor, which runs at the rate of from 140 to 150 revolutions per minute with no greater consumption of current than is found in the ordinary desk fan motor. These fans are made up in three finishes, nickle, oxidized copper and polished brass, all of which are decidedly handsome and ornamental. The motor is provided with a special metallic brush, requiring practically no attention during a season's run. The construction throughout conforms to the high standard observed in the Meston desk fan.



NEW ALTERNATING CURRENT CEILING FAN.

Special Decorative Incandescent Lamps.

Several styles of special incandescent lamps suitable for decorative purposes are being placed on the market by the Columbia Incandescent Lamp Company, of St. Louis, two of which are shown in the accompanying illustrations. Fig. 1 represents a 16-cp coiled filament, round bulb lamp, full size, which is made in high voltages for window and ceiling decorations. These lamps may be used in a horizontal position without the disadvantage of having the filament droop to the side of the bulb. Fig. 2 shows a candelabra lamp which is made to burn, several in series, on circuits of 100 volts and upward. These lamps used with small red and yellow silk shades produce a very attractive and harmonious effect. These special lamps are said to maintain their candle-power to the same degree as the new type of standard high economy Columbia lamps, and are furnished in either ground or clear glass, as desired.

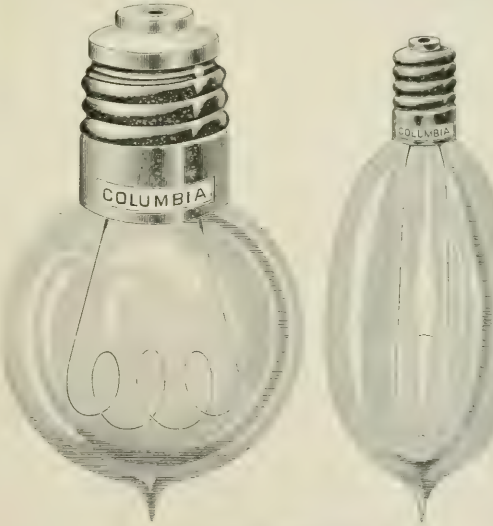


FIG. 1.—SPECIAL LAMPS – FIG. 2.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, May 4, 1895.

AMERICAN BELL continues to confute the numerous bearish predictions which have recently been circulated, by climbing steadily upward from 184 last Saturday to 189 at to day's closing. The explanation is by no means obvious, and the bears vouchsafe none, but look wise and intimate a "change for the worse" ere long, while the bulls cry "I told you so" in a rather uncertain manner, as though watching for an opportunity to hedge.

GENERAL ELECTRIC remained practically unchanged during the week, though it is said the stock would have gone to 40 upon the publication of the annual report but for a bear movement which has been fostered for some occult reason. For nearly a month there has been a pressure to hold the stock down, and semi-official denials of all good news. The annual report shows gross earnings of over $1,000,000 per month for 1894, and a net earning of $1,348,164 for the whole year, of which $933,520 was charged off to depreciation, leaving $414,644 surplus. The report is given in full in the next and succeeding columns.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	96½	97½
" " " Brooklyn	100	..	108
" " " Boston	100	130	..
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	29	29¾
General Electric	100	33	33⅝
General Electric, pref	100	63¾	64¼
Westinghouse Consolidated, com	50	33¾	34
" " pref	50	52	52½

BONDS.

	Par.	Bid.	Asked
Edison Electric Ill., New York	100	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co. deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

	Par.	Bid.	Asked
American Bell Telephone	100	189	189½
American District Telegraph	100	30	40
American Telegraph & Cable	100	92½	.
Central & South American Telegraph	100	117	120
Commercial Cables	100	141	..
Erie Telephone	100	53½	54
Gold & Stock Telegraph	100	105	
New England Telephone	100	66½	69
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63½	
Western Union Telegraph	100	88¾	89

ELECTRIC TRACTION STOCKS.

	Par.	Bid.	Asked
Baltimore Traction	25	16⅝	16⅞
Binghamton RR. com	100	100	..
Brooklyn Traction	100	9	11
" " pref	100	..	53
Buffalo St. Ry	100	66	69
Cleveland City Ry	100	68	70
Cleveland Electric Ry	100	59	60
Chicago City Ry	100	305	315
Columbus St. Ry	100	46	49
Consolidated Traction of N. J	..	30	33
Electric Traction, Philadelphia	50	71	71½
Long Island Traction	100	11	11¼
Louisville St. Ry. com	100	37	39
" " " pref	100	87	88
Metropolitan Traction, Philadelphia	100	90	90½
New Orleans Traction	100	15	18
" " pref	100	56	60
North Shore Traction	100	..	..
" " pref	100	74	83
People's Traction $30 pd	25	58¼	58½
‡Philadelphia Traction	50	81½	82
Rochester St. Ry	..	38	..
Union Ry. (Huckleberry)	100	112	115
West End, Boston	100	65¼	65¾
" " pref	100	90	..
Worcester Traction	100	13	16
" " pref	100	82	86

BONDS.

	Par.	Bid.	Asked
Buffalo St. Ry. 1st con. 5s	100	101	..
*Binghamton Railroad Co. 5s	100	99	100
*Columbus St. Ry. 1st 5s	100	9	..
Rochester St. Ry. 1st. 5s	100	95	97
*Union Ry. 1st. mtge 6s	100	105	108
*Westchester Electric 1st. mtge. 5s	100	98	101

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* With accrued interest.

‡ Ex-rights.

WESTINGHOUSE ELECTRIC also remained steady during the past week. The annual meeting of the company will, in all probability, be adjourned for a month or six weeks. The Board of Directors at their recent meeting expressed the opinion that, owing to the fact that the company has but recently become thoroughly established in its new works, and the material benefits to be derived therefrom will be much more apparent in a few weeks, it would be desirable to adjourn the stockholders' meeting until the latter part of June or early in July, in order that a more adequate showing of the importance and advantage of the new works may be then given to the stockholders.

Third Annual Report of the General Electric Company.

For the sake of greater clearness, the following report has been divided into two sections, showing:

1st. The result of liquidating the assets which appeared on the company's books prior to Jan. 31, 1894.

2d. The result of the business of the fiscal year ending Jan. 31, 1895.

As previously reported, the profit and loss statement showed on Jan. 31, 1894, a debit balance of	$12,454,967 42
The result of liquidating and providing for loss on the old assets, as explained below, has increased this by	2,754,312 27
Making the total loss on old accounts (prior to 1894) as now ascertained or estimated	$15,209,359 69
The business of the year 1894 has yielded a net profit (over interest on debentures) of	414,642 72
Leaving the present debit balance of profit and loss	$14,794,716 97

LIQUIDATION OF OLD BUSINESS.

In the last annual report your directors sought to exhibit the extent to which your company had suffered from the panic of 1893, and from other causes inherent in some of the enterprises in which it became interested at the time of its organization. Mention was made of the fact that the accounts receivable included $2,531,609.88 due by the Fort Wayne and Northwest Companies and other allied interests. Contrary to the expectation of your directors, and the statements of persons directly interested in the Northwest Company, your claim as a creditor of that company now proves to be without value; and certain other interests, inherited by your company through the Northwest Company, are also valueless. The aggregate loss from these sources is about $945,000 (viz., $456,484.43 on the account owned, and about $489,000 on other items), and this sum is included in the charges to Profit and Loss in the Supplementary Statement for the year 1893 attached hereto.

During the past year the Fort Wayne Electric Company, a former ally of one of your constituent companies, has gone into the hands of receivers, and its affairs are now being liquidated by the Court. Your company has filed with the receivers its claim for $1,137,555.48.

The balance sheet, and the schedules accompanying it, show the outstanding interests of your company as stockholder in manufacturing and other companies. Many of these securities will be sold as opportunity offers. Such a course will, in some instances, involve considerable shrinkage from former book values.

There exists also several unsettled contracts antedating the formation of your company, but which your company has to recognize, and which will cost, perhaps, $500,000 to settle.

To cover the estimated loss on all the matters above mentioned, your directors have arbitrarily charged $2,000,000 to Profit and Loss account, and the results, as shown at the head of this report, are after making this deduction.

BUSINESS OF THE FISCAL YEAR ENDING JAN. 31, 1895.

Notwithstanding the adverse conditions of the past year, the output of your various factories at cost value was only slightly below that of the previous year. The output in the amount of material produced was considerably in excess of the previous year.

Special attention has been given to the supervision of credits, economy of administration, and the improvement of factory facilities, and your directors and officers have sought to adopt every device calculated to increase the efficiency of manufacture and to reduce the cost of the manufactured product. In this they have been in a marked degree successful, and great credit is due those officers and employees of your company directly in charge of manufacturing details.

In the last annual report mention was made of the shrinkage in inventory values of electrical machinery arising from new inventions and improvements, whereby types of machinery which have been the best of their kind are often rendered obsolete. It is impossible to guard wholly against loss from this source, inasmuch as it is essential for your company to keep on hand at all times a considerable stock of manufactured goods. Such stock has been greatly reduced in the past year, and it will be the policy of your board to keep it down to the lowest point consistent with prompt filling of orders. This, together with the work accomplished in developing standard types of apparatus and supplies, warrants belief that the loss from this source will be diminished in the future.

In the last report, your directors expressed the opinion that they could, out of the then unliquidated assets, pay off the balance of your floating debt and also provide all necessary working capital. These expectations have been realized, and in addition thereto the company has purchased and cancelled $1,250,000 of its own debentures at an average cost of less than 89 per cent.

As will be seen by the statement of Profit and Loss herewith, the business of the year just closed amounted to	$13,263,611 58
The cost of goods sold, legal and general expenses and taxes were	11,451,863 98
Leaving a gross profit of	$1,811,747 60
Against which is charged interest on debentures outstanding	464,583 33
Leaving (over interest on debentures)	$1,347,164 27

There are further charged off:

Various old losses which are difficult of division between 1894 and earlier years, and are, therefore, all charged against the year ending Jan. 31 1895	$443,023 96	
Cost of all patents and franchises acquired or settled for during the year	162,298 11	
Depreciation of inventories	288,401 14	
Sundry losses	38,798 34	
		932,521 55
Leaving a net profit of		$414,642 72

EXPIRATION OF THE INCANDESCENT LAMP PATENT.

As a result of the decision in the "Bate case," recently announced by the Supreme Court of the United States, it is now settled that the fundamental patent upon the Edison Incandescent Lamp expired in November, 1894. Your company still owns patents of more or less importance upon the incandescent lamp, but it will chiefly rely upon the high quality of the lamp manufactured by it and its facilities for manufacturing in large quantities at a low cost to maintain its commanding position in the lamp business irrespective of patent control. Lamp prices have necessarily been greatly reduced. While the volume of this important part of your business will without doubt be largely increased in the future, the percentage of profit thereon will necessarily be less than heretofore.

PATENT LITIGATION.

During the year the company has been successful in a number of suits in which it has been attacked by the owners of patents which it was charged with infringing. It has been defeated in no such suit. A valuable patent on the Edison form of socket has been sustained by a Court of Appeals. Several important suits on railway patents owned by the company are in progress, some of which will be argued this spring.

ENGINEERING DEPARTMENT.

The work done by the Engineering Department during the past year deserves special mention. Much has been accomplished in the development of large units, as well as in the perfection of the minor details of manufacture.

The only successful work yet accomplished in the operation of elevated roads by electricity has been done by your company, and it is now engaged in important installations of underground electric conduits for street railways.

In large power generators, in mining and power transmission work, in regulating and measuring devices, and in railway motors, the development and perfection of design have been especially noticeable.

SELLING DEPARTMENT.

The selling organization has been conducted on an efficient and economical basis, and the sales made during the past year have been almost wholly on a cash basis; the average terms of payment on all sales being 40 days after shipment.

LICENSEE COMPANIES.

These companies contribute an important part of the business done by your company in central station lighting and distribution of power, and their growth and prosperity are closely identified with the welfare of your own company. The relations which have heretofore existed between these Licensee Companies and your company continue, and the policy of your company in the future, as in the past, will be to cultivate their business and co-operate in the development of such licensees.

REDUCTION OF CAPITAL STOCK.

At the last annual meeting the following vote was passed:

"*Resolved*, That the matter of reducing the capital stock of the company in the manner prescribed by law be referred to the incoming Board of Directors, with request that they give it attention; and, if such a course commends itself to them, that they call a special meeting of the stockholders for consideration and proper action."

Your Board, after careful consideration, has deemed it inexpedient to take any action with reference thereto.

FUTURE BUSINESS.

The indications are favorable for a volume of business in excess of that last year; but prices are abnormally low, and satisfactory results will largely depend upon the ability of your company still further to reduce the cost of production and distribution of its manufactures.

PATENTS.

The $8,159,264.02 at which patents are carried is the amount at which their value was taken on pages 8 and 9 of the first annual report of your company.

AUDITOR'S REPORT.

CONSOLIDATED BALANCE SHEET.—This includes the assets and liabilities of the Edison General Electric, Edison Electric Light, and the Thomson-Houston Electric Companies, which, for convenience of bookkeeping only, are consolidated with those of the General Electric Company. The assets and liabilities of the Thomson-Houston International Electric and Pennsylvania General Electric Companies were taken over by the General Electric Company during the past year and are also included in this balance sheet.

CONSOLIDATED STATEMENT OF PROFIT AND LOSS.—This includes the profit and loss accounts of all the companies above mentioned.

ASSETS.

PATENTS AND FRANCHISES.—This account remains at the amount shown in the last two annual reports. It represents, as stated in those reports, the cost to the General Electric Company of the Edison and Thomson-Houston patents and contract rights, and its interest in the patents of the various Thomson-Houston sub-companies. During the year, $94,917.11 was expended in purchasing and taking out new patents, and $67,381 in acquiring the territorial licenses which the Thomson-Houston Company had granted to the Thomson-Houston International Electric and the Thomson-Houston Electric Light Companies, the latter being the predecessor of the Pennsylvania General Electric Company. These amounts, as well as all expenses of patent litigation for the year, have been written off to profit and loss.

MANUFACTURING PLANTS.—This account represents the real estate, buildings, machinery, tools, etc., at Schenectady, Lynn and Harrison. Their book value at Jan. 31, 1894, was $3,941,128.98. During the year [illegible] was expended for new buildings, and $268,079.73 for new machinery. On the other hand [illegible] has been written off to profit and loss as an allowance for depreciation, leaving the present book cost of these plants $3,900,000, or $41,128.98 less than at Jan 31, 1894.

REAL ESTATE.—This account has been increased during the year [illegible] chiefly by taking real estate mortgaged to secure old accounts in settlement of those accounts.

STOCKS AND BONDS.—Those securities having a market value have been taken at book values slightly under the price of recent sales. Where there is no established price it has been necessary to estimate their value from financial statements submitted by officers of the respective companies. Effort has been made to keep the book values of stocks and bonds of "local companies" down to present cash values.

There are stocks and bonds of various companies amounting to $3,500,000 at par, but of so speculative a character that they are carried at a total book value of only $82, being one dollar for each lot. Some of these latter are practically worthless, but others possess some merit and their aggregate value is likely to be considerable.

NOTES AND ACCOUNTS RECEIVABLE.—This account represents what is believed to be a conservative value of notes and open accounts of customers, after deducting and charging off to profit and loss old notes and accounts receivable of 466 debtors, not now dealt with except on a C. O. D. basis, amounting to $2,291,844.48, heretofore carried at $234,973.69, but no longer carried as assets except for the aggregate sum of $466, being one dollar for each debtor. They will be liquidated as speedily as possible.

INVENTORIES.—This account represents raw materials, goods manufactured and in process of manufacture at the works, and manufactured goods on consignment and at sales offices, all at factory cost. They have been inventoried item by item.

Reductions from the sum at which they were previously carried have been made and charged to profit and loss. The continued writing down of manufactured goods is with the intent that only standard salable apparatus shall be considered an asset.

WORK IN PROGRESS.—This account represents the amount expended on installations in progress, without any credit for the profit to be derived from such installations when completed and billed.

LIABILITIES.

CAPITAL STOCK.—To acquire five shares of common and four shares of preferred stock of the Thomson-Houston Electric Company, which had not been exchanged at the date of the last annual report, three shares of common and one share of preferred stock of this company have been issued during the year.

INDEBTEDNESS.—Pursuant to the policy announced in the last annual report, various stocks and bonds, which it was not desirable for the company to hold permanently, have been marketed. Their proceeds were placed in a special fund. The cost of all securities purchased has been charged to that fund, as follows:

Securities were sold for	1,307,298.07
Securities were acquired at a cost of	1,085,226.56
Leaving a balance	$222,071.51
To this was added from the liquidation of old notes and accounts receivable the sum of	$85,996.82
Making a total of	$1,108,068.33

which was used to buy $1,250,000 of the company's debentures in the open market at an average price of about 88⅝.

By liquidating as above, and by adhering to the policy of selling for cash or on short time, the company has not only collected enough cash to retire all its floating and reduce its funded debt, but has had sufficient working capital to pay cash for all its purchases during the year.

The following comparison shows the debt of the company, other than outstanding debentures and real estate liens, on the 31st days of January, 1894 and 1895:

	1894	1895
Notes Payable	744,341.31	None.
Accounts payable, accrued interest, etc	446,307.92	494,258.01
Total	$1,190,649 23	$494,258.01
Less cash on hand	591,143.88	404,236 48
Net amount of unfunded debt	$599,505.35	$90,021.53
Paper endorsed and discounted	1,422,949.48	None.
Total	$2,022,454.83	$90,021.53.
Reduction of unfunded debt		$509,483 82
Reduction of real estate liens		26,200.00
Debentures cancelled		1,250,000.00
Reduction of debt during the year		$1,785,683.82
Reduction of endorsements		1,422,949.48
Total reduction of obligations		$3,208,633.30

PROFIT AND LOSS.

It is difficult to separate losses ascertained during the current year into those properly chargeable to this year, and those due to the errors or misfortune of previous years. The division of the profit and loss statement has been made with a view to exhibit, as far as could be distingushed, the profit of the year just ended. The losses incurred on notes and accounts, over and above the allowance made therefor last year, are due largely to diminished values of notes and accounts of customers of the Northwest General Electric Company.

GENERAL EXPENSES.

The general expenses decreased $774,832.09 as compared with the previous year.

CONSOLIDATED BALANCE SHEET, JANUARY 31, 1895.

ASSETS.

Patents and Franchises		$8,159,264 02
Manufacturing Plants		3,900,000 00
Real Estate (other than Manufacturing Plants)		
Edison Building, N. Y. City	$412,584 63	
Less mortgage thereon	200,000 00	
	212,584 63	
Other Real Estate	211,198 79	423,783 42
Stocks and Bonds (see Schedules A and B)		5,079,012 51
Cash	404,236 48	
Notes and Accounts Receivable	6,550,499 50	
Work in Progress	757,087 04	7,711,823 02
Inventories		
At Factories	$3,046,014 59	
At Sales Offices including consignments	813,654 39	3,859,668 98
Sundry Debits		27,989 09
Profit and Loss		14,794,716 97
		$43,956,258 01

LIABILITIES.

Capital Stock.		
Common	$30,460,000 00	
Preferred	4,252,000 00	$34,712,000 00
Five Per Cent Gold Coupon Debentures		8,750,000 00
Accrued Interest on Debentures	72,916 65	
Accounts Payable	421,341 36	494,258 01
		$43,956,258 01

CONSOLIDATED PROFIT AND LOSS ACCOUNT OF JANUARY 31, 1895.

Adjusted Balance as of January 31, 1895			$15,209,359 69
Business of the Current Year:			
Cost of Goods Sold	$9,557,327 69		
Legal and General Expenses and Taxes	1,894,536 29	$11,451,863 98	
Interest on Debentures		464,583 33	11,916,447 31
Losses Chargeable Partly to Previous and Partly to Current Years' Business:			
Consignments and Contracts written off		134,772 96	
Additional Depreciation Allowed for:			
On Plants, Consignments and Contracts	177,417 50		
On Notes and Accounts Receivable	130,833 50	308,251 00	
		443,023 96	
Further Amounts now charged off:			
Patents and Franchises	162,298 11		
Various Inventories	288,401 14		
Sundry Losses	38,798 34	489,497 59	932,521 55
			$28,058,328 55
Business of the Current Year:			
Sales	12,540,395 12		
Royalties and Sundry Profits	420,818 17	12,961,213 29	
Interest and Dividends on Securities owned	187,946 81		
Interest and Discount	114,451 48	302,398 29	13,263,611 58
Balance, January 31, 1895			14,794,716 97
			$28,058,328 55

SUPPLEMENTARY CONSOLIDATED PROFIT AND LOSS ACCOUNT OF JANUARY 31, 1894.

Balance, January 31, 1894		$12,454,967 42
Losses Chargeable to Further Liquidation of Last and Previous Years' Business:		
Sundry Liquidation Accounts	$264,048 36	
Claims against Northwest General Electric Company	456,484 43	
On Account of Settlements with United Electric Securities Co. of Bond Transactions under Thomson-Houston Electric Co.'s Contracts	46,382 86	
Old Notes and Accounts Receivable wholly charged off	234,973 69	
Sales of Plants and Real Estate below book values	41,501 97	1,043,391 31
Special Allowance (see page 2)		2,000,000 00
		$15,498,358 73
Profits Belonging to Last and Previous Yea s' Business:		
Discount on Debentures purchased	$141,931 67	
Sales of Stocks and Bonds in excess of book values	147,067 37	288,999 04
Balance carried down		15,209,359 69
		$15,498,358 73

Special Correspondence.

NEW YORK NOTES.

Office of the Electrical World,
253 Broadway, New York, May 6, 1895.

THE PORTER STANDARD MOTOR COMPANY has removed its offices to 66-68 Broad street.

MR WILLIAM TAYLOR, formerly of Taylor, Dee & Mack, Chicago, and for many years prominently identified with electrical interests, has accepted a responsible position in the business office of The Electrical World.

THE EDISON ELECTRIC ILLUMINATING COMPANY, by a considerably more than two-thirds vote required by law, has decided to issue $15,000,000 of 100 year 5 per cent. bonds. About $12 000,000 of this money will be used in retiring existing bonds of the parent company and of the Harlem and Manhattan Companies, which have been absorbed by it. The remainder of the proceeds will be expended in future construction and improvements.

THOS. A EDISON'S bid of $125,100 for the entire assets and effects of the North American Phonograph Company was rejected by Chancellor Alexander T. McGill and instructions were given Receiver John R Hardin to gather into one lot all the assets, including the stock of the Edison Phonograph Company and all the patents, and offer them in an entirely public sale. Mr. McGill stated that his decision in nowise reflected upon Mr. Edison, who he believed, had acted all through as a high minded, honorable man.

ELECTRIC THEATRE SIGNS.—The Bureau of Encumbrances has notified the managers of the Bijou, Casino, Miner's, Garden, Palmer's, Herald Square, Pastor's and other theatres to remove the electric advertising signs displayed in front of the play-houses outside of the stoopline in violation of the city ordinance. The signs will have to be remodelled and rehung to conform to the letter of the law, as they have proved too valuable as advertising mediums to be abolished. In addition they add greatly to the beauty of New York's night scenes.

BROOKLYN'S ALDERMEN last week had an exciting discussion over the electric light specifications there being three separate resolutions before them. Alderman Clark's resolution, requiring the companies to furnish light at a price not exceeding 35 cents per lamp per night, and Alderman Walkley's, requiring them not to exceed 40 cents per night, were both voted down. Alderman Walsh's (which is alleged to have been prepared in the office of one of the old companies, and to practically debar the Edison Company from competition), after a stormy discussion, was laid over to the next meeting by a very close vote. Alderman Walsh's resolution appears to have some new features on the general subject. One of these proposes to allow the company interest on money due since Jan. 1 on the city's unpaid bills.

THE BOARD OF ELECTRICAL CONTROL last week approved the application of the American District Telegraph Company for subways in Eighth and Ninth avenues from Waverley place to 20th street; Eighth street, from University place to Third avenue; 14th street, from Broadway to Third avenue; 30th street, from Broadway to Seventh avenue, and 26th street, from Broadway to Fourth avenue. These subways will be built if the Commissioner of Public Works does not object to the streets named being torn up Permits for subways were also granted to the Manhattan Electric Light Company, from 54th to 70th street, and to the Madison Square Electric Light Company on First avenue, from 28th to 42d street. The board departed from its usual rule and voted to tear up Fifth avenue in order that the Metropolitan Telegraph and Telephone Company may have subways in that avenue from 12th to 23d streets and from 42d to 57th streets. During his administration Mayor Gilroy refused to permit Fifth avenue to be disturbed for any such purposes. The request of the Brush Electric Light Company for permission to erect poles on Nassau street was referred to Commissioner Kearney.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, May 4, 1894.

MR GEO. H. MILLS, of the New York Carbon Works, has been for several days a welcome visitor in and around Boston, holding old friends and making new ones.

WADDELL-ENTZ AFFAIRS.—Judge Robinson has ordered that the stock and machinery of the defunct Waddell-Entz Company be sold within two months. Receiver Hughes had reported that there was nothing to be gained by continuing the business.

MR. W. C. LANGFORD, of the late firm of Hutchings, Langford & Hutchings, Providence, R I., has located in business for himself in that city at 174 Westminster street, where he will continue the business of electrical contracting, construction, supplies, etc Mr. Langford has hosts of friends, all of whom wish him success.

UNDERGROUND WIRES.—The matter of putting wires underground is worrying the Brockton (Mass.) authorities. Those who are opposed to burying the wires are few, but those who disapprove the proposal of the telephone company to bury its wires in a conduit to be owned and controlled by it, are many in number and positive in opinion.

THE FOLLOWING ELECTRICAL ESTABLISHMENTS of Boston will close their places of business during the months of May, June, July, August and September at 1 o'clock Saturdays and 5 o'clock other days: Pettingell, Andrews Company, Holtzer-Cabot Electric Company, Anchor Electric Company, Gillis & Gleeson, Ziegler Electric Company, Thompson-Brown Electric Company and the Electric Gas Lighting Company.

DURING THE PRESENT WEEK, owing to the extremely warm wave that has prevailed, the West End Railway has had to run quite a number of open cars. In anticipation of its summer traffic the company has recently built and purchased a large number of new cars. They are very handsome, commodious and comfortable and the traveling public fully appreciates the progressive and enterprising policy of the company.

WORK IS BEING PUSHED on the new Subway, notwithstanding the frantic efforts of the opponents of the entire project to induce the legislature to put a stop to the work. Petitions have been gotten up in various forms. A motion was submitted in the House of Representatives, but the same was lost by a large majority. It is believed now that no further attempts will be made to obstruct the work. Hundreds of men are employed, many trees on the Common and in the Public Gardens have been cut down or removed, and piles are now being driven for the roadway at the southern entrance to the tunnel, which is near Park Square Station.

ELECTRIC POSTAL SERVICE IN BOSTON. On May 1 the Post Office Department in Boston established the new trolley car service, which cannot fail to be of great advantage to the people residing in the suburbs. These cars were put into commission at 10 a.m., May 1, and the departure from Post Office Square attracted a good deal of public attention. The round trip of each car occupies about one hour, and the schedule on which they are running is so arranged that each car will leave the General Post Office hourly. Chutes are provided in the sides of each car for the reception of mail matter en route. As there is considerable car traffic through Post Office Square all day long, the West End Railway Company is laying a new track up Water street at north end of Post Office Building, where the cars can stand while discharging or loading the mail sacks. Should the service realize the expectations of the Railway Mail Service Department, other cars may be added for running to more remote districts.

THE ELECTRIC HEAT ALARM COMPANY, Boston, reports an excellent business in its varied line of manufactures and specialties. It is doing a nice business with manufacturing, hotel and general business interests through its admirable Automatic Fire Alarm and Journal Bearing systems, the application of which for marine purposes is also being rapidly recognized. Work is in progress equipping a new steamboat now building for the Marine Coast Navigation Company, Bath, Me. Its system has also been adapted to the "Hart Signal and Stop Engine" apparatus, which will hereafter be handled by this company. The system for stopping the engine is so arranged that a short circuit will not stop the engine, but simply ring a bell in the engine room, while breaking the glass in the box plainly marked "To Stop the Engine, Break the Glass," located on any of the floors in various sections of the building will cause immediate stopping of the engine. This, it is said, is the only apparatus that cannot be tampered with and thus cause a stopping of the engine needlessly. Mr. Hart, of the Hart Electric Signal Company, of Fall River, has installed quite an amount of this apparatus and it is giving good satisfaction. The Electric Heat Alarm Company is also receiving extraordinary demands for the "Simplest" Cleat, one of its recent specialties.

WESTERN NOTES.

Branch Office of the Electrical World,
936 Monadnock Building, Chicago,
May 4, 1895.

GEO. CUTTER has pleased the trade once more with a neat bit of literature on "Cutter's Electric Street Lighting Specialties," having all his latest, 1895, devices illustrated. It is especially interesting.

SUNBEAM LAMPS are now being turned out nearly 6,000 a day. The company is making it known that it has a good lamp, consequently the cheapest lamp, though not the lowest priced lamp in first cost. There seems to be a great change of sentiment to this new doctrine, and the "Sunbeam" seems to be well to the front.

IT IS UNDERSTOOD that in selecting the incandescent lamps for the new Steinway Hall, several types were submitted to a severe test under the direction of the architect, and that the Columbia, manufactured at St. Louis, was awarded the contract on the point of superiority. At the same time it is whispered that architects and contractors are about to inaugurate a series of efforts to determine ahead of time just which is the best lamp to buy.

General News.

ELECTRIC LIGHT AND POWER.

ROPER CITY, N. C.—Steps are being taken to establish an electric light plant.

GLENS FALLS, N. Y.—An electric lighting system is to be installed here in the near future.

WEST RANDOLPH, VT.—Steps are being taken to establish an electric light and power plant.

ONARGA, ILL.—J. B. Owen has been granted a ten-year franchise for an electric lighting plant.

HEMPSTEAD, L. I., N. Y.—It is reported that this place is to be lighted by electricity in the near future.

GLENWOOD, MINN.—It is reported that an electric lighting system is to be installed in this village in the near future.

KNOXVILLE, TENN.—An electric lighting plant is to be built here by the East Tennessee Marble Producers' Company.

RED WING, MINN.—It is reported that a fire-proof addition is to be built to the St. James Hotel. Electric lighting will be introduced.

WOODRIDGE, N. J.—It is reported that electric street lighting is to be introduced. Address the clerk of the Borough Council for particulars.

CHERAW, S. C.—An electric lighting plant is to be installed in the Cheraw Knitting Mills. Bids for the construction of same will be received.

STEPHENVILLE, TEX.—The erection of an electric lighting plant at this place is contemplated. The clerk of the City Council can give particulars.

LYNBROOK, L. I., N. Y.—The establishment of an electric lighting system at this place is contemplated. The Village Improvement Society is interested.

GREEN ISLAND, N. Y.—A bill has been passed authorizing the installation of an electric lighting system in this village. The clerk of the Council can give further details.

TECUMSEH, MICH.—The streets of this village are to be lighted with electricity in the near future. W. J. Ingersoll is village clerk and can furnish detailed information.

NEW YORK CITY.—The Gerlach Hotel, located at 49-55 West 27th street, is to be enlarged at a cost of $200,000. The structure is to be equipped with all appliances for electric lighting.

BARDSTOWN, KY.—The erection of an electric lighting plant is contemplated by the city authorities at an estimated cost of $7,500. Orville Arnold can be addressed for further particulars.

CASCADE, IA.—At a recent election it was decided to erect a new electric lighting plant. The work of construction will commence at once, and the clerk of the Council can give detailed information.

MOOREHEAD, MINN.—The City Council, at a recent special meeting, decided to build an electric lighting plant at this place. Bids will be received until May 12, and the clerk of the Council can furnish detailed information.

CHATTANOOGA, TENN.—Bids will be received until June 3 for the construction of a municipal electric lighting plant with a capacity of 3,200 arc lights and 100 incandescent lights. O. S. Martin, chairman of the lighting committee, can be addressed.

MECHANICSBURG, PA.—Sealed proposals will be received until 12 o'clock noon May 23, 1895, for the lighting of the streets of the borough of Mechanicsburg, Cumberland County, Pa., by electricity, for one year, with the privilege to the town of renewing the contract for two years. J. S. Huston is chairman of the light committee.

SEATTLE, WASH.—The Union Electric Company has recently been formed for the purpose of leasing the properties of the Union Electric Company and the Seattle Gas & Electric Lighting Company. The arc light station formerly operated by the gas company will be discontinued. The offices have been consolidated in the rooms formerly occupied by the Union Electric Company. Dr. E. C. Kilbourne, formerly general manager of the Union Electric Company, continues in the general management of the consolidation.

THE ELECTRIC RAILWAY.

OCEAN VIEW, VA.—An electric railway is to be built at a cost of $250,000.

MANCHESTER, N. H.—Soulle, Dillingham & Co. are pushing forward the electric road.

HAZELTON, PA.—The Traction Company will shortly lay tracks to run east on Spring street.

PITTSBURGH, PA.—Messrs. Oliver Bros. have petitioned for a franchise for an electric railway.

PORTSMOUTH, VA.—An electric railway is to be constructed from Portsmouth to Port Norfolk.

NASHUA, N. H.—Work on the track of the electric railway will be at once commenced in Hudson.

BRUNSWICK, GA.—A franchise has been applied for by J. E. Du Vignon to construct an electric railway for this place.

LOWER PROVIDENCE, PA.—The Norristown & Perkiomen Railway Company has applied for right of way into this place.

CARTHAGE, N. Y.—Steps are being taken to build an electric road from this company to Copenhagen, a distance of eight miles.

PIKEVILLE, MD.—The Pikesville, Reistertown & Emory Grove Electric Company expect to have their line complete about May 1.

TOWANDA, PA.—The Towanda Traction Company has been granted an extension of three months in which to complete its road.

BAY SHORE, L. I., N.Y.—The Brentwood Trolley Railway Company has been granted a franchise to construct their line through this place.

PORTLAND, ME.—Work has been commenced on the erection of the new electric power house for the Portland Street Railway Company.

TAMPA, FLA.—The Consumers' Street Railway Company has purchased the Palmetto Beach Railway, and will extensively improve and extend the system.

BINGHAMTON, N. Y.—The Binghamton, Lestershire & Union Railway Company will extend its line. Address Manager J. E. Clark for detailed information.

WASHINGTON, D. C.—Work has been commenced by the Washington & Mt. Vernon Electric Railway Company on the construction of its underground railway.

WARREN, MASS.—The Warren, Brookfield & Spencer Electric Railway Company has applied for a franchise. Address I. L. Currier for further information.

CHATTANOOGA, TENN.—Surveys are being made for an electric line to be constructed from Rossville to Chickamauga Park. John R. McFarland is general manager.

CAMDEN, N. J.—A crosstown trolley line is to be erected on Second and Third streets from Kaighn to Erie street, by the Camden Horse Railway Company.

VERSAILLES, PA.—It is reported that the Versailles Electric Street Railway Company will extend its line to Scotthaven and West Newton, a distance of eight miles.

NEW HAVEN, CONN.—The New Haven Street Railway Company has applied for permission to extend its line on Townsend avenue from Four Corners to Morris Cove.

SAGINAW, MICH.—It is reported that two electric railways are to be built between this place and Bay City. Address the Rapid Transit Company for detailed information.

SUSQUEHANNA, N. Y.—The construction of an electric railway between this place and Lanesboro is contemplated. Address the clerk of the Council for detailed information.

BROOKLYN, N. Y.—The Brooklyn & Brighton Beach Railway Company has been granted permission to construct a connecting line with the Kings County Elevated Road.

FAIR HAVEN, CONN.—The Fair Haven & Westville Railway Company will extend its line to Montowese. The extension will be 3¼ miles in length and work will be commenced in the near future.

SPENCER, MASS.—The Warren, Brookfield & Spencer Railway Company has petitioned for a franchise for right of way through the streets of this town. R. L. Courier and C. O. Richardson are among the directors.

PIERMONT, N. Y.—The Nyack Traction Company has petitioned for permission to construct, operate and maintain an electric street railway through this village. C. H. Kane, town clerk, can furnish further details.

COLUMBUS, GA.—It is reported that the Columbus and Rome narrow guage railroad is to be changed to standard guage and extended to Atlanta. The road will be operated by electricity. Grisby E. Thomas, Jr., is interested.

NEW YORK, N. Y.—The Flushing & College Point Electric Railway Company has been sold to Cravath & Houston, representing the reorganized company, for $25,000. The new company will operate the road and improve its facilities.

BUFFALO, N. Y.—The Buffalo & Gardenville Electric Railway Company will soon be incorporated with a capital stock of $40,000, to connect Gardenville and Ebenezer by an electric line. The route will be from Seneca street to Winchester avenue (Indian Church road), thence to Gardenville and to Ebenezer. The road will be double track, and the work of construction will be begun as soon after incorporation as possible.

PERSONAL NOTES.

LIEUT. J. B. CAHOON on May 1 severed his connection with the General Electric Company to take the position of general manager of the Elmira Municipal Improvement Company, which owns the water, gas and electric lighting plants, and the principal electric railway of Elmira. Lieut. Cahoon made an enviable record with the Thomson-Houston and General Electric Companies, his organizing abilities having been of particular service to the former in connection with the organization of the different departments at Lynn, while his successful conduct of the expert departments and students' courses of both companies showed that he also possesses executive talents of a high order. The recent duty of Lieut. Cahoon in inspecting and reporting on lighting and street railway plants in which the General Electric Company has an interest will be especially useful to his present employers, who are to be congratulated upon having secured the services of one so thoroughly competent to take charge of their extensive interests.

MR. CHARLES T. SNEDEKER, the inventor of "Salamander" wire, returned to New York on May 1, after a trip of 14 months through England, Germany, Russia, Hungary, Austria, Italy and France, where he visited the more important central stations and the works of the largest manufacturers of electrical machinery and insulated wire. Mr. Snedeker has been successful in selling his patents and starting the manufacture of "Salamander" insulated wire in the works of Messrs. Felten & Guilleaume, at Cologne, Germany, and also at Vienna and Budapest. The French patent he sold to the Societe Industrielle des Telephones at Paris, which is the largest wire and cable manufacturing company in France. This company has bought the Rutier and Menier Works, and has just completed the new cable between Madagascar and the main land. Mr. Snedeker reports that "Salamander" wire has been ordered in all the French arsenals, power magazines and government store houses where electric light is used, as well as in many theatres and libraries.

MISCELLANEOUS NOTES.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS announces that the annual meeting for the election of officers, reception of reports, and transaction of other business of the institute will be held at 12 West 31st street, New York City, Tuesday evening, May 21, instead of May 14, as previously announced on the balloting circulars. At the same meeting the discussion of Prof. Anthony's paper will be resumed, and it is expected that a paper will also be presented by Mr. A. D. Adams, of Boston, on "The Most Economical Form for Bipolar Field Magnets."

ELECTRIC LEAGUE NO. 1 OF AMERICA was incorporated in New York last week and held its first meeting on May 1, at Third avenue and Sixteenth street. There was an attendance of about 300, and interesting addresses were made by Colonel Taliaferro, Prof. S. S. Wheeler and Mr. DeGuerro. The object of the League is to elevate the standard, morally and mentally, of electrical workmen and the general advancement and education of its members. The organization will be conducted on conservative, but broad gauge principles, and it is proposed to establish branch leagues in other cities. The Electric League starts out with fine prospects and has the unqualified approval of some of the most prominent persons connected with electrical interests. The officers for the first year are George Porter, president; Louis W. Dillman, recording secretary; John S. Rockefeller, financial secretary; William A. Slack, inside sentinel; John C. Scott, outside sentinel.

TELEGRAPHIC HISTORICAL SOCIETY.—A meeting of the Telegraphic Historical Society was held in Washington on May 1. The society was organized last year through the efforts of Mr. Geo. C. Maynard, and has now a membership of 265. Several interesting papers were read, one by Mr. Henry A. Reed on "The Paternity of the Telegraph," the author of which had played a prominent part himself in the early days of telegraphy, and had been associated with Prof. Morse in some of his early experiments. Mr. T. D. Lockwood also read a paper on the early history of the telegraph. The following officers were elected for the ensuing year: President, Alonzo B. Cornell, Ithaca, N. Y.; first vice-president, S. H. Kauffmann, Washington, D. C.; second vice-president, Wm B. Wilson, Philadelphia, Pa.; third vice-president, Thomas D. Lockwood, Boston, Mass.; secretary and treasurer, Geo. C. Maynard, Washington, D. C.; members of executive council, J. H. Emerick, New York City; B. F. Dillon, Jacksonville, Fla.; Wm. R. Plum, Chicago, Ill.; J. Q. Mason, Tacoma Washington.

THE ELECTRIC POTENTIAL CLUB, Boston, held its annual meeting and dinner at Young's Hotel, on Tuesday evening, April 30, with 30 members present, and the various branches of the electrical industry of Boston well and prominently represented. At the conclusion of the dinner President C. W. Holtzer presented seven names for membership, all of whom were elected. The following officers were then elected for the ensuing year: President, Frank Ridlar; vice-presidents, Col. E. H. Hewins and George W. Blodgett; treasurer, I. H. Farnham and secretary Sidney Hosmer. President Holtzer was renominated, but declined the honor. Treasurer I. H. Farnham submitted his report, which showed no outstanding debts, something in the treasury, and a paid membership of 35. Reference was made in the report to the death of Mr. Samuel G. Sturess, of Pawtucket, R. I., to which subsequent allusion was made by Mr. R. F. Ross in fitting terms, and a committee was appointed to draft resolutions of sympathy to his family. Following the business meeting, Mr. D. N. Bliss, of the Holtzer-Cabot Electric Company, delivered an interesting address upon "Automatic Insulation, High Potential Apparatus, Controlling of Currents, etc." Apparatus was in position in the room to illustrate the lecture, but owing to the inability to get the alternating current supplied it was not in operation, much to the regret of all present. The discussion which ensued, by Prof. Puffer, Mr J. M Oxford, Mr. I. H. Farnham and others, was decidedly instructive. The meeting was a success in every respects, and a vote of thanks tendered Mr. Holtzer, through whose efforts the organization was brought into existence, for the hard work he has done against many obstacles, in holding it together.

Trade and Industrial Notes.

GEO. F. WOOLSTON, JR., 40 Wall street, New York, will make purchases for machinery and material for a complete electric light plant for Guayaquil, Ecuador, S. A.

THE NEWTON ELECTRICAL COMPANY, New York, has sold all its property to Walter Boardman, of Lancaster, Pa., who is considering the feasibility of reorganizing the business.

DOUBLEDAY, MITCHELL & CO. have removed their offices from 136 Liberty street to the Thames building, corner of Thames and Greenwich streets, New York, where they occupy rooms 101, 102, 103.

CHAS. E. CHAPIN'S numerous friends were greatly distressed by the news of his assignment last week. Mr. Chapin is an energetic, conscientious business man, and it is sincerely hoped that he will soon be on his feet again.

JULES GERAUD & LECLERC, patent attorneys, of No. 43 Rua do Rosario, Rio de Janeiro, Brazil, are sending out circulars containing explicit information for the guidance of patent agents having South American patent work to be executed.

PIERCE & MILLER, lately at 42 Cortlandt street, New York, are now occupying new and commodious offices in the Havemeyer Building, 26 Cortlandt street. They will continue to conduct a business of the same general character as heretofore.

THE COTTON STATES & INTERNATIONAL EXPOSITION COMPANY, Atlanta, has issued a prospectus setting forth the objects and scope of the exposition, and describing in detail the various buildings, etc. A map of the grounds is contained in the circular.

THE BALL & WOOD COMPANY, engine builders, of New York, represented in Chicago by C. E. Sargent, will remove its Chicago offices on May 1 to 404 Fort Dearborn Building, where Mr. Sargent would be very glad to see all his acquaintances.

THE SIEMENS & HALSKE ELECTRIC COMPANY OF AMERICA, Monadnock Block, Chicago, has published a circular setting forth the merits of its direct-connected, continuous current apparatus, and giving figures to show the relative efficiency of alternating and continuous current systems, belted and direct driven.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., is putting up an iron bridge at Thomaston, Conn., consisting of two plate girder spans, each 60 ft. long, with a roadway 22 ft. wide, and two sidewalks, each 6 ft. wide. The bridge will be made entirely of iron and concrete, no woodwork being used in the construction.

THE HORNBERGER ELECTRIC MANUFACTURING COMPANY, of Elkhart, Ind., has opened a branch office at 136 Liberty Street, New York, with Mr. E. B. Latham in charge as eastern manager. Mr. Latham was employed by the T.-H. and General Electric companies in different important positions for twelve years previous to his association with the Hornberger Company.

THE MASON TELEPHONE COMPANY, 3 Governor street, Richmond, Va., has secured the contract for a 250-wire telephone exchange at Petersburg, Va., one of 100 wires at Greenville, Tex., and one of 60 wires at McKinney, Tex. The Mason Company has also in course of construction an exchange at Bryan, Tex., and one at Anderson, S. C. The company wishes prices on poles, wires, brackets, insulators, etc., delivered at Petersburg, Va.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is getting a large share of the telephone supply business, which just at present constitutes a very considerable part of the demand for electrical supplies. The fact that the company carries on hand a very large stock of telephone line material, such as cross arms, insulators, etc., and can ship almost any kind of an order promptly from Chicago, gives it a valuable advantage which counts for a great deal in the telephone business.

THE AUTOMATIC SWITCH COMPANY, of Baltimore, Md., recently shipped to its Boston representative, the Boston Electric Company, a 35-hp, 500-volt, Whittingham automatic motor starter, which is probably the largest self-contained device of the kind ever constructed. The dimensions of the rheostat are 7 x 12 x 18 inches, but notwithstanding the small space occupied, the radiating surface is said to be over 3,100 square inches. The weight of the complete starter is about 90 pounds.

THE LOUISVILLE ELECTRICAL WORKS, of Louisville, Ky., reports already a most gratifying demand for its Phœnix transformers, described recently in THE ELECTRICAL WORLD, and in order to keep up with orders the factory is running nights. Such a prompt acknowledgement upon the part of the public of the merits of the transformer was not entirely anticipated, and consequently the company was unprepared for the rush of business, but it is now in position to take care of all orders promptly.

THE SCOTT ELECTRIC LAMP COMPANY, 126 Liberty street, New York, reports the following remarkable adventure of a Huntingdon search light. In January last, just prior to the sailing of the ill-fated "City of Haverhill," the Scott Company installed on her a Huntingdon search and position lamp. The pilot boat "James Gordon Bennett" recently found the lamp attached to the roof of the "Haverhill's" pilot house, floating around some 100 miles off Sandy Hook. The lamp is now on exhibition in the Scott Company's office.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, 32 Cortlandt street, New York, has published its seventh illustrated catalogue of electrical supplies, and the book is very complete and exceedingly well gotten up. The paper is good, the cuts clear and sharp, and the contents logically arranged. The line of goods advertised is comprehensive, embracing telegraph and telephone instruments and supplies, gas lighting and medical apparatus, annunciators, burglar alarms, electric bells, electric light supplies, etc., etc.

THE BALL & WOOD COMPANY'S works at Elizabeth, N. J., present a scene of great activity just now. The company has orders ahead for a good many engines for both eastern and western points, and the new western agent, Mr. Sargent, has just obtained a contract for several cross-compound engines for the new Milwaukee city hall. Ball & Wood engines are now being installed in the Temple of Music, Grace Hotel, Fort Dearborn building and for Messrs. Morgan & Wright, Chicago. In St. Paul the Ball & Wood engine recently placed in the Manhattan building is attracting very favorable attention. This engine is directly connected with a Western Electric dynamo, and runs smoothly and noiselessly, and with very close regulation. In New York the list of recent sales of Ball & Wood engines embraces the equipment of the new St. Luke's Hospital, on the Heights of Morningside Park; a second engine for the 42d street house of the Manhattan Storage Warehouse Company; several engines for the new Syracuse station of the New York Central Railroad. Messrs. Stoutenburgh & Co., of Newark, are also putting in two of these engines, and the Danbury & Bethel Railway Company, of Danbury, Conn., is having a second 42-hp cross-compound built.

JAMES G. BIDDLE, who, for some five years past, has been manager of the electrical department of Queen & Co., has recently opened an office at 526 Drexel building, Philadelphia, as dealer and manufacturers' agent for scientific and electrical apparatus. As sole American agent Mr. Biddle represents Elliott Bros., of London, which firm is perhaps more widely known throughout the world than any other makers of scientific instruments In addition to electrical measuring apparatus, for which they are chiefly noted, the Elliotts manufacture telegraph instruments of the highest order, chronographs and other recording instruments, engineering instruments, standards of length, micrometers, cathetometers, optical instruments, etc. They have largely supplied the various English home and colonial departments, numerous foreign governments, London Board of Trade, London City Council, the principal colleges and universities everywhere, all of the submarine cable companies, and many of the important standardizing laboratories. The last extensive exhibit of their instruments was at Paris in 1889, where they received the only "Grand Prix" accorded to any English electrical exhibit. To make the line of electrical instruments complete, Mr. Biddle has arranged with the Weston Instrument Company, of Newark to handle its portable and switchboard voltmeters, ammeters, wattmeters, etc., as special agent, so that he is in a position to execute orders of any size at bottom factory prices. Mr. Biddle is also selling agent for the Electric Storage Battery Company, and is making a specialty of the "Chloride" accumulator for college and laboratory work. Full particulars are set forth in a catalogue recently issued which describes batteries of all sizes and for all purposes, including cells mounted in portable hard wood cases for phonographs, kinetoscopes and other small motor work.

Business Notice.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENT ISSUED APRIL 23, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

538,158. ELECTRIC RAILWAY SYSTEM; J. M. Faulkner, Philadelphia, Pa. App. filed Jan. 12, 1895. In an underground electric railway system, an exposed conductor having rigid contact points in the conduit, vertically movable bodies of magnetizable material in the conduit and connected electrically with the live wire, each body having a vertical opening, a cup set beneath the opposite conductor contact and containing mercury, and an upwardly extending insulating guide surrounding the contact

UNITED STATES PATENTS ISSUED APRIL 30, 1895.

538,248. CHANGEABLE ELECTRIC HEADLIGHT; W. Dibb and F. C. Rorabeck, Syracuse, N. Y. App. filed March 19, 1894. The combination of a contact board, spring fingers normally in circuit with wires connected to them, a second negative pole upon the said board and a reflector stem adapted to break the circuit through the said fingers, and make it through the positive pole of said circuit and a lamp attached to the said poles.

538,247. ELECTRICAL SIGNALING SYSTEM; B. A. Fiske, United States Navy. App. filed Dec. 20, 1894. In an electrical signaling apparatus, a conductor in circuit, and at a distant station an indicating instrument having its terminals electrically connected by line to two points on said conductor, one of which is movable and the other fixed on each side of the fixed terminal, causing the index of said indicating instrument to move in a direction corresponding to the movement of the movable terminal, and over a distance depending upon the fall of potential on the conductor between said terminals.

538,271. ELECTRICALLY AND CHEMICALLY HEATED CRUCIBLE; H. G. O'Neill, Boston, Mass. App. filed March 24, 1894. A crucible, with electrodes contained therein, electrical circuit connections to the said electrodes and a mixture of earth and carbonaceous material interposed between the said electrodes.

533,272. ELECTRICAL CIGAR LIGHTER; H. G. O'Neill, Boston, Mass. App filed Aug. 27, 1894. A hollow handle in combination with circuit conductors extending within the same, springs to which the said conductors are attached, terminals arranged to cause such contact on the depression of a button.

538,275. ELECTRICAL BRAKE; C. E. Pearson, St. Louis, Mo. App. filed April 2, 1894. The combination with a moving element, a core provided with a polar extension, coils on the core, each of which magnetizes the polar extension to different degrees, means for energizing the coils separately and in succession to magnetize the polar extension to a lesser degree at first, and increasing the intensity as the coils are successively cut in, and means for cutting in the current to all of the coils at once.

533,281. BRUSH HOLDER; E. D. Priest, Lynn, Mass. App. filed Aug. 25, 1892. The combination of a stationary part, two elbows, levers fulcrumed thereon, adjustable springs bearing against the said levers stop to limit their movement, spring arms attached to the levers, and a socket piece pivotally connected with the outer ends of the said arms.

538,284. THERMAL CUT-OUT DEVICE; C. A. Rolfe, Chicago, Ill. App. filed Feb. 21, 1895. The combination of a body of fusible material, a section of circuit conductor removably held in circuit and comprising a wire of high resistance in part coiled within the fusible mass and a holder for the wire having contacts with which the wire is connected, and a spring normally held in tension by the fusible mass and arranged to throw the movable section of the circuit conductor away from its co-operating contacts and out of circuit when it is released by the fusion of the mass of fusible material.

538,289. MANUFACTURE OF CARBON FOR ELECTRICAL PURPOSES; C. P. Shrewsbury, London, England, and J. H. Dobell, Modbury, Eng. App. filed Sept. 10, 1894. The combination of combining certain ingredients, heating and then forming or shaping into carbons for electric lamps.

538,295. TROLLEY; J. D. Swacick, Canton, O. App. filed Oct. 22, 1894. The combination of a supporting frame, spindles secured thereto, a wheel composed of two parts, one part being provided with an oil chamber having a screw edge, and the other part having a thread edge to take the threaded edge of the chambered part, and a set screw for the double purpose of preventing the two parts of the wheel from unscrewing, and to afford means for allowing a lubricant to be introduced into the chamber.

538,320. MAGNETIC ORE SEPARATOR; J. W. Carter, Brooklyn, N. Y. App. filed Dec. 30, 1893. The combination of a supply hopper, a series of permanent magnets, the pole ends of which are located below the hopper, and an adjustable deflecting plate located above and at a short distance back of the pole ends of the magnets in the path of the falling material.

538,325. MEANS FOR VENTILATING ELECTRIC MOTORS ON CARS; J. J. Devine, Clifton Heights, Penn. App. filed March 14, 1895. The combination with the motor box in a car of a conduit arranged in the under part of the car, and provided at its ends with caps which may be opened or closed as desired, and flexible connections between the pipe and the lids of the motor box, and opening from the motor box into the main pipe.

538,327. TELEPHONE CENTRAL OFFICE SYSTEM; E. T. Gilliland, Pelham Manor, N. Y. App. filed June 5, 1894. In a switchboard, the combination of a spring jack comprising two normally united but separable contact pieces, forming respectively the terminals of the direct and return circuit conductors, and a third contact point insulated from the others, connected with that conductor which includes the call annunciator at a point external to the annunciator, the mouth of the spring jack being sufficiently capacious to admit of two plugs therein at once.

538,328. MAGNETO TRANSMITTER; E. T. Gilliland, Pelham Manor, N.Y. App. filed June 5, 1894. A transmitter having pole pieces hinged to the poles and in contact therewith, being mounted on a non-magnetic bolt and separated from each other by a non-magnetic tongue.

538,329. MAGNETO GENERATOR; E. T. Gilliand, Pelham Manor, N. Y. App. filed Nov. 28, 1894. A generator consisting of a magnet, pole pieces and a bracket in one casting, a driving shaft supported in the bracket, driving mechanism, an armature with bearings mounted between the pole pieces, and a clamping screw for clamping the bearings and holding them in position.

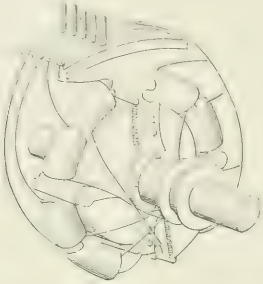
538,344. ARMATURE FOR DYNAMOS AND ELECTRIC MOTORS; H. Penn and L. Lowndes, London, Eng. App. filed Aug. 13, 1894. In armatures of dynamos and electric motors corrugated sheet discs comprising the armature being suitably separated from each other.

538,345. DYNAMO-ELECTRIC MACHINE OR ELECTRIC MOTOR; E. H. Porter, Radford, Va. App. filed Aug. 11, 1894. A dynamo or motor consisting of a single magnetic frame having six pole pieces with coils and armatures embraced therein in such relation that each has a four-pole field.

[illegible] ELECTRIC ENGINE; I. M. Sabin, Washington, D. C. App. filed [illegible]. The combination of a compound tubular magnet, having [illegible] and means for commutating an electric current through the same, of an electro-magnetic armature having a spool of non-magnetic [illegible] wound with a conducting coil and conductors whereby the coil may be connected with a source of electrical energy.

[illegible] UNDERGROUND ELECTRIC RAILWAY; J. F. Smith, New York, N. Y. App. filed Aug. 15, 1894. A carriage for the contact brushes consisting of a frame provided with longitudinal bars having angular deflectors at the ends and plates fastened between said bars having upwardly extending portions provided with means for attaching the carriage to the car.

[illegible] CONDUIT SYSTEM FOR ELECTRIC RAILWAYS; F. H. Homan, Brooklyn, N. Y. App. filed April 24, 1894. A conduit having at intervals exposed portions, a conductor suspended by a lever, a return conductor also enclosed in the conduit, and a transmitting trolley running on the conductor to supply current from the conductor to a motor, and a trailing trolley for returning the current from the motor to the return conductor.



No. 538,275.—Electrical Brake.

538,377. ELECTRIC ELEVATOR; N. O. Lindstrom, Union Course, N. Y. App. filed Feb. 26, 1895. The combination of a driving electric motor, a controller on the car, a motor rheostat for graduating the speed, an auxiliary reversely wound field magnet coil adapted to be cut into circuit, and a variable resistance for graduating the effect of the auxiliary coil.

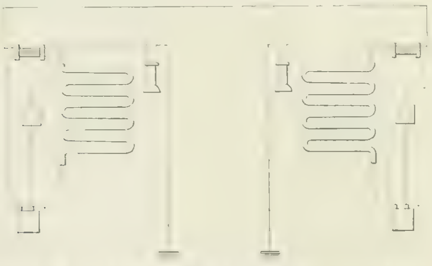
538,390. TROLLEY BREAKER; W. R. Scott, Buffalo, N. Y. App. filed Dec. 19, 1894. A hanger provided with a pair of upright ears separated by a space which receives the end portion of the wire, a rear pin connecting the ears, around which the wire is bent, and a front pin also connecting the ears and bearing upon the bent end of the wire.

538,391. TROLLEY WIRE HANGER; W. R. Scott, Buffalo, N. Y. App. filed March 5, 1895. A hanger provided with a seat for the trolley wire having a pair of cams pivoted to the body above the seat, the latter having a locking device.

538,408. ELECTRIC TRANSMISSION WHEEL OR TROLLEY; C. C. Burton, Pittsburgh, Pa. App. filed Aug. 11, 1894. A wheel having a rigid rim with a series of yielding contact blocks mounted in it, a separate current collecting plate within the rim with which the blocks make contact, and a conductor extending from the annular plate to the wheel hub.

538,417. MAGNETIC ORE SEPARATOR; J. Houlehan, Chicago, Ill. App. filed June 6, 1894. The combination of a movable magnet and an armature forming an interposed ore passage to separate the ores when passing.

538,423. ELECTRICAL COUPLING; M. F. Koenig and I. Mann, Hazleton, Pa. App. filed Oct. 15, 1894. A coupling consisting of a female portion with enlargement and binding screws and a flat hollow extension, and the male portion with enlargement and binding screws also, and an integral spring tongue bent upon itself twice, and its free end curved and formed with a lug stamped therefrom.



No. 538,474.—Apparatus for Transmitting Speech.

538,454. TELEPHONE SWITCH; A. F. W. Meyer, Blue Island, Ill. App. filed Jan. 11, 1895. The combination of a base carrying the main line terminals, yielding contacts connecting said terminals to the main line or to the ground, respectively, through the secondary winding of the induction coil and the signaling instrument circuit, a non-conductive lever switch provided with a support for the receiver and extending at one end between the contacts so connecting the main line terminals, and its opposite end adjacent to the contact connecting the local battery terminal, whereby the turning of the said lever in either direction forces one contact against an adjacent main line terminal and releases the other from the terminal adjacent to it.

538,457. ELECTRIC ARC LAMP; J. A. Mosher, Chicago, Ill. App. filed Feb. 9, 1893. A lamp having the poles of an electromagnet; a rotatable armature mounted between the said poles, the armature consisting of a number of plates successively overlapping each other; devices for supporting the lower carbon pencil; a vertically movable carbon rod adapted to support the upper carbon pencil over the lower pencil, and devices connecting the rotatable armature with the carbon rod in such a way that the length of the arc may be regulated by the rotation of the armature.

538,458. RAIL CONNECTOR; L. E. Myers, Chicago, Ill. App. filed Dec. 19, 1894. The combination of a connecting wire, and split sleeves adapted to receive the wire and to be driven into the holes in the rails, the sleeves being provided at one end with projecting parts which may be turned outwardly against the rail to prevent withdrawal of the sleeves from the holes in the rails.

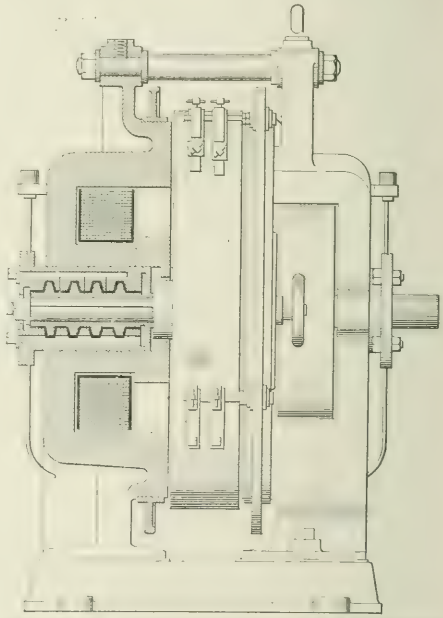
538,474. ART OF AND APPARATUS FOR TRANSMITTING SPEECH; J. Absterdam, New York, N. Y. App. filed Feb. 18, 1891. A line for electric telephone transmission formed in two or more "open circuit" sections extending adjacent to one another at their ends, but at all times disconnected from one another and from the ground during transmission, so as to be incapable of use for telegraphic service, or for sending calls from one section to another.

538,569. TROLLEY POLE RESTRAINER; F. Wheeler, Meriden, Conn. App. filed Feb. 8, 1895. A restrainer comprising a tube containing a movable head having detents and a spring connected with the head, the head als having means extending outside of the tube for enabling it to be moved by hand, and also means at each end of the car to hold it in place.

538,590. BLOCK SYSTEM AND APPARATUS ON ELECTRIC RAILWAYS; E. Lang, Cologne, Germany. App. filed July 16, 1894. The combination of a contact conductor divided into sections, an auxiliary contact conductor divided into sections, an auxiliary contact conductor divided correspondingly, a switch on each contact conductor section adapted to be moved by a passing vehicle, and an electromagnet on each auxiliary conductor section adapted to move the switch of the preceding section, so as to put this into circuit again when the said auxiliary conductor section receives current.

538,614. INSULATING MATERIAL; J. W. Kidwell, Washington, D. C. App. filed Sept. 8, 1894. An insulating material composed of different compounds adapted to prevent contact wherever it is applied.

538,617. COMMUTATOR BRUSH AND MEANS FOR ADJUSTING SAME; R. Lundell, Brooklyn, N. Y. App. filed July 20, 1893. In a generator or motor, the combination of an annular body having pins extending therefrom and upon which the holders for the commutator brushes are mounted, and another annular body having projections adapted to move in the path of the brushes and so cause them to be shifted.



No. 538,617.—Commutator Brush and Adjustment.

538,628. METHOD OF MAKING ELECTRODES FOR SECONDARY BATTERIES; W. L. Silvey, Dayton, O. App. filed Jan. 23, 1893. The method of preparing at one operation a positive and a negative secondary battery electrode, consisting in applying a paste composed of water and oxide of lead to form the negative plate, and a paste composed of sulphuric acid and water to form the positive plate, and then pickling the two sets of plates in an acid solution.

538,803. LIGHTNING ROD; H. Simpson, Burlington, Wis. App. filed March 2, 1895. A rod tubular at its lower end and closed at its upper end, an opening or cup arranged adjacent to the said rod to divert the water into the opening and so conduct it into the ground.

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A THEORY OF DEMAGNETIZATION

In another column we print an interesting article by Messrs. Houston and Kennelly, on the relations that should exist between the length, cross-section and magnetization of a permanent magnet in order that it shall retain permanently its magnetic strength. This is a question of considerable importance in connection with the use of permanent magnets in measuring instruments, and the general solution of the authors, therefore, has a practical value besides being an interesting addition to magnetic theory. It was found in general that if the value of an expression deduced, and containing the known data of a permanent magnet, is not below a certain value the magnetism is permanent, and numerical examples show that this deduction agrees with the empirical rule of Hookham. It is also shown that certain conditions with respect to seasoning are necessary, and that certain proportions may be chosen to give the magnet the most efficient form for a given purpose.

WHAT IS INVENTION?

In another column Mr. Gustav Bissing discusses a recent decision of the United States Supreme Court which, under one interpretation, greatly limits the patentability of inventions. The suit to which the opinion applies related to a mechanical process entailing a number of different operations, the patent being based upon the nature and sequence of these, but without claiming invention in any one. The decision of the court was that the process was not patentable, and it may possibly apply to all mechanical processes. As against this latter view, however, it is shown that the court quoted a case in the suit in question, in which a patent on a mechanical process was held to be patentable. In this case the machinery necessary for executing the process was old, and the prior use of elements in the process was acknowledged. In conclusion Mr. Bissing discusses the meaning of the much abused phrase "the function of a machine," which he considers may admit of a definite interpretation. "If a process which is carried out," he says, "by a machine involves no inventive idea in the "process as such, irrespective of the machine, then the process is "for the function of the machine; otherwise it is not. This is "all there is to it. The phrase adds nothing to our knowledge; it "describes a conclusion, not a cause; it gives us no criterion for "determining the patentability of process; it is merely a descriptive "title applied to such processes as have, from entirely independent "considerations, been found to be unpatentable. To attempt to "use it for determining patentability is to turn logic upside down." We are, therefore, brought back to the definition of the word "invention," and owing to the difficulty of the case we shall probably continue to lack a legal definition, each case depending for its decision upon the personal views of non-technical judges, based on what they consider to be its particular merits rather than upon any guiding and permanent principle.

THE NEW YORK SUBWAY COMMISSION.

One of the New York municipal departments that should have received early attention from the reform government is the New York Subway Commission, but for some occult reason it has been about the only one entirely neglected. Mayor Strong has now only a few weeks left in which he may exercise his power of summary removal, and we trust that before the expiration of this period he will see fit to inquire whether the present Subway Commission might not with advantage be submitted to a process of reorganization. Many will recall the scandalous deals in the first years of this Commission, when Maurice Flynn, through Jacob Hess and his father-in-law, Theodore Moss, obtained control of the subway rights and finally turned them over to the Metropolitan Telephone Company and the Western Union Telegraph Company, who together own all the subways for low tension wires and possess the exclusive right to construct further extensions in the streets of New York. It is claimed that the prices charged by this monopoly are extortionate and its regulations extremely onerous, and that the Subway Commission has always been subservient to private interests. That the ownership of the subways should be with these monopolies is in itself a scandal, and while it may now be too late to remedy this evil, the protection of what rights are left to the public in the matter should be placed with a body entirely above suspicion. This requirement is not fulfilled by the present Commission, which is the result of a Tammany-Platt deal, and therefore can be legitimately considered hostile to public interests. Were no other evidence present, the fact that Jacob Hess, one of the members in the days when gross corruption was openly charged, was retained, is in itself sufficient evidence that the deal was not made in the interest of the public. At the present time especially, owing to the expiration of the Bell Telephone patents, the status of the Metropolitan Telephone Company with respect to the subways should be cleared up and the various charges made as to extortion and arbitrary rules thoroughly investigated. In order, however, that this may be done, the majority of the present Commissioners will have to be replaced by men whose entire devotion to public interests is beyond question, and this duty is one that Mayor Strong cannot well neglect. It is well to add that one of the Commissioners, Col. Kearney, is free from the objections applying to the majority of the Commission, his appointment having been made in the line of promotion from the position of subway engineer. Neither he nor Dr. Wheeler, the electrical expert, has ever had part in the political and other manipulations that have brought the Commission into disrepute, their connection with it having always been a purely professional one.

MATHEMATICS AND PHYSICS.

In another column a correspondent challenges some editorial remarks made by us several weeks ago on the subject of the present method of teaching higher mathematics, but his letter shows that he has entirely misapprehended our position. We did not assert that only those parts of mathematics should be studied capable of direct application, nor did we intend to convey the impression that we are in sympathy with the prevailing sentiment in favor of a purely industrial training as opposed to one in which the teaching of principles and not of details is the main object kept in view. On the contrary, we have uniformly held that the teaching in technical schools should be directed to the broadening of the student's mind and to his thorough instruction in the principles of science, as the workshop and practical training he receives there is not only amateurish in character, but can be much better acquired after graduation in the vocation adopted, while the opportunities for intellectual development thus displaced are usually lost forever. We may here remark that in a recent address Hon. Eckley B. Coxe, who has had ample opportunities of observation among his numerous technical employees, said that the young man of liberal scientific education, while at a disadvantage with respect to one having a practical technical training during the first two years, after that period, however, usually begins to forge rapidly ahead of the latter, and soon entirely outdistances him. To return to our subject, what we criticised was not the study of higher mathematics, but the method by which it is taught. The question is akin to the old one of the relative value of instruction in dead and living languages, which we believe has been definitely decided in favor of the latter. What we contended for was that the higher conceptions of mathematics, such as rates and space analysis, should be taught in connection with physical phenomena, and not as mere abstractions. By so doing the ideas would take on a real significance, and both the mathematical and physical principles would be more clearly comprehended, one aiding the other. If, for instance, instead of a point A in mathematical space, we took a point in a medium subject to a stress whose laws implied the given conditions, the understanding of the mathematical interpretations would be assisted at every point by the physical conditions of the problem, their limitations and complications being clearly indicated by the nature of the phenomena under consideration. In this manner mathematical principles could be established and their deductions illustrated, while the imagination would have a scope much broader than when confined to mere abstractions. But few minds can readily deal with the abstract without lengthy training, and while this training has its value, the other method is more in accordance with the habits of scientific thought, dealing with phenomena and not with metaphysics. In order, however, for mathematics to be taught in this manner, the teacher must also be a physicist, and we therefore believe that not much progress will be made until the more advanced courses of the professor of mathematics are transferred to the chair of mathematical physicist.

Contact Resistance of Metals.

In the *Comptes Rendus* of the 22d ult., M. Edouard Branly describes some experiments recently carried out by him in regard to the electrical resistance between two sheets of metal in close contact with each other. M. Branly employed thin sheets, 48 mm square, piled one on the top of the other and compressed together by a weight of six kilogrammes. Electric connection was made with the column by means of sheets of brass at the top and bottom of the pile of plates. When a sheet of zinc was placed between two of copper, the contact resistance was very small and remained constant; but when a sheet of aluminium was placed between two sheets of bismuth, the resistance was quite appreciable and increased with time. Thus, in one experiment, the resistance was, to start with, 0.4 ohm, and 25 minutes after the contact had been made it was 0.74 ohm, and five hours after it was over three ohms. If the experiment was varied by putting the sheets of bismuth together and separating the aluminium from the bismuth by a sheet of brass, there was no appreciable resistance. M. Branly remarks that his experiments show that for certain metals, such as copper and zinc, the surface of contact is not the seat of any appreciable resistance; but for others, such as lead aluminium, lead iron, tin aluminium, tin iron, bismuth iron, bismuth aluminium, etc., there is an appreciable resistance. When the six-kilogramme weight was replaced by one of 26 kilogrammes, the resistances at the beginning and the resistances as measured later on were smaller, and the same was the case when the pile of sheets was compressed in a vise; but in all these cases a higher resistance was found than one would have expected according to current notions, and this resistance always increased with time. The contact resistance of two metals in air can, M. Branly states, be altered by mechanical shock or by electric spark.

Operating Canal and River Locks by Electricity.

Within the last few years it has been found necessary to build new locks alongside the existing locks (at Ymuiden) in Amsterdam, in the canal which connects the city with the North Sea. These locks are now nearly completed. It will be remembered that in June, 1893, plans were invited for hydraulic and electric transmission of power for operating the locks. It was found that none of these plans fulfilled the required conditions, and the senders were invited to submit revised plans. The result of the subsequent comparison was that two manufacturers were invited to conjointly make the preliminary trials at Ymuiden. These trials will consist principally in measuring exactly by electric machinery the power required to open the doors of the new locks. In a temporary shed, in close proximity to the locks, the necessary boilers, engines and dynamos will be placed to generate the electric current. This current will be carried through overhead cables, and will be used to turn two capstans, having a force of 5,000 kg by 20 cm and 10,000 kg by 10 cm velocity per second.

To this proposed installation also belong large storage batteries, powerful enough to act as auxiliaries in operating the locks for a certain length of time, should emergency require it.

The Quantity upon which a Knowledge of the Nature of Electricity and Magnetism Depends.

BY REGINALD A. FESSENDEN.

All that we know of the properties of the ether can be summed up in the first three of the following equations:

A. $q \; b = k^{\frac{1}{2}} \; \mu^{\frac{1}{2}}$

B. $k^{\frac{1}{2}} \mu^{\frac{1}{2}} = T \; L.$

C. $qbk^{\frac{1}{2}} \mu^{\frac{1}{2}} \; ML$

D. $k^{\frac{1}{2}} \; \mu^{\frac{1}{2}} \; Z$

where q, b, k, μ, are the dimensions of quantity of electricity, quantity of magnetism, specific inductive capacity and permeability, respectively.

The second equation is Maxwell's well-known formula (Maxwell, vol. 2, page 434, Elect. and Mag.) and concerns wave motion in the ether.

The first equation is derived from Weber's law for the equivalent magnetic shell and circuit carrying current. For, from this we have

$$\mu \times q \quad T \times L^2 = bL.$$

The third equation is obtained from Faraday's law, that the voltance in a circuit is measured by the time rate of change of magnetic induction in that circuit, joined with the fact that quantity of electricity × voltance = work. Thus,

$$dN \; dt \times Q = ML^2 T^2$$

We have thus only three equations* to determine four unknown quantities necessary to a knowledge of the true nature of electricity and magnetism.

We are therefore obliged to form another equation, having for one of its terms an unknown quantity, Z. Let the quotient of specific inductive capacity by permeability equal this unknown quantity, as in equation D.

Solving these equations, we get

E. $q = M^{\frac{1}{2}} L T^{\frac{1}{2}} Z^{\frac{1}{2}}$

F. $b \quad M^{\frac{1}{2}} L T^{\frac{1}{2}} Z^{\frac{1}{2}}$

G. $k = TL^{-1} Z$

H. $\mu = TL^{1} Z^{1}$

Now, by giving different values to Z we can obtain all the modern electrical theories, *i. e.*, those which are consistent with themselves; for, as we shall see, at least one theory is impossible because self-contradictory.

1. Let $Z = L^3 TM^{-1}$, then μ is a density, k is the reciprocal of an elasticity, and electric current $= L^2 / T$ and magnetic induction $= M / T$.

2. Let $Z =$ the reciprocal of this, and we get k as a density, μ as the reciprocal of an elasticity, the electrical and magnetic quantities in the first theory being interchanged as to dimensions.

3. Let $Z = T \; M$. Then,

Quantity of electricity $= L$,
Current of electricity $=$ velocity,
Voltage $=$ force,
Magnetic induction $=$ momentum,
Magnetizing force $=$ velocity.

This is one of the most commonly received of electrical theories, and may or may not be true. But to it is generally joined the theory that μ is a density or the reciprocal of an elasticity. We see, however, that this is impossible, for if magnetism be momentum, μ cannot be either density or reciprocal of elasticity, but must be M / L.

4. This theory is obtained by giving Z the value $M \; T$ when the dimension given in theory three are simply interchanged.

5. Let $Z \quad M^{1} \; L T^{1}$ Then,

Quantity of electricity $=$ moment of inertia,
Current $=$ angular momentum,
Magnetic induction $=$ angular velocity,
Electrical potential $=$ angular acceleration,
Magnetizing force $=$ angular momentum.

This may be modelled by attaching a mass by a rigid arm, loosely to a revolving shaft. It is then evident that the angular acceleration of the shaft (difference of potential across the ends of a wire) will determine the angular velocity of the mass round the shaft (quantity of magnetic induction produced by the current). This represents one well-known theory.

6. The reciprocal theory to five, an equally well-known theory, is got by giving the reciprocal value to Z.

It is thus evident that we can obtain an infinite number of theories by giving different values to Z. This quantity, Z, then, is the one which we must know before we can know what electricity really is. These equations also suggest a number of experiments as possibly throwing light on the subject. For instance, does an anchor ring wrapped with wire weigh more when a current is passing through the wire than when not? Does light travel faster along the centre of a magnetizing helix than in free air?

Another point becomes very obvious. That is, that the accepted dimensions of electrical potential and force are incorrect, even when we have taken into account μ and k. For the potential of a point is defined as the work which must be done in moving unit quantity from that point to infinity. Therefore the dimensions of quantity are included in those of potential at a point. But in every table of dimensional formula, this factor has been left out, it having been, apparently, supposed that, since we multiply the numerical value of the potential at a point by the numerical value of the quantity, to get total potential, that we must multiply the dimensions of potential at a point by the dimensions of quantity to get the dimensions of work. *But potential at a point has already been defined with respect to unit quantity, and already includes the dimensions of quantity*, so that the usual method is incorrect. Our estimation of the results of multiplying 10 volts by three coulombs should therefore read,

$$10 \; M \; L^2 \; T^2 \times 3 = 30 \; M \; L^2 \; T^2.$$

If we correct the usual formula in accordance with this consideration, then we have the following table, which is correct on any theory of electricity, no matter what the true nature of electricity and magnetism may be:

	Usual Formulæ.			Proposed Formulæ for all Systems
	Electrostat.	C. G S	Electromag	
Quantitity of elect.	$L^{\frac{1}{2}} M^{\frac{1}{2}} T^{-1}$		$L^{\frac{1}{2}} \quad \frac{1}{2}$	Un known.
Strength of pole.........		$L^{\frac{1}{2}} M^{\frac{1}{2}} T^{1}$		
Elec. force at point	$L^{\frac{1}{2}} M^{\frac{1}{2}} T^{1}$	$L^{\frac{1}{2}} M^{1} T^{1}$	$L^{\frac{1}{2}} M^{1} T^{2}$	$L M T^{2}$
Mag. force at point......				
Electric potential........	$L^{\frac{1}{2}} M^{\frac{1}{2}} T^{1}$		$L^{\frac{1}{2}} M^{\frac{3}{2}} T^{2}$	
Magnetic potential		$L^{\frac{1}{2}} M^{\frac{1}{2}} T^{-1}$		$L^2 M T$
Elect. resistance.........	$L^{1} T$		$L T^{1}$	$L^2 M T^{1}$
Elect capacity.	L		$L^{1} T^{2}$	$L^{2} M^{1} T^{2}$

There are some very interesting analogies between the action of matter and that of electricity and magnetism. It has been pointed out by the writer (*Science*, Dec. 22, 1893), and no doubt by others, that matter possesses two entirely distinct properties, *i. e.*, attraction and inertia.* Thus, writing m for the dimensions of matter, considered from the standpoint of its attractive properties, and i for its dimensions connected from its property of having inertia, and a and l for the dimensions of two properties of the medium, we have,

---

*It might be supposed that the electromagnetic rotation of light would give us a fourth equation, but it appears to the writer that Lord Kelvin's proof that there must be some actual rotation in a body which is rotating the plane of polarized light under the influence of magnetism, is not conclusive. For we are able to produce, by suitable arrangement of plates, a model of optically rotating quartz, and so it would seem that if the electric charges on the atoms are not symmetrically disposed about the centres of the atoms, the purely mechanical stresses due to magnetism, might produce optical rotation, in which case it should be possible to produce the same effects by pressure obtained in any way. Or, since the atoms carrying charges are vibrating in every direction, we have really an infinite number of electric currents, and it is obvious that when such a system is placed in a magnetic field, the velocity will be greatest in a direction parallel to the current in the nearest part of the magnetizing coil, as if the motion be otherwise, work will be done in forcing the atom to move in that direction. In either case we only get an equation between electrical and magnetic quantities which is implicitly contained in the first three equations.

* As evidence that these have *not* hitherto been generally considered as distinct properties of matter, compare the statement made in most works on physics (for instance, Daniell, page 12), that masses are compared by weighing them against one another in a balance. Also see Tait and Steele's "Dynamics of a Particle," page 51, where it is stated that "the force with which the earth attracts a body is proportional to its mass. Gravity is not, like magnetism, for instance, a force depending on the quality as well as the quantity of matter" in a particle. See also the definition of mass, ibid, page 42. Had it not been for the discovery of the bodies, iron, nickel, cobalt and platinum, we should have supposed that quantity of magnetism was always proportional to quantity of magnetism. Text books on physics would then have contained the following definition, as a parallel to that given for mass in "Dynamics of Particle": "The quantity of electricity on a body, or the magnetism, is proportional to the force with which the body is attracted to a unit quantity of electricity, when placed at unit distance."

I. [illegible] $m \;\; a \;\; k, \;\; M l^{1}$ [illegible]

This leads us to a very simple proof of Maxwell's celebrated formula. For, from I. we get,

J. $Ml^{-1} = m\,a\;l^{2}$ and

K. [illegible] $T\;a = m\;T$ [illegible]

Also we know from experiment that the energy of a condenser is $1/2\,V^2C$, which equals [illegible]. And therefore the dimensions are $b^2 T^{-2} kL$, which must equal the dimensions of work, $m^2 a^{-1} L^{-1}$, or,

L. $b^2 T^{-2} kL = m^2 a^{-1} L^{-1}$.

Therefore $aT^{-2} \div KLT^{-2} = \mu T^{-2} \div a^{-1} L^{-1}$.

Whence we have Maxwell's equation,

B. $k^{\frac{1}{2}}\mu^{\frac{1}{2}} = T/L$.

We may now follow the analogy out much further, and show that the ratio $a \phi l$ must also be a velocity.

Experiments with Electric Waves.

BY ALFRED G. DELL.

In an arrangement of sheet zinc similar to the one described in THE ELECTRICAL WORLD of May 4, 1895, the four plates were made 8 x 10 inches in size, and the brass wires running to the spark gap so arranged that the plates could be shifted any distance apart from six inches to two feet. To the plates were attached two parallel copper wires, the other ends of which were fastened to the electrodes of a Geissler vacuum tube seven inches long. With a bridge wire across the two parallel wires, the nodes at which the tube lights up were found and all the different phenomena noted for a distance of two feet apart. The plates were then gradually moved nearer to the spark gap, and it was found that the nodes did not change their distance, nor were there any changes in any of the phenomena. Everything was entirely independent of the distances of the plates from the spark gap, the position of the nodes seeming to depend entirely upon the length of the two parallel wires.

When a Ruhmkorff induction coil is discharged through a Geissler tube, one of its bulbs is partially filled with light and the other one with a glow. I shall designate the former as the positive and the latter as the negative in the description of the following experiments.

Two sheets of zinc, 2 x 3 feet each, were placed with their planes inclined to each other; an edge of each one was attached to an electrode of a Ruhmkorff induction coil, and a wire fastened to the opposite edges so that the sparks could be caused to pass. Between the plates was placed a Geissler vacuum tube, each end of the tube being about six inches from the adjacent plate, the arrangement being similar to the figure /—\; the tube was not in any way connected with the coil. On turning on the current, the tube lighted up, and on moving the wire at the other ends of the plates, it was found that the tube remained lighted and increased in brightness when long sparks passed, but as soon as the sparks became shorter and lost in part their loud snapping noise, the tube became entirely dark. The tube was then placed nearer the plates, when it was found to hold its light a little longer; on shortening the spark gap, however, it again became dark. An earth connection was then attached to the electrode of the tube situated on the positive side, when the corresponding bulb became nearly empty and the other one filled with light. On reversing the current, both bulbs became filled with light.

One of the 2 x 3-ft. plates and the tube were then removed and the positive electrode of the coil attached to the remaining plate so as to connect or spark to earth from the negative electrode; with a new incandescent lamp bulb placed with its apex turned toward the plate, the different effects produced on the light in the bulb by using the ground connection were investigated.

It was found that when the bulb was about six inches from the plate it lighted up and that upon making earth connection at the negative end of the coil it increased in brightness as soon as the sparks commenced passing; when connection to earth was completed, it became very bright, but when the bulb was moved further away from the plate, the light went out when there was no earth connection, but lighted up when the earth connection was re-made. On reversing the current, the bulb would light up when it was very close to the plate, but dimly, even when the positive electrode was connected to earth.

For the incandescent bulb there was substituted a resonating circle with its plane perpendicular to the 2 x 3 feet plate, and upon adjusting the spark gap of the circle (the positive end of the coil being attached to the plate and the negative to earth and with no sparks in the secondary of the coil) flashes of light were obtained in the spark gap. On placing a finger on the wire of the circle a constant light was obtained at the spark gap, and also at the point where the finger touched the wire. I immediately recognized the same condition that was encountered in working with a pair of parabolic reflectors described in THE ELECTRICAL WORLD of Feb. 23, in which case, however, the spark gap of the receiver was outside of the field of force, while in this case it was within the field.

A circle was next used, two feet in diameter and made of two wires, each about three feet long, the break being made in the other end of the diameter containing the spark gap; to one of the wires a piece of sheet zinc about 1½ by 7 inches was connected. With this arrangement brilliant and steady sparking was obtained when near the zinc plates without any earth connection with the coil. When placed at such a distance from the zinc plate that sparking ceased as soon as the earth connection was made at the other electrodes of the coil and when sparks commenced to pass to earth, it lighted up, becoming very bright upon making the earth connection. It appeared to spark in nearly all positions of the circle, but not when placed perpendicularly to the zinc plate, with the sparking gap facing the plate; it also seemed to spark equally well with either end of the coil connected to the earth.

The experiment is novel and a beautiful one. Sometimes the spark seemed to scintillate and throw out rays of light, and it was interesting to see it flash up when the ground connection was made.

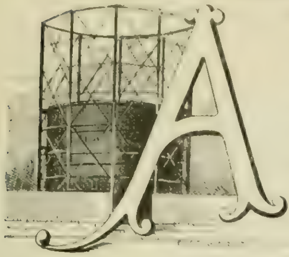
When the positive side of a Ruhmkorff induction coil is connected to a pointed wire and the negative to a small plate, the sparking distance is greater than when the negative is connected to the wire and the positive to the plate, the sparks passing between the pointed wire and the flat surface of the plate. When the positive is connected to the 2 x 3 feet zinc plate and the negative sparks to the earth, the sparking distance is greater than when the negative is connected to the plates and the positive sparks to the earth.

The Governing of Steam Engines.

A correspondent in the London *Electrician* criticises the method proposed by Mr. G. Addenbrooke (see THE ELECTRICAL WORLD, May 11), for the regulation of the voltage of a compound dynamo by the governor of the engine instead of by a resistance in the shunt. This arrangement, he states, may be very good for a single unit of plant, as a voltmeter connected across the dynamo terminals would enable the engine attendant to adjust the governor as required. But with two or more units running in parallel, how, he asks, is the engine attendant to know how the load is divided, and which engine governor requires adjusting? "Surely the switchboard attendant is the proper person to regulate the voltage. A glance at the ammeters in circuit with the dynamos would show how the load is divided, and with the shunt resistances close at hand both current and voltage can be varied to suit requirements."

In reply Mr. Addenbrooke says he did not advocate the running of compound dynamos in parallel, but merely spoke of a compound dynamo in one instance, as it happened to be coupled to the engine on which the governing experiments were tried. As to how the engine driver is to know how the load is divided, Mr. Addenbrooke asks, "How is an engine driver to drive engines to the best advantage if he does not know what work they are doing?" In the case proposed, the dynamo ammeters and voltmeters would be situated near the engine driving each, and under observation of the driver, who would then know exactly what he was doing. He would also know the extra voltage required as the load increased, and therefore could keep his engines properly loaded, and adjust them as required to the best advantage. The duty of the switchboard attendant is to look after the circuits in a central station, and he should not have his attention divided by having to superintend running engines also, a duty for which he is often unfitted. He will have a main voltmeter and ammeter on the omnibus bars, so that he can judge the state of matters, and he can, of course, signal to the driver. With this arrangement Mr. Addenbrooke thinks the use of resistances can be almost dispensed with.

Gas Engines in a Central Station.



A NUMBER of attempts have been made in Great Britain to utilize gas engines with commercial success in central stations, notably at Bridlington, Coatbridge, Morecambe, and recently at Belfast. The failure of the system at Coatbridge served to somewhat check the movement in favor of gas engines, although the unsatisfactory results in this case cannot reasonably be attributed to the engines, for it is pretty well understood that the difficulties arose from the attempt to run alternators in multiple. At the Morecambe station the use of water gas in the engines, it is reported, has caused some annoyance.

The station at Belfast, Ireland, however, gives promise of better results. This plant, which was installed by the municipality according to plans prepared by Prof. Kennedy, is located almost exactly in the centre of the city, and has already about 8,000 incandescent lamps connected.

Viewed from the exterior, the station building presents an unusual appearance as compared with a steam plant on account of the absence of any boiler room, stacks or chimney. It is long and narrow and looks like almost anything else than an electric light station.

The electrical equipment consists of four bipolar dynamos of 57½ kilowatts capacity each, two smaller dynamos of 26½ kilowatts capacity each, and 126 cells of accumulators, of the 34-K, E. P. S. type. The dynamos are rope-driven, the larger ones by tandem cylinder, double-acting engines and the smaller by single-cylinder, double-acting engines. Fig. 1 gives a partial view of the interior of the station and shows the position of each dynamo with relation to its engine. The engines run "under" so as to put the slack of the ropes on top. Unusually good regulation is obtained, owing to the fact that there are two impulses for each revolution, the active period of one cylinder alternating with that of the other, which feature places these engines on equal footing, in this particular, with the steam engine.

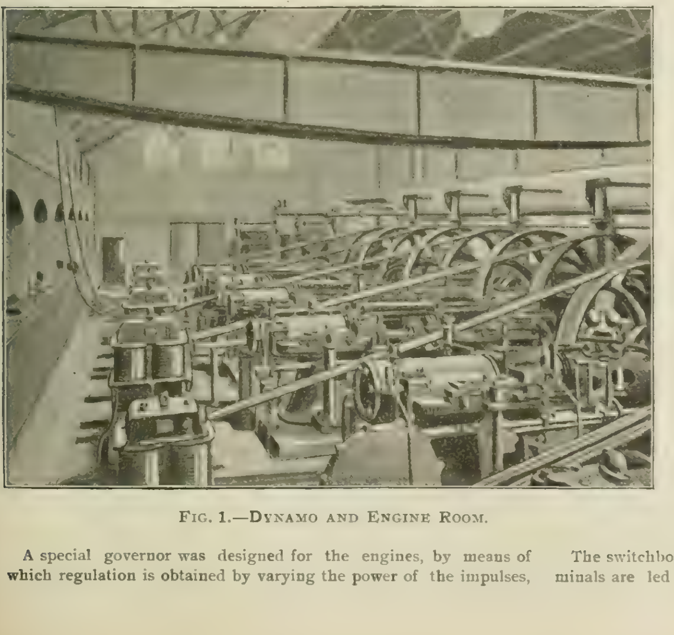


Fig. 1.—Dynamo and Engine Room.

A special governor was designed for the engines, by means of which regulation is obtained by varying the power of the impulses, down to a low limit, when further diminution of power is caused by cutting out the charges, one at a time, until the engine runs idle.

The consumption of gas is said to be very low, the statement being made by the builders that at an official trial of a tandem engine, extending over six hours, at full load, the gas used was somewhat less than 24 cubic feet per electrical horse-power, or about 21 cubic feet per brake horse-power at the engine pulley. During this trial the main fuse blew, but so well did the governor handle the engine that there was no sign of racing, a very slight increase of speed being the only result.

Gas is delivered practically from the street mains directly to the cylinders, passing through meters on the way. The main gas pipe is connected to the engines exactly as a steam supply pipe would be, a branch pipe leading off to each engine. The gas for the ignition tubes, however, is taken through a separate pipe and is measured by a special meter. Water for the cylinder jackets is obtained from a tank, and circulation is maintained by a small centrifugal pump under each engine. The speed of the engines is 160 revolutions per minute.

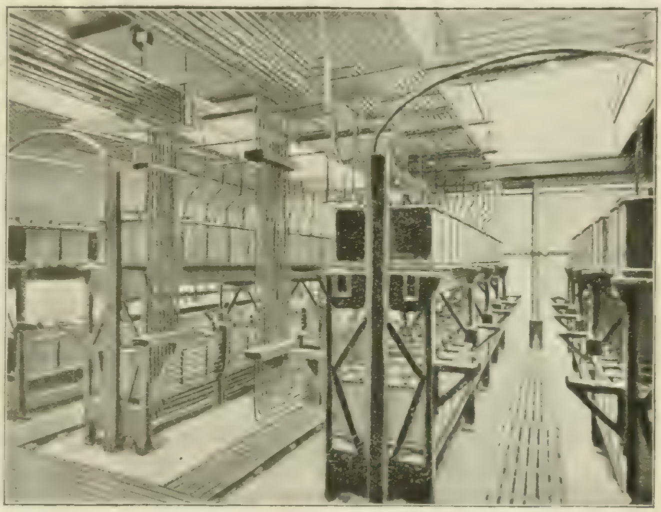


Fig. 2.—Accumulator Room.

There is nothing special or novel in the construction or operation of the four large dynamos. They are plain 230-volt machines and are driven each by eight ropes, seven-eighths inch in diameter, at 600 revolutions per minute.

The two smaller machines are special both as to construction and functions. Each armature has two distinct windings and commutators, and the brush cables are led to a switch by means of which the windings are connected in series for an output of 250 volts and 100 amperes, or in parallel for 125 volts and 200 amperes. The field winding is in shunt to one pair of brushes. These machines are used for charging the accumulators and balancing the two sides of the three-wire system.

The gas engines are started up in a rather novel way, each dynamo acting as a motor to start its own engine, the necessary current being furnished by the accumulators. When the proper speed is attained an automatic switch disconnects the dynamo (running as a motor) from the accumulators.

The batteries are divided into two sets of 63 cells each and regulation is effected by an automatic device which places cells in parallel to reduce the E. M. F., as opposed to the old method of cutting them out entirely. Fig. 2 gives a view of the accumulator room. The accumulators are used to handle the day load and in starting the engines, as above described.

The switchboard is divided into panels and all the negative terminals are led to one side of the board and all the positive terminals to the other. The automatic devices above referred to are mounted on the switchboard, along with the usual quota of voltmeters and ampere meters.

In the distributing system a good deal of care and skill has been necessary to overcome the obstacles imposed by the peculiar conditions of the soil. For the most part bare copper conductors have been adopted, though unde the roadways Callender's cable is used as well as in some of the narrow streets. A concrete trench is employed, inwh ich the bare copper mains are laid. Owing to the extremely wet nature of the soil, a most careful system of inspection has been organized; the box covers are provided with inspection plugs which, when taken out, allow the men, who are sent round every morning, to pass in a pole and thereby ascertain the height of the water.

The above data and illustrations were taken from the columns of the London *Electrical Review.*

Contribution to the Theory of Demagnetization.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

It has long been known that in order to retain the magnetism in a permanent magnet of hard steel, certain relations must be maintained between length and cross section of the bar as compared with the dimensions of the air gap between its poles. In other words, it has been known that a certain proportion of the reluctance of the magnetic circuit must exist in the air gap for a given value of the retentivity or hysteretic coefficient in the steel employed, in order that the magnetic flux in the circuit should be permanently retained.

Mr. Hookham states in the *Philosophical Magazine* for 1889, vol. 27, pp. 187-189, that, from his observations, the ratio of length to cross section in a magnet should not be less than 70 times the ratio of length to cross section in its air gap, in order to retain its magnetism indefinitely.

So far as the authors are aware, the theory of demagnetization in permanent magnets has not been developed except in a few geometrical forms of magnets, such as ellipsoids, which rarely present themselves in practice. It is here proposed to present this theory of the demagnetization of steel horseshoe magnets in a general form, and to show the relation existing between this theory and Mr. Hookham's empirical rule.

In Fig. 1, A, B, C, represent a horseshoe magnet of hard steel, l cms in length, and of uniform cross-sectional area s, sq. cms. Fig. 2 represents a portion of the descending curve in the hysteretic cycle of this steel. When the ring is magnetized, by the application of a M. M. F. to an intensity of, say, 6,000 gausses, and the M. M. F. is withdrawn, a certain residual intensity of $\mathcal{B}$ gausses will exist in the bar, and the total residual flux will be $\Phi = \mathcal{B}\, s$ webers. Of this residual flux, a certain fraction Φ / n, or, say ϕ will pass through the air gap, whose width is d cms, and active cross section S sq. cms., producing in the air gap an intensity of ϕ / S gausses. The remainder of the flux or $\Phi - \phi$, webers, will pass through leakage or air paths outside the air gap.

Just as in the electric circuit, a current of i amperes, passing through a resistance of r ohms, produces a difference of potential of $e = ir$ volts, so a flux of ϕ webers passing through a reluctance $\mathcal{R} = d / S$ oersteds, in the air gap, will produce a difference of magnetic potential of $\mathcal{M} = \phi\, \mathcal{R} = \frac{\phi\, d}{S}$ gilberts. The mean difference of potential per centimetre length of the ring A, B, C, will be $\mathcal{H} = \frac{\mathcal{M}}{l} = \frac{\phi\, d}{S\, l}$ gausses, and this will be the mean demagnetizing force exerted through the bar. The effect of this demagnetizing force will be to reduce the flux through the bar until the residual intensity $\mathcal{B} = \frac{n\, \varphi}{s}$, is the intensity which corresponds in the descending branch of the hysteretic cycle to the demagnetizing force $\mathcal{H} = \frac{\varphi d}{S l}$. As soon as the residual flux descends to this intensity, equilibrium will be reached. The equilibrium, however, is unstable, for any mechanical agitation or variation of temperature to which the bar may be subjected in the presence of this demagnetizing force will cause a further demagnetization to take place. In order, therefore, that a magnet should not be liable to variations in its intensity, owing to slight accidental jars or variations of temperature, it is necessary that the demagnetizing force $\mathcal{H} = \frac{l}{S}$, should be considerably less than the value of $\mathcal{H}$, which corresponds to the residual intensity $\mathcal{B} = \frac{n\, \varphi}{s}$ in the descending curve of the cyclic diagram for the quality of steel employed. The ratio of the cyclic value to the actual value of $\mathcal{H}$, may be called the *factor of safety of demagnetization.* According to the experiments of the authors a reliable factor of safety is 3, and this factor of safety can usually be provided by proportioning the length and cross section of the magnet and of the air gap with reference to the hysteretic curve of the steel employed.

Suppose, for example, that an air gap has to be provided 0.5 cms in width, and 10 sq. cms in active cross sectional area. Let the desired residual intensity in the steel be 1,500 gausses, and in the air gap 600, also let the assumed value of the leakage factor $n = 1.3$, and D, E, F, Fig. 2, be the descending curve of magnetization for the steel employed. Then the flux $= 1{,}500\, s = 600 \times 10 \times 1.3$, or, $s = 5.2$, so that the cross section of the magnet must be 5.2 sq. cms.

The cyclic value of $\mathcal{H}$, which corresponds to $\mathcal{B} = 1{,}500$ is 26, so that with a factor of safety of 3, the value required is 8.7. The M. M. F. in the air-gap will be $600 \times 0.5 = 300$ gausses, and the mean $\mathcal{H} = \frac{300}{l} = 8.7$, so that $l = 34.4$. The length of the ring must, therefore, be 34.4 cms. When an intensity is set up in the bar of, say, 6,000 gausses under the magnetizing M. M. F., a powerful counter M. M. F. would tend to be set up on its withdrawal. If, for example, 6,000 gausses remained in the bar, the intensity in the gap would be 2,400, and the demagnetizing force 34.8. Reference, however, to Fig. 2, shows that such a demagnetizing force, if sustained, would reduce the residual intensity to about = 750, at which the cyclic demagnetizing force would only average 4.35 gausses. It is evident, there ore, that the intensity would fall along the line D, E F, until equilibrium is reached between the intensity and demagnetizing force. This would be met under the assumed conditions as $\mathcal{B} = 2{,}250$, approximately. That is to say, if the magnet were allowed to assume its natural condition, the intensity in the steel would fall to about 2,250 gausses, and the demagnetizing force rise to about 13 gausses, and this condition would be unstable, being probably followed by a slow and gradual decline in intensity under mechanical or thermal agitation. The process of seasoning a magnet consists, therefore, in designedly lowering its intensity below the natural intensity of equilibrium, so that the residual demagnetizing force may then be too small to precipitate further demagnetization even when aided by considerable mechanical or thermal disturbance. Thus, if the magnet be boiled in water or oil, or its air gap be momentarily widened, or if it be violently agitated, the intensity may be reduced to 1,500 gausses, with a corresponding demagnetizing force of 8 7, which is three times less than the cyclic force required to reduce the intensity still further.

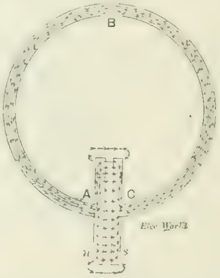


FIG. 1.

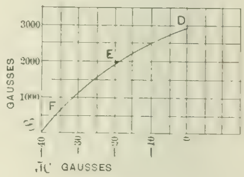


FIG. 2.

If the magnet is not properly designed, it will, after seasoning, be either unnecessarily heavy for the work it has to perform, or unduly weak in residual intensity.

$$\text{Since } \mathcal{B} = \frac{n\, \varphi}{s} \text{ and } \mathcal{H} = \frac{\phi\, d}{S\, l}$$

$$\frac{1}{n} \cdot \frac{}{\mathcal{H}} = \frac{l}{s} \Big/ \frac{d}{S}$$

So that if $\mathcal{B}$, the residual intensity, be given an assigned value, $\mathcal{H}$, defined as being, say, one-third of the cyclic value corresponding thereto, bears a fixed ration to $\mathcal{B}$, and $\frac{1}{n} \cdot \frac{\mathcal{B}}{\mathcal{H}}$ is for magnets of the same form and material a definite numerical quantity, which is the ratio of l / s in the steel to d / S in the air gap.

According to Mr. Hookham's formula, this ratio should not be less than 70. If we make the assumption that the intensity in the steel he employed was 2,000, that it was powerfully magnetized at the outset, and that n was 1.3 in his magnetic circuit, then $\frac{1,000}{1.3\,\mathcal{H}} = 70$, or $\mathcal{H} = 11$ approximately, while the cyclic value of $\mathcal{H}$ corresponding to $\mathcal{B} = 1,000$ is 33 gausses, giving a safety factor of three.

In the well-known Weston permanent magnet ammeters and voltmeters, the accuracy of the instrument depends upon the permanence of the conditions existing in the magnetic circuit. The length of a particular Weston horseshoe magnet is 27 cms, its cross sectional area 2.7 sq cms. There are two air gaps in series, each approximately 0.275 cm long, and 11 sq cms. in active cross section, offering, therefore, a total reluctance of approximately 0.05 oersted. The intensity in the steel is approximately 1,250 gausses, and the total useful flux through the air gap 2,500 webers, making the total C. M. M. F. $2,500 \times 0.05 = 125$ gilberts, and the mean demagnetizing force $\frac{125}{27}$, or nearly 5 gausses. For steel with a cyclic curve represented in Fig. 2, this would represent a factor of safety of 6, and the well-known satisfactory permanence in the magnetism in these instruments is, no doubt, owing to a large magnetic safety factor.

A Recent Supreme Court Patent Decision.

BY GUSTAV BISSING.

The Supreme Court of the United States, speaking through Mr. Justice Brown, has recently handed down a decision (Ridson Locomotive Works vs. Medart) in the case of a mechanical process which has resulted in a wide difference of opinion as to its proper construction and interpretation. The process before the Court related to the manufacture of pulleys and consisted in, first centering the pulley centre or spider; second, grinding the ends of the arms concentrically with the axis of the pulley; third, boring the centre; fourth, securing the rim to the spider; fifth, grinding the face of the rim concentric with the axis of the pulley; sixth, grinding or squaring the edges of the rim. It was held that the process was not patentable. If this opinion is to be taken as holding that the process in question involves merely the skillful use of perfected machinery in a workmanlike manner, it expresses no more than the application of well understood principles to the case in hand, and need give us no concern. If, on the other hand, the opinion holds that no purely mechanical process which is executed by machinery is patentable, it is evidently of wide reaching importance and materially restricts the field for invention. It is not believed that the decision can be made to bear the latter interpretation.

The opinion begins with a statement of the process in controversy and of a few general considerations which will hereafter be referred to. It then subjects to analysis some of the leading Supreme Court cases in which patents for processes have been sustained and finds a mark which is supposed to be common to all, namely, that such processes were either chemical or else consisted in the use of one of the agencies of nature for a practical purpose. It proceeds to discuss two Supreme Court cases in which patents for processes have not been sustained and finds in effect that these processes covered "nothing more than the operation of a piece of mechanism or, in other words, the function of a machine" So far there is certainly nothing harmful to patent interests, and much less anything of a revolutionary character. But it is insisted by some that the decision covers more than this; that it holds in effect that it is *necessary* for a patentable process to be either chemical or else to consist in the use of the agencies of nature for a practical purpose, and that any purely mechanical process which can be executed by mechanism, or which must necessarily be executed by mechanism, is necessarily for the function of the machine and hence unpatentable.

But it is not thought that the decision can be thus construed. First of all, it is one thing to find a certain mark common to all processes which have been found patentable in the past and quite another thing to predict that this mark must necessarily attach to any patentable process which may be discovered in future. Such conclusion would directly contradict fundamental and well settled principles of inductive logic. It is not sufficient to find a certain mark common to a certain class of phenomena in order to predicate such mark for all future phenomena of the same class. It is necessary in addition that this common mark should appear as sound and reasonable in itself from entirely à priori consideration.

Thus, if we found five men in a street car, all of them suffering with strabismus, this would not give us the slightest warrant to infer that the next man who entered the car would be affected in the same way. Or, to use an illustration of a professor of inductive logic, whose lectures the writer had the pleasure to attend, if we should select the first five poets from a biographical dictionary and find that their ages were all divisible by three, this is no possible reason for asserting that the age of all poets is a multiple of that number. The fact is that each object or phenomena in a group of objects or phenomena has an infinite number of marks or characteristics, and it is a mere question of probabilities to find how many of such marks are common to all the objects of the particular group which we have selected. It furnishes no reason for supposing that another object or phenomena added to the group will have any one of such marks. When, therefore, the Justice found, if so he found, that all processes which had previously been declared patentable by the Supreme Court were either chemical or consisted in the use of one of the agencies of nature for a practical purpose, he could not have intended more than to call attention to an interesting and possibly instructive fact; he could not be supposed to declare that as a matter of law all patentable processes must of necessity be of the same nature, that they must have this same mark, unless he believed that such mark was, in the nature of things, and, from à priori and fundamental considerations, sound and proper.

But it does not appear that this mark or characteristic to which we have referred is sound and proper or that the learned Justice thought it so. It does not appear, in a word, that he considered it as a criterion. First of all, let us examine processes from their philosophical and scientific aspect. They consist of an act or a series of acts, that is, they consist in the manifestations of energy upon matter. The proposed criterion, if it is to be a criterion at all, and if it is to be construed as necessarily excluding purely mechanical processes which are the operations of pieces of mechanism, would attempt to distinguish between the manifestation of physical energy in certain forms and of physical energy in other forms. It would pretend to include the manifestations of energy when in the form of electricity, as found in the telephone and telegraph cases; when in the form of heat, as found in the tempered car wheel case; when in the form of a blast of air, as in the flour-bolting case, all of which were quoted with approval by the Justice; and it must also include the case of energy in the form of centrifugal force as appears from the centrifugal casting case which was sustained by the Supreme Court as being for a valid process and has not been overruled. Such criterion, on the other hand, would pretend to uniformly and necessarily exclude the manifestation of energy when in the form of vis viva or impact, as in a drop hammer, and when in a form developed by any other purely mechanical tool.

That such distinction cannot be maintained on philosophical grounds seems reasonably clear. Your Hume, Kant, Hegel and Locke have written much upon the nature of the different forms of energy and force, but it is not pretended that they have found any fundamental or philosophical distinction between them. The fact is that elementally we know as little about the ultimate nature of impact as we do about the ultimate nature of electricity. Nor can the scientist or technical man draw any hard and fast line between the different forms in which energy manifests itself. The expert physicist knows as much about heat and its laws as the expert engineer knows about impact and the strength of materials. There is a gradual merging of one type into the other, and the more we learn, the more we are led to suspect a common origin for all forms of energy and a common rule by which all can be subjected to calculation. It is hardly more than a question of the order in which we shall take them up for study. Some are treated early in books on physics, some come later on; but they are all recognized as branches of one and the same subject. The philosopher knows as little, the physicist knows as much, about one as about the other.

It seems clear, therefore, that if Mr. Justice Brown intended the statement that the patentable processes discussed in the opinion were either chemical or consisted in the use of the agencies of nature for a practical purpose as a definition of the necessary characteristics which all patentable processes must have, and as a criterion by which the jurist might distinguish between such processes as are patentable and such as are not, he did not base his action on any philosophical or scientific considerations. The fact is that he did not consider it even necessary to emphasize sharply the distinction between chemical phenomena, in which the constitution of the molecule is changed, and physical phenomena in which each molecule itself remains unaltered, although its relation to other molecules may be changed, for he gives, without remark, as a "chemical" effect the case of the tempered car wheel in which the cooling is retarded by a second application of heat. If, then, for the purposes of the decision, a sharp distinction between chemical and physical phenomena was not considered as necessarily important, it would certainly be somewhat venturesome to accuse the learned Justice of attempting to establish a sharp line between several classes of phenomena, all of which are purely physical. It is certainly unreasonable to suppose that we are to have the sword of the Arabian Nights hewn between the members of the body constituting physical science, and that chemistry and physics are to be left undivorced. If, then, any basis for the criterion which it is supposed has been set up is to be found, it cannot be in science; it must be in law.

Now, the Constitution of the United States merely provides that Congress may protect "inventors," and the Statute made in pursuance of this provision gives to any person who has "invented" or "discovered" a new and useful art or any new and useful improvement thereof the right of patent. It follows, then, that both the Constitution and the Statute make the "invention" of a new and useful process the test of the right of patent. If the courts have held that purely mechanical processes can never be patentable, it must be either because they have determined that mechanical processes can never involve invention or because they have imposed a narrower meaning on the word art than is given it in common usage, and this for the mere purpose of crowding out certain new and useful inventions without any stated reason of public policy. Since, however, the tendency of the courts has uniformly been the other way, in the direction, in fact, of construing the words art, machine, manufacture or composition of matter in their broadest sense to include all inventions of whatever kind, even if they do not apparently fall within the letter of the Statute, it is only reasonable to conclude that if certain processes have been declared unpatentable it was not because they did not come within the meaning of the term "art" as used in the Statute, but because they did not involve invention, as processes. Whatever may have been the language in which the various decisions have been couched, there is nothing in them to negative the presumption that if the process in controversy as a process involved that peculiar kind of novelty and utility which is called invention, that is to say, if the novelty and utility and invention in their real essence resided not in the machine which may have been devised to execute the process but in the process as such, the patent therefor may be sustained. The question of invention in the process as a process is the test.

There have been before the courts a number of processes in which there has been no merit or invention in the process as such, but rather in the machine which has been devised to execute it. Such processes, to use the language of Mr. Justice Brown in the decision under discussion in this paper, "involve nothing more than the operation of a piece of mechanism," that is, they involve the mere operation of the useful mechanism with no meritorious or inventive idea beyond the mechanism; or, again, they "consist solely in the operation of a machine," that is, they consist in the *mere* operation of the machine; and such processes, which as processes involve no inventive idea beyond what is found in the machine which executes them, have been called functions of the machine. But the fact that processes of this type have been declared unpatentable does not for a moment prove, or even indicate, that any other test than that of invention in the process *per se* has been set up. On the contrary, Mr. Justice Brown expressly states that "there is somewhat of the same obscurity in the line of demarkation (between patentable and unpatentable processes) as that between mechanical skill and invention."

In a word, processes which are purely mechanical come within the natural meaning of the term art as used in the Statute. If they are not to be considered patentable in any conceivable case, it must be either because the Supreme Court has placed a narrower meaning upon the term "art" than dictionary usage justifies, or because it has been declared that no mechanical process as such can even involve invention. The first alternative, however, is not to be presumed. It is directly counter to the uniform policy of the Court in protecting meritorious inventors independent of any merely technical questions. It follows, then, that the criterion which Mr. Justice Brown is said to have set up must mean that no purely mechanical processes, as a process, can ever involve an inventive idea.

This, however, accuses the learned Justice of a desire to assume the role of a prophet. It also accuses him of a slip in logical method, for, as pointed out above, the fact that the five cases of processes involving invention discussed by him were either chemical or consisted in the use of one of the agencies of nature for a practical purpose, and that the two Supreme Court cases of processes not involving invention especially relied on (Wyeth vs. Stone and Corning vs. Burden) were both purely mechanical, is no reason why every purely mechanical process which may in future be discovered shall not involve invention, and hence be unpatentable. This fact of experience, if it be a fact, which is denied, may instruct us about the inherent probabilities of the cases, but it can not and does not lay down a rule. It is doubtless true that purely mechanical processes, being usually for the mere manipulations of well known materials by methods and tools well known to craftsmen, very rarely involve inventive ideas in the processes. It is an abuse of the law to attempt to cover such every day manipulations by process claims. The invention in the very large proportion of cases lies in the apparatus which has been devised to execute the process. It does not lie in the process. But to say that the invention in cases of purely mechanical processes can never lie in the process is an obvious nonsequitur, and to say that the Supreme Court will not protect arts because they happen to belong to the class of mechanical processes, whether they involve invention or not, has no warrant in decision or reason.

Let us take for illustration the case of an old paper bag which has before been made by creasing, folding and pasting the paper by a dozen or more successive steps. It is found that by merely holding the old paper blank in the hand in a new way and making a change in the manipulation, it can be converted by the fingers into the same completed bag by *two* successive steps. Let us suppose, to strengthen the argument, that such a process had long been sought, and that when attained, it had largely replaced other bag-making processes. Here obviously is an invention. It is not a new composition, certainly, nor a new article of manufacture, whether bag or blank, nor a new machine. If it cannot be protected as an art or process, the inventor has no protection Now, it will not be denied that so far as the present description of the process has gone, there is nothing in Mr. Justice Brown's opinion holding it unpatentable. This opinion merely refers to processes which involve "nothing more than the operation of a piece of machinery," or processes which consist "solely in the operation of mechanism" and no machinery or mechanism has yet been used. But let us assume further that our inventor, after having successfully practiced his process on a commercial scale by hand operators for a number of years, invents a machine, a bag making machine, for carrying out the same process. Can it be supposed that this future act of his annuls his right to a patent for a process attained by his former invention of the process, or that it vitiates his patent for the process if already granted? Yet the writer has heard those skilled in patent matters declare that such is the effect of the decision with which we are dealing. Whatever the language of the decision may be, it must be clear that it was never intended to apply to such a state of facts. If the language seems to cover it, and the writer is not one of those who thinks it does, then such language must be interpreted in view of the specific case which the Supreme Court had before it. No decision is to be given an interpretation which will lead to absurdities, and especially not one by Mr. Justice Brown.

But it seems equally clear that there may be cases of processes involving invention in which the process cannot be executed by hand, but in which it necessarily requires a certain type of machine. As a well defined instance of processes of this kind, we may take the case of a loom for weaving linen. Let us suppose that a person discovers by running this machine at ten times its previous speed, and reversing the motion, if you please, that he can produce a most beautiful pile fabric in a manner entirely distinct from all other modes in which pile fabrics have been produced, and not in any way suggested by them. Add, further, the customary indicia of invention, a long-felt need and a revolution in the art. That this person has made an invention cannot be questioned. Since, again, it cannot lie in a composition or article of manufacture, and since it cannot lie in the machine, for the machine is the same whether running fast or slow, whether going forward or backward, the invention must lie in the process or the inventor loses protection. There may be those who suppose that the Supreme Court of the United States would throw out a patent for such an invention as this on merely technical grounds, because of a strained and narrow meaning of the word art as used in the Statute. The writer is not one of them. A court which has sustained the telephone process, which has always shown itself desirous of reaching the fundamental merit of a patentee's invention and of disregarding mere legal quibbles, technical ties and abstractions, may be counted on to sustain the patent of a real inventor for a real invention. If the increased speed of the machine was sufficiently beyond the expected skill of the calling, if it was novel and unexpected in result, startling and useful in practice, it is clear that a patent for this means or process may be sustained, even though, in one sense of the word, it involves nothing more than the operation of mechanism, for, in another sense of the word, it involves a great deal more than this, namely, a great invention.

The fact that a patent for centering, trueing and finishing a pulley has been held invalid is, perhaps, a basis for holding that a mechanical process for squaring off the edges of a door and then fitting the door to the jamb may also be held invalid, but it is no reason for believing that a process really meritorious in itself, which involves more than the obvious skill of a carpenter or machinist, shall meet the same fate.

Specific attention may here be called to the fact that the flour-bolting case (Cochrane vs. Deener, 94 U. S., 780) was commented on and approved in the opinion delivered by Mr. Justice Brown. As it furnishes the most persuasive argument, perhaps, against the criterion which it is assumed has been set up—that all purely mechanical processes which may or even must be executed by machinery are necessarily unpatentable—it will repay a moment's investigation. The process invented by Cochrane consisted in passing ground meal through a series of bolting reels composed of cloth of progressively finer meshes and at the same time subjecting the meal to blasts or currents of air by which the superfine flour was separated and the specks and impurities were so eliminated as to be capable of being reground and rebolted. This process, it will be seen, consists in main of two steps, subjecting the material to the action of sieves and then to the action of a blast of air. Both of these actions are purely mechanical. They do not cease to be mechanical because they operate on comminuted material. A sieve is certainly a purely mechanical tool. A blower for producing a blast of air is an equally well-known mechanical tool, and was so recognized in the art of milling before Cochrane's invention. The process is, therefore, purely mechanical from beginning to end, and was so understood by the Court. Furthermore, Mr. Justice Bradley, who delivered the opinion in Cochrane vs. Deener, stated that "If one of the steps of a process be that a certain substance is to be reduced to a powder, it may not be at all material what instrument or machinery is used to effect that object, whether a hammer, a pestle, a mortar or a mill." Language could not be more clear to show that a purely mechanical process may be patentable. An example or illustration could not be more happily chosen to prove that hammers or mills, and by parity of reasoning, lathes and planers, are not necessarily excluded from the instrumentalities which may execute processes worthy of legal protection. Nothing can better indicate that in all processes it is not the instrumentality or machine for executing them which is to be considered, but the inventive ideas in the processes as such, whether they be executed by a hammer, by a mill, or by any other mechanical, hydraulic or electrical machine.

Another instructive fact appears from the Cochrane case. The machinery, in its broad and generic aspect, and so far as it was necessary for executing the process of the patent, was confessedly old. The patentee admitted "the prior use of currents of air in the interior of reels introduced by means of hollow perforated shafts for the purpose of keeping back the speck and increasing the quantity of superfine flour, but not for purifying the middlings preparatory to regrinding." An examination of his patent shows that his own machine, so far as it was necessary to carry out the broad process, consisted of hollow reels with perforated shafts therein for introducing blasts of air. The machine or mechanism was, therefore, old. The process alone was new, and it was sustained despite the fact that it was purely mechanical, as purely mechanical certainly as the hypothetical case set up above of the loom for weaving linen which turned out to be capable of manufacturing a pile fabric, and we have this conclusion strengthened by the consideration that the Justice who delivered the opinion referred to hammers, pestles and mills as proper tools for executing patentable processes. These considerations in themselves must show that Mr. Justice Brown, who had the case of Cochrane vs. Deener before him and discussed it, could never have intended to hold that purely mechanical processes are, *ipse facto*, necessarily, and in all cases, unpatentable.

A few words may, in conclusion, be said about that much abused phrase, "the function of a machine." What five words in patent literature have a more terrible sound? And what words have their meaning less understood? No sooner does a pleader find himself in the attitude of antagonizing a patent for a process than he remembers them as old friends and proceeds to wield them with delight. It is a hard case, indeed, into which they cannot be dragged. And yet the words in themselves, when properly understood, are perfectly harmless. If a process which is carried out by a machine involves no inventive idea in the process as such, irrespective of the machine, then the process is for the function of the machine; otherwise it is not. This is all there is to it. The phrase adds nothing to our knowledge; it describes a conclusion, not a cause; it gives us no criterion for determining the patentability of a process; it is merely a descriptive title applied to such processes as have, from entirely independent considerations, been found to be unpatentable. To attempt to use it for determining patentability is to turn logic upside down.

Rope Driving—XVI.

BY J. J. FLATHER.

It has been stated that a further decrease of from 5 to 8 per cent. of the power transmitted by a rope may be attributed to losses in the rope itself due to resistance to bending, wedging in the groove differential driving effect, and creep, all of which affect the loss to a greater or less extent. Various formulas have been proposed by several eminent authorities by which the resistance of a rope to bending might be determined.

Eytelroein's formula assumes that the resistance of a rope is directly proportional to the tension and the square of the diameter, and inversely proportional to the radius of curvature of the pulley; in which case the stiffness of a hemp rope for each winding and unwinding is given by

$$\sigma = C \frac{d^2}{r} T,$$

where C is a constant equal to 0.23, d is the diameter of rope in inches, r is the radius of pulley in inches and T is the tension in the rope. If the ratio of the diameter of rope to the diameter of pulley over which it runs equals 1 to 30, the above formula becomes, for a rope running over two pulleys:

$$\sigma = 0.03\ d\ T.$$

Reuleaux states that since transmission ropes are usually quite slack the coefficient of stiffness should be taken somewhat less than Eytelroein's value, and suggests that two-thirds would represent a fair approximation; this would give

$$\sigma = \frac{2}{3} \times 0.23\ \frac{d^2}{r}\ T = 0.15\ \frac{d^2}{r}\ T$$

for each pulley in the system.

If the tension on the tight and slack sides of the rope be represented by T_1 and T_2, respectively, the average load on the rope will be $\frac{1}{2}(T_1 + T_2)$; if, further, the conditions be assumed such that the slack side tension equals one-half that in the tight or driving side we shall have $T = \frac{1}{2}(\frac{3}{2} T_1)$; hence for two pulleys, when the diameter of the latter equals 30 times the diameter of rope,

$$\sigma = 2\left(\frac{0.15\ d^2}{15\ d} \times \frac{1}{2} \times \frac{3}{2}\ T_1\right)$$

$$= 0.02\,d \times \frac{3}{4}\ T_1.$$

Since T_1 has been taken in our previous work as equal to 200 d^2 pounds, the stiffness in the rope will now become

$$\sigma = 0.02\ d\ \times 150\ d^2\ =\ 3\ d^3.$$

Now under these relations of tension the driving force may be obtained from

$$P = T_1 - T_2 = 200\,d^2 - \frac{200\ d^2}{2} = 100\,d^2;$$

hence the ratio of loss due to bending will be

$$\frac{\sigma}{P} = \frac{3\,d^3}{100\,d^2}.$$

For a ¾-inch rope running over two pulleys the loss equals 2.25 per cent., while for a 2-inch rope under similar conditions the loss becomes 6 per cent. This is what we might expect, for it is reasonable to suppose that the percentage of loss should increase with the diameter of rope.

It will be noticed that the work done in bending a rope over its pulley is directly proportional to the number of bends, and, therefore, in designing a rope transmission every effort should be made to restrict the number of bends, as this is not only a large factor in the wear, but, as just shown, the power transmitted for a given tension is constantly reduced as the number of bends increase.

This feature is a decided disadvantage with installations on the continuous rope system where one rope is bent in both directions around a number of pulleys on the several floors of a factory.

Under such conditions, and also in those special cases where it is absolutely necessary to run pulleys smaller than 30 times the diameter of rope, the user should put in the very best quality of loosely twisted rope and run it at a less strain than would otherwise be adopted, for under such conditions the flexibility and elasticity of the rope are more desirable than a high breaking strength. While the foregoing formula of Eytelroein may give a measure of the force required to bend a rope over a pulley under a certain set of conditions, it will be evident since the conditions vary considerably in different installations that, in order to be generally applicable to any given case, a formula must contain other factors than those included in Eytelroein's and other similar formulæ.

In a flying rope running in *V* grooves, in addition to the bending of the fibres there is a permanent reduction in cross section due to the uniform compression of the rope, as will be noticed by measuring a rope that has been running some time; beside this there is a temporary deformation due to the distortion of the rope as it passes over the pulley. The flexibility and elasticity of the rope undoubtedly have much to do with the resistance to bending, and the degree of twist put into a rope is an important factor in this connection; for although hard-twisted ropes are very much stronger than those loosely twisted, the internal wear is much greater, as the fibres are held more rigidly and do not slide as freely upon each other. The advantages of lubricating the fibres of a manilla rope have been already discussed; it is sufficient to state here that the degree of lubrication affects the flexibility of the rope, and hence enters as a factor in determining the loss due to bending.

The varying angle of contact, and to a lesser extent the angle of the groove, must also have a certain influence upon the resistance. In view of these considerations it will be seen that any deductions from existing formulas are of doubtful utility when applied to transmission ropes in use, and should be considered only as relative and not absolute.

Another source of loss is that due to the wedging of the rope in the groove. Although this action exists to a greater or less extent in all rope transmissions where the shape of the groove is such that the rope does not bottom, yet it is undoubtedly true that its effect in a well-constructed plant has generally been over-estimated. That it does exist to a harmful degree can be seen in many installations from the wav in which the tight side of the rope follows up on the driven pulley.

With the single rope method this is especially true in new installations where the tension is purposely made rather high to allow for stretch in the rope; it is, however, frequently found in the continuous rope system where the tension carriage is over weighted. The factors which enter into the consideration of this loss are: tension on the driving and slack sides of the rope, the angle of groove, and the velocity, weight and condition of the ropes.

As we have previously shown[1] the driving side tension T_1 is made up of three parts, namely, the driving force, P, the centrifugal force, F_0, and the tension, T_3, necessary to balance the strain for adhesion; that is:

$$T_1 = P + F_0 + T_3;$$

in like manner the tension in the slack side of the rope consists of the strain necessary for adhesion plus the strain due to centrifugal force; that is:

$$T_2 = T_3 + F_0.$$

It has been claimed that no loss can occur in pulling the rope out of the groove since the centrifugal force set up in the rope is many times greater than any caused by the tension on the slack side when leaving the pulley, but it is obvious that a part cannot be greater than the whole, and, therefore, the centrifugal force, while greatly reducing the wedging force, cannot altogether eliminate it.

(To be continued.)

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[1] See [illegible] April 14, 1894.

Mathematics and Physics.

To the Editor of The Electrical World:

SIR:—In a recent editorial in THE ELECTRICAL WORLD on "Mathematics and Physics," a position was taken which, with all respect for the judgment of the writer, I beg leave to challenge—not that I object to the conclusion in itself, but to the manner of arriving at and applying it after being reached, and because the sentiments there expressed represent a growing tendency, both in the press and among so-called "practical men," that, if not hindered, must surely prove disastrous to the formative engineer.

A bright young "school" engineer was heard to say that he is actually ashamed to use a respectable scientific method for fear of being jeered by his comrades and perhaps dismissed by his old-school, slide-rule chief. But even in the schools there is a deplorable impatience in the study of pure mathematics. The student will hardly consent to anything that has not an immediate application.

The truth is that a first-class constructive engineer can be turned out in a year or two. In this day of tables, formulas, automatic instruments, etc., with a little common sense taken for granted, there is no reason why a person could not creditably execute any ordinary engineering specifications with that length of training. But the world is overstocked with that class of men already. The present demand is for *creative* engineers who can and will push out into entirely new paths and originate new methods, and the most versatile training is needed to produce these men. Hence the practice of to-day cannot be a test of the training for the future. Hence topics in mathematics must be studied that at present have no application.

One of the values of a technical education is found in the new ideas formed and these ideas need by no means have immediate application. If that were the test, a very large part of such subjects as thermodynamics, applied mechanics, etc., would have to be thrown out. The greatest present objection is the necessary meagreness of the mathematical courses in our technical schools. At present only the barest fundamental principles are taught and about all the examples are given from mechanics that can be. As a rule such applications require highly developed ideas at the start. The graduate does indeed forget many of the particular processes employed, but he will never lose the general ideas and methods of thought there acquired.

I admit the necessity for "flexibility" rather than "rigidity" in practical work. A great deal of practice must be merely approximation. But I maintain that all "flexibility" in method is extremely dangerous without a previous rigidity in the determination of what is the theoretical condition. It would be foolish to tell a workman to cut a wire *about* a yard long if he did not know exactly what a yard was. You must know the ideal before making a safe approximation. It is in the forming of this ideal that *pure* mathematics is indispensable. I cannot conceive how any one can maintain that "the rigorousness of mathematics leaves little field for the exercise of the imaginative faculty." There is no study in existence that more develops and necessitates this faculty than mathematics. It takes a great deal more imagination to succeed in mathematics than to write poetry. Indeed, without a highly developed imaginative faculty, no matter how great his reasoning ability, it is useless for one to attempt the study of the higher mathematics. The reason can only act when the material is well organized, and pictured to the mind.

There is no "drudgery" in mathematics when properly taught, and it is in the *methods* of *teaching* that at present fault should be found. As you conclude, the professor of mathematical physics is a growing necessity, but his work must commence where that of the pure mathematical courses now end and develop and apply the ideas therein imparted. CHARLES EDWARDS.

NEW ORLEANS, LA.

A Peculiar Phenomenon.

To the Editor of The Electrical World:

SIR:—On the night of April 26, 1895, a friend and myself were riding our bicycles through some of the irrigated country nine miles north of Lamar, and my attention was attracted by the electricity on the barbs of the wire fence. Next I noticed it on all metallic parts of our bicycles. There seemed to be a concentration at the hub when we rode fast, and when we rode slowly it scattered over the whole wheel. The electricity came up the fork, separated and traveled along the handle bars, going under the cork handles and sending a jet of electricity at least three inches beyond the end of the handles. I felt as though I had hold of an electric battery. This lasted about 30 minutes, leaving gradually. The ground was damp but not what might be called wet. I should be pleased if some of your readers would offer an explanation of this peculiar phenomenon. T. A. PEPLOW.

LAMAR, COLO.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors, or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 927 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French, or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Single-Phase Synchronous Motors.—The "Elek. Zeit.," April 25, contains a communication from Prof. Blondell in which he calls attention to a statement in the recent paper of Messrs. Bedell and Ryan (see ELECTRICAL WORLD, March 30), to the effect that Mordey was the first to announce the law that for a synchronous motor there is a certain value of the exciting current for which the armature curve is a minimum and the power factor a maximum; the present writer states that he annunciated this law a year previously to Mordey's announcement in "La Lumiere Elec.," 1892, where he also showed how to calculate this exciting current (vol. 45, p.423 and 563); he also showed in that article that there is a value for the self-induction which will insure the maximum stability. He calls attention to the peculiar behavior of the motor used by Bedell and Ryan which is different from any that he has used. Regarding parallel coupling of alternators he says that experience with the transmission of power does not completely solve the problem, because in parallel coupling both machines are shunted by the external circuit; all alternators can be easily connected in parallel when not loaded, the difficulty arises when they are loaded, which reduces the relative values of the synchronizing currents; he believes to have shown, in the article referred to, that the ease of parallel coupling, for a non-inductive circuit, depends on the ratio of the current which each machine will give when short-circuited and that which they are to generate for the external circuit; he therefore does not include himself among those who believe the ideal will be found in the reduction of the self-induction; there is a limit below which one must not go but in practice there is no fear of reaching this limit. On account of the use of synchronous motors it is not allowable to reduce the armature reaction to a minimum.

Armature Reaction.—Referring to a recent paper of Bedell and Ryan in THE ELECTRICAL WORLD, March 30, the Lond. "Elec. Rev.," April 26, states that it is strange to see how people disregard the fact on which Mr Sayers laid so much stress, namely, that his device is not designed simply to prevent sparking, as machines are built sparkless without it, but the advantages secured by his device are that the machines can be designed with iron imbedded conductors, minimum clearance, minimum exciting force and minimum weight and cost, at the same time securing absolute sparklessness.

Reversible Regenerative Armatures and Short-air-space Dynamos.—Mr. Sayers' Institution paper, which was abstracted in the Digest, March 16, 23, and 30 (also April 13 and 20), is published in full with all the illustrations and the discussion in the "Jour. Inst. Elec. Eng." for April.

Multiple Current Dynamos.—Mr. Rankin Kennedy in a communication to the Lond. "Elec. Rev.," April 26, refers to a statement in the serial by Mr. Wiener in THE ELECTRICAL WORLD in which he ascribes to Mr. Sayers the invention of the method of obtaining two or more currents of different voltages from the same armature (which consists in cutting deep wide slots parallel to the armature producing neutral points upon which intermediate brushes may be placed); Kennedy claims that this is a mistake as this method was patented to him April 4, 1892, English patent No. 1,640.

Continuous Current Dynamo.—An illustrated description of the 4-pole machine of Messrs. Balas and Couffinhal is given in "L'Ind. Elec.," April 25.

Dynamo and Motor Design.—A brief abstract of a recent lecture by Mr. Dunn is published in the "Jour. Frank. Inst." for May; the lecture was in many respects similar to the one by that writer which was abstracted in the Digest, Jan. 5.

Design and Construction of Dynamos.—A serial on "The Factory Practice in the Designing and Construction of Dynamos" by Mr. Woods, is begun in "Elec. Ind." for May; the present portion is somewhat elementary in character.

LIGHTS AND LIGHTING.

Search Light in the Japanese War.—According to the "Elec. Friend" (Japan) for March, the search light on the Chinese man of war in the battle of Wei-Hai-Wei formed a very good target for the Japanese torpedo boat.

Wilbrant Arc Lamp.—A brief description of this lamp is given in the Lond. "Elec. Eng.," April 26.

Train Lighting.—According to the "Amer. Eng.," "R. R. Jour.," for May, the Midland Railway of England has abandoned the electrical system of train lighting with which several of its trains have been equipped, on account of its unreliability and expensiveness; the efforts to perfect the system sufficiently to meet the requirements of the service were unavailing.

Stage Lighting.—The Mayrhofer system is described and illustrated in the "Elec. Eng.," May 8.

POWER AND HEAT.

Heating and Cooking.—A Society of Arts paper by Mr. Crompton is reprinted in the Lond. "Elec." and Lond. "Elec. Eng.," April 26, the latter containing also the discussion, apparently in abstract, and the illustrations; the "Elec. Rev." contains a short abstract of the paper. The application of electricity to heating and cooking has been regarded as impracticable and too costly; the object of this paper is to show that this is far from being the case and that electric heating and cooking has now advanced to a highly practicable and useful stage. He describes in detail the construction of the apparatus made by his company; they use nickle steel alloys which are much better than German silver and the enamel consists of two or more layers of different refractory characters, the wire is applied in the form of a crimped ribbon bent by a machine and transferred to the heated metal plates by means of a magnet. He describes his platinum thermometer (see below under instruments) by means of which measurements of the heat required in cooking were made with a high degree of accuracy and from this the amount of energy required for different operations; the results are given in a table in which the cost per kw hour is estimated as 8 cents; the following are some of the results: the cost of the energy required to raise a plate for roasting, baking, or frying to 400 degrees F. in 30 minutes is 3.62 cents; that for heating a radiator plate to 264 degrees F. (apparently in one hour) for warming the air of a room is 4 cents; that for boiling one pound of water in a tea-kettle is 0.64 cent. He claims that the opinions frequently stated that electrical heating is too expensive to become general, are based on an insufficient knowledge of the economy of cooking as generally carried on; the smallness of the results obtained by electrical methods are astonishing; the amount of heat actually utilized in cooking on the ordinary stove he found by experiment to be not more than 2 per cent.; the enormous waste, except when boiling water and stewing, is due to the fact that radiated heat is used; with a properly arranged griller heated electrically 65 per cent. of the heat energy is used in the meat; with gas cooking the percentage is not so striking but is still very favorable to electricity because the heat communicated to the food is by radiation from gas flames, the ventilating current carrying away at least 80 per cent.; with electric cooking the vessel is perfectly air-tight, no ventilation being necessary; in an oven fully 90 per cent. of the heat may be utilized representing 4.5 per cent. of the whole energy of the coal; thus the electrical oven is twice as economical as the ordinary oven. He refers also to the convenience and the superior results, the food in the ordinary method being frequently injured or dried up while the absence of the ventilating currents in the electric process prevents this and the facility for regulating the temperature is much greater. He sees no reason why in a few years a majority of the users of electric light will not do all their cooking by electric means using solid fuel only for boiling purposes. Regarding the heating of the Vaudeville Theatre he added that it was found that the electric radiators are convenient, safe and economical. The discussion, as abstracted, contained nothing of interest.

Polyphase Plant.—A long abstract of Mr. Boucherot's description of the lighting and power plant at the Weyher & Richmond works, is published in the "Jour. Inst. Elec. Eng." for April. An abstract of the original appeared in the Digest, Feb. 2; see also Jan. 26 and April 6.

Electrically Operated Canal Locks.—"L'Ind. Elec.," April 25, refers briefly to experiments which are to be made in Holland.

Crane.—A brief illustrated description of an odd form is given in "L'Elec.," April 27; it travels on a single rail on the floor and is guided by two rails on the ceiling.

New Science of Electrical Heating.—The "Eng. Mag." for May contains an article with this title by Mr. Hadaway; it is in favor of electric heating under certain circumstances. In a good steam and electric plant 10 per cent. of the fuel energy can be secured in the electric current, and of the balance 35 per cent. is a direct loss, and 55 per cent. indirect; the latter can be utilized over limited distances. He suggests the term multi-potential thermo system for one in which electric energy is used as the "high potential heat factor," that is, for heating above 212 degrees F., and the exhaust steam is used for the low potential heat factor, for temperatures below 212 degrees F.; the ratio of the high and the low potential heat is about 1 to 5 based on the thermo-units, and the total fuel efficiency is then about 50 per cent.; a fair rate of charge would be about 4 to 5 times as much for the high potential heat as for the low. The cost of electric cooking at 4 cts. per horse power hour is not greater than gas at $1 per thousand, provided the water heating is omitted. He believes that this double system brings electric heating to a practical and remunerative basis; he cites two illustrations of an approach to this system. He shows the effect on the load factor of a station and compares the prices charged by the New York Steam Company and the Edison Electric Illuminating Company, of New York, from which he finds that the former furnishes heat at 40 cts. for 1,110 thermo-units, while the latter, allowing 50 per cent. discount to large users, will sell 20,518 thermo-units for 40 cts., the ratio between the two being nearly 54 to 1; even allowing a charge of 5 times as much for the high potential heat as for the low, the ratio will still be 10 to 1, which indicates what might be accomplished could two plants be run conjointly for a multi-potential heat supply. He quotes from Lord Kelvin's well-known article of the year 1853, and suggests applications of it in the form of a uni-potential system which he thinks would largely increase the central station load factor. For electric heating to be economical a multi-potential system must be used. Regarding car heating he suggests that a small amount of sensible warmth is all that is necessary, and this can be produced by less than 100 watts per sq. ft. of surface and in a 20-ft. car 20 sq. ft. of radiating surface is sufficient for average conditions and 35 for extreme conditions. He suggests that electric roads should locate their stations near business blocks so as to utilize their exhaust steam for heating. Regarding the cost of electric cooking he refers to an experimental plant which has been operated for 15 months under ordinary conditions, the results of which show that the cost of electric cooking is practically equal to that with the gas and coal stove as usually run, when electricity cost 4 cts. per horse-power hour; under the best control this would be still more favorable. He sees no reason why hotels and public institutions operating their own plants so as to secure a multi-potential system should not employ electricity for cooking, very extensively and solely for the purpose of economy, for electricity in a well-designed isolated plant costs much less than 4 cts. per horse power hour; in domestic life the ratio required is found to be practically five parts of diffused heat and one part of high temperature heat.

Electric Motors at the Southwark Foundry.—A brief description of the electrical distribution of power at these shops is published in the "Amer. Eng. & R. R. Jour." for May.

Three-phase Plant at Pachuca.—A brief description of this plant, near the city of Mexico, is published in the "Eng. & Min. Jour.," May 4; the power is derived from a waterfall and aggregates 20,000 hp; the line potential is 10,000 volts.

Polyphase Plant.—An abstract of Mr. Boucherer's article, mentioned above, is published in the "Elec. Rev.," May 8.

TRACTION.

Mountain Railways in the Alps.—In a brief article by Mr. Boistel in "L'Ind. Elec.," April 25, he gives tabular data for five Swiss mountain roads for steep grades, three of which are operated electrically, one by steam (Pilatus) and another by a water counter-weight (Santerbrunnen), and compares the results. It appears that the cost of construction of the electric lines is about one-third of that of the others, the cost of operation from one to two-thirds, the weight of the trains from 40 to 63 per cent., and the fare 60 per cent.; the results therefore show in a striking manner the great superiority of electric traction for steep grade mountain roads.

Surface Contact System.—The recent paper of Mr. Vuilleumier on the system used at Lyons, mentioned in the Digest, Feb. 2 (for description see Oct. 13, 20 and 27), is abstracted in the "Jour. Inst. Elec. Eng." for April. The motive power is obtained from gas engines run with power gas; the results of some tests are given showing that with 10 cars at work the consumption of coal was from 2 to 3.5 pounds every kilowatt hour; the cost of the system is said to compare well with the overhead trolley system.

Electric Traction in a Mine.—The "Bul. Soc. Int. des Elec." for March contains a well illustrated paper by Mr. Hillairet describing a provisional installation in a coal mine near St. Etienne, France, in which a locomotive is used; it has been in operation 15 months and the results are very satisfactory; the current is taken from a conductor about nine inches above the ground; the illustration of the locomotive was reproduced in the "Elec. Eng." (N. Y.), May 1.

Electric Traction on Canals.—The "Bul. Soc. Int. des Elec." for March contains a long paper by Mr. de Bovet giving an illustrated description of his system of canal boat traction in which the current is taken from a side overhead trolley wire and the tractive force obtained from an anchored chain passing over a side pulley on which the friction is produced by a magnetic pull. The illustrations of some of the apparatus were reprinted in the "Elec. Eng." (N. Y.), May 1.

Electric Ferry.—The "Elek. Zeit.," April 18, contains an illustrated article by Mr. Trumpy, describing the electric ferry at Bergan, a full abstract of which with the illustrations, was published in THE ELECTRICAL WORLD last week, page 553.

Accumulator Traction.—A summary of the data for the experimental roads at Hagen and Vienna in which the alkaline accumulator is used, is given in "L'Ind. Elec.," April 25.

Traction Motors.—In Mr. Dawson's long serial on electric traction in Lond. "Engineering," April 26, he gives a well-illustrated description, including dimensions, of several of the prominent American and European motors.

Resistance of Traction.—A translation of Mr. Pellisier's recent article (see Digest, Dec. 6, 25, Feb. 23), is given in abstract in the "Jour. Inst. Elec. Eng." for April.

Geneva.—A translation of the description of this road, referred to in the Digest, April 6, is given in abstract in the "Jour. Inst. Elec. Eng." for April.

Railway Competition.—The "Eng. Mag." for May quotes from a recent article in the "R. R. Gaz.," March 29, and comments on it. In the quotation it is stated that the true cost of performing the service receives very little attention from the "aggressive competitors" (referring to the trolley roads); electric roads with a new track and equipment can get along for a while with very little expenditure for repairs, and managers in many cases base their calculations on a false assumption that the first low operative expenses can be permanently maintained, "they know it is false but that makes no difference"; the favorable attitude of the public may not last and taxes may be imposed where now everything is free. Quoting from the same journal for April 5, it is thought certain that the trolley lines will before long begin to do a parcel express business and can carry this on with great efficiency; it is quite probable that they may eventually carry heavy freight to some extent. The question is asked how steam roads are going to defend themselves, and it is suggested that they will either use electricity themselves and build cheap branches or buy up the electrical lines outright and operate them as an integral part of their system; the convenience of the public must finally decide the question of competition "and it is idle for any one to claim that electric lines shall be confined to the limit of the old horse car roads in our large cities;" the inevitable mutual adjustment of the competition is a matter which individuals, legislatures and courts are alike powerless to prevent.

Direct-Connected Machines.—The "St. Ry. Jour." for May contains a communication from Mr. Wright (of the Siemens & Halske Co.) giving his views regarding the direct-connected machines. If the choice is between several belt connected generators and a large direct-connected generator the latter will prove the cheapest in first cost, in operation and especially in maintenance; the saving in the cost of operation will be from 20 to 40 per cent.; he gives the loss of energy due to the use of belts under favorable conditions as assumed by leading companies in the United States, which are as follows: horizontal belts 6 per cent., vertical 10 per cent., countershaft with horizontal belt 12 per cent., countershaft with vertical belt 16 per cent., slow-speed engine with main and countershaft and belts 25 per cent. He quotes from an article by Mr. Crompton published about a year ago. In nearly every case he (Wright) believes that the ultimate economy will warrant the adoption of direct-connected machinery; with a station of sufficient capacity he recommends 2,000 hp as a unit. He quotes Mr. Kapp as showing that more than four times the electrical output can be obtained at a little more than twice the cost in a large as distinguished from a small dynamo.

Emergency Brake.—Mr. Walker in the "St. Ry. Gaz.," May 4, states that the Bonta brake (see Digest, May 4), is exactly the same as the one which he has been using on steep grades for over three years with perfect satisfaction and he now has a great many in operation; a single movement of the switch handle stops the car in about a single car length when it is at full speed; the cost of the attachment on the old Sprague switches is less than one dollar.

Conduit Systems.—The Olbricht system is briefly described and illustrated in the "Elec. Rev.," May 8; it is quite simple, the two conductors being secured directly beneath the two flanges forming a slot; (how the pressure of heavy wheels on the slot is taken up is not shown).

A description of the Dion system, taken from a daily newspaper, is given in the "Elec. Eng.," May 8; the system is being tried in Brockton, Mass.

Heilmann Locomotive.—A brief illustrated description of one of the new locomotives, which are approaching completion, is given in the "St. Ry. Gaz.," May 4.

Electric Carriage.—The "first electric carriage in Boston" is illustrated in "Elec. Rev.," May 8.

Rapid Transit in Philadelphia.—A recent discussion on the subject at the Engineers' Club of Philadelphia is published in their "Proceedings" for April.

Power for Electric Railways.—The translation of Mr. Pellissier's article, abstracted and referred to in the Digest, Dec. 8, 22, and Feb. 23, is published in "Elec. Age," May 4.

Motor Repairs.—The "St. Ry. Jour." for May contains an article by Mr. Shepard on repairing the Westinghouse motor.

Legal Aspect of Electrolysis.—Mr. Townsend's article, which was abstracted in the Digest, April 13, is reprinted in the "West. El.," May 11.

Detroit & Mt. Clemens High Speed Railway.—A description of this line, which is under construction, is published with a number of illustrations in the "St. Ry. Gaz.," May 4; the "St. Ry Jour." for May contains a brief description of it. The line is about 15 miles in length and the cars will be run at a speed of 35 miles an hour; the road is practically without grades or curves; each car will be equipped with two motors having an aggregate capacity of 100 hp and is intended to draw a trailer; the line is designed to carry freight as well as passengers.

Electric Railways in Connecticut.—A short article in the "St. Ry. Jour." for May gives a map of the State of Connecticut with the lines of the New York, New Haven & Hartford R. R. Company together with the electric railways in operation and in course of construction. A table is given showing the falling off in the steam railway traffic on different roads due to the parallel electric lines.

Philadelphia.—A brief summary of the electric roads in Philadelphia is given in the presidential address of Mr. Trautwine in the "Proc. Eng. Club, Phila.," for April; at the end of 1894 the total mileage of the electrical roads was 250.

Hoboken.—A well-illustrated description of the North Hudson County Railway is published in the "St. Ry. Gaz.," May 4.

Steinway.—A well-illustrated description of the power house of this railway is published in the "St. Ry. Jour." for May.

Columbus.—A new power house of the Columbus Central Railway Company is described and illustrated in "Elec. Ind." for May.

Hartford.—A long well-illustrated description of the street railway system of Hartford is given in the "St. Ry. Jour." for May.

Lock Haven.—Some details of this road are described and illustrated in the "Elec. Eng.," May 8.

Dayton.—A brief illustrated description of this road is given in "Elec. Ind." for May..

Chicago.—A brief description of the Metropolitan West Side Elevated Road is published in the "St. Ry. Jour." for May.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Regulating Installations Driven by Turbines.—The "Elek. Zeit.," April 25, contains a long article by Mr. Egger in which he calls attention to the difficulties in regulating the speed in electrical installations driven by turbines and describes an apparatus devised by himself which is in use in a number of installations with great success, in some of which the ordinary methods failed completely. The principle of the apparatus is to automatically insert a resistance in the circuit of the dynamo corresponding to a load equal to the difference between the full load and that which is being utilized, thereby always keeping the load on the dynamos and turbines exactly the same; the resistance consists of an electrolyte made of water and soda, and containing one fixed electrode and another movable one the latter being inserted to a greater or less depth by an automatic apparatus; the electrodes consist of a row of carbon rods; the movable electrode is connected to the armature of a machine like a dynamo, whose armature, however, has only one large coil and no commutator (being therefore the equivalent of a mere magnet); this machine is series wound and is connected in the main circuit, the current in which is to be kept constant; the current through this regulator tends to turn the armature so as to lift the electrode out of the solution and a counterweight tends to move it in an opposite direction; the current through the resistance shunts the motors in the circuit; for different positions the torque for a constant current is said to be nearly constant and a position of equilibrium between this torque and that of the counterweight will be reached for loads in the external circuit. The results obtained are said to have been surprisingly good; the greatest difference in speed which could be noticed was only 2 per cent.; he suggests using a similar principle for other automatic regulators.

Installation Statistics for Japan.—The "Elec. Friend" (Japan) for March gives full statistics for isolated lighting plants in Japan up to August, 1893; total 54, number of incandescent lamps 17,145 nearly half of which are used in cotton factories, number of arc lights 123; the first isolated plant was installed in Japan in April, 1883, in the Yokosuka navy yard.

Statistics for Germany.—The Lond. "Elec.," April 26, abstracts briefly the table of statistics referred to in the Digest, April 27.

Novel Lighting System.—There is a proposal on foot to light various towns and villages near the Seine from Paris to Havre consisting in providing the cities with accumulator plants which are charged from a large floating central station which is moved up and down the river, charging batteries in turn.

Tokio.—According to the "Elec. Friend" (Japan) for March the chimney for the Electric Light Co. of that city is made of iron lined with brick; it has no stays; the height is 200 feet, the diameter at the top 9 feet, and at the base 18 feet; it appears to withstand the frequent earthquakes in that country.

Leicester.—A description with good illustrations of this alternating current station is published in the Lond. "Elec. Rev." and "Elec. Eng.," April 26, the latter containing a plan.

Belfast.—A description of this accumulator station with some good illustrations, is published in the Lond. "Elec. Rev.," April 26.

Louisville Auditorium Plant.—An illustrated description is published in the "West. El.," May 11.

Manchester.—A brief description of this English municipal plant, giving costs, is published in the "Elec. Rev.," May 8.

WIRES, WIRING AND CONDUITS.

Underground Mains in Berlin.—A translation of the portion of Dr. Kallmann's paper referring to the precaution taken to insure safety, is published in the Lond. "Elec.," April 26; the paper was referred to in the Digest, April 27. A somewhat lengthy discussion of the paper is reprinted apparently in full in the "Elek. Zeit.," April 18.

Bending Tests of Copper Wire.—The "Bull. Soc. Belge," Oct.-Dec., contains a short article by Mr. Colard in which he gives simple formulas for calculating the number of bends which a wire of a given diameter will stand, through a circle of given radius; tables of data are given showing how the figures agree with those obtained from experiments.

Earthing the Neutral Conductor.—The Lond. "Elec.," April 26, reprints in part a translation of the report referred to in the Digest, April 13, which is strongly in favor of earthing; the report is discussed editorially.

Distribution Tower.—That used in the Salzungen installation referred to in the Digest, May 4, is illustrated in the "West. El.," May 11.

ELECTRO-PHYSICS AND MAGNETISM.

Alternating and Interrupted Electric Currents.—A reprint of a Royal Institution lecture by Prof Forbes is begun in the Lond. "Elec. Eng.," April 26; the whole lecture is briefly abstracted in the Lond. "Elec. Rev.," April 26. He describes mechanical analogies for the various cases of the propagation of electricity with special reference to submarine telegraphy. Among others he describes an experiment with an endless chain hung vertically over a motor pulley and driven at a high speed, which then acts like a rigid body, going through a series of motions if displaced (but in the present portion he does not seem to draw any analogies from it). Electrical momentum corresponds to self-induction and capacity involves a certain pliability or flexibility of the chain, representing the conductor; the torque or twist in a shaft is analogous to a current in a conductor; capacity may be taken as a yielding in the direction of motion; a further analogy with a cable is illustrated but the description in the abstract is not sufficiently clear, (it will be referred to again when the paper is published in full.)

Effect of Electric Railways on Physical Laboratories.—According to an editorial in the "Elek. Zeit.," April 25, the Electrical Society of Germany and the Imperial Technical Institute are about to investigate and report on this subject, compiling the literature, including any communications which may be sent them; the chief questions are how great the effect on the magnetic field is and for what measurements and researches the use of instruments which cannot be made to be independent of the earth's field, are absolutely necessary.

Electrostatic Capacities.—The Lond. "Elec. Rev.," April 26, calls attention to the recent (American) paper by Prof. Nipher calling attention to an error in the statement that the lines of force or induction around an electrified body distribute themselves as if the space offered resistance to their passage; this is not the case, which is shown by reference to a hollow spherical conductor with an opening into its interior and which would be absolutely devoid of charge on its inner surface but if immersed in a conducting fluid quite an appreciable amount of current would flow from the inside, neither could the discharging effect of points be properly accounted for on this resistance basis; the analogy fails wherever the shape of the body causes a want of uniformity in the surface density. The statement that the difference of the electric potentials produces electrostatic induction is claimed to be very misleading as it gives the impression that the electrification of the body is the primary effect and the propagation of lines of induction the result.

Electrostatic Rotation of Rarefied Gases.—A brief abstract of an article by Mr. Arno is given in the "Jour. Inst. Elec. Eng." for April.

Propagation of Magnetization in Iron.—The paper of Dr. Hopkinson and Mr. Wilson, which was abstracted in the Digest, March 16, 23 and 30, is published in full with the discussion and illustrations in the "Jour. Inst. Elec. Eng." for April. Several of the illustrations of this paper are published, with a brief description, in the Lond. "Elec.," April 26.

Form of a Flexible Conductor in a Magnetic Field.—"L'Eclairage Elec.," April 13, contains the first part of a mathematical article on this subject by Mr. Colard.

Foucault Currents.—A mathematical article by Mr. Janet is published in "L'Eclairage Elec.," April 13.

Mechanical Equivalent of Light.—The Lond. "Elec. Rev.," April 26, calls attention to an error in the cut referred to in the original of the article which was abstracted in the Digest last week.

Compass Deflections.—The "Eng. Mag." for May quotes from a letter by Capt. Malet in the "Nautical Mag.," in which he refers to the effects of magnetic storms, as often indicated by auroras, upon eccentric variations of the compass needle and he suggests that when an aurora is visible the navigator, essentially when near land, will do well to watch the compass closely for any eccentric movement.

ELECTRO-CHEMISTRY AND BATTERIES.

Accumulators.—The Lond. "Elec. Rev.," April 26, publishes a short report by Mr. Hall concerning comparative tests between the International Storage Battery Co.'s cell and the E. P. S. cell; the results are merely relative, no actual capacities, rates, or weights being given. At rates equal to from six to eight times the maximum rate for the E. P. S. cell the capacity of the former was from 3.4 to 2.77 times as great. The claims made for it are high rate of discharge, high capacity per weight and greater mechanical strength. To give 5 hp for 19 hours requires 2,915 pounds of battery. The report is very vague and unsatisfactory and is severely criticised in the leading editorial in that journal where it is stated to be absolutely meaningless on account of the absence of statements of actual discharges.

Accumulators.—An illustrated description of a number of different forms is published in "L'Eclairage Elec.," April 13.

Pulverizer.—A well-illustrated description of an apparatus intended chiefly for pulverizing lead for accumulators, is given in "L'Eclairage Elec.," April 13; a stream of hot air is blown through a nozzle through which molten lead flows.

[illegible].—The Lond. "Elec. Rev.," April 26, states that ferricyanide of potassium has a great tendency to become ferrocyanide exercising an oxidizing action in doing so, and adds that this reaction can readily be reversed by electrolysis.

Production of Organic Compounds.—In a short article by Mr. Hess in "L'Eclairage Elec.," April 13, he discusses the possible application of electrical energy for the protection of organic compounds; it deals with the compound carbide of calcium and its application for producing acetylene and organic compounds.

Nickel Plating.—According to "L'Elec.," April 27, the bluish or greenish oxide which forms on nickel-plated objects can easily be removed by a solution of 50 parts of rectified alcohol and one part of sulphuric acid, after which the object is washed in alcohol.

Quantitative Analysis.—The Lond. "Elec. Rev.," April 26, calls attention to a paper by Mr. Classen in the "Ber. Deut. Chem. Gesellschaft," 27, p. 2,060, and to another in the "Zeit. f. Ang. Chemie," 1894, p. 388, by Mr. Rudorff.

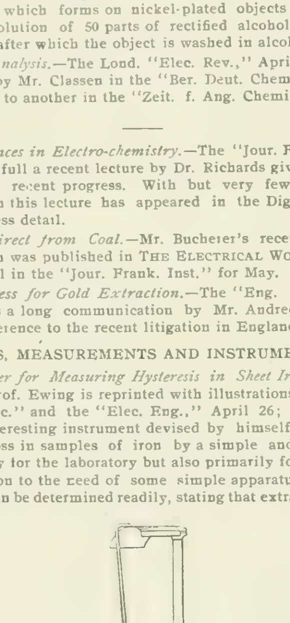
Recent Advances in Electro-chemistry.—The "Jour. Frank. Inst." for May reprints in full a recent lecture by Dr. Richards giving a very good summary of the recent progress. With but very few exceptions the subject matter in this lecture has appeared in the Digest, although in many cases in less detail.

Electricity Direct from Coal.—Mr. Bucherer's recent paper, a full abstract of which was published in THE ELECTRICAL WORLD, April 6, is published in full in the "Jour. Frank. Inst." for May.

Cyanide Process for Gold Extraction.—The "Eng. & Min. Jour.," May 4, contains a long communication by Mr. Andreoli (of London) with special reference to the recent litigation in England.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Magnetic Tester for Measuring Hysteresis in Sheet Iron.—An Institution paper by Prof. Ewing is reprinted with illustrations and curves in the Lond. "Elec." and the "Elec. Eng.," April 26; he describes in detail a very interesting instrument devised by himself for measuring the hysteresis loss in samples of iron by a simple and rapid process suitable not only for the laboratory but also primarily for the workshop. He calls attention to the need of some simple apparatus by which the hysteretic loss can be determined readily, stating that extraordinarily wide differences exist in different samples of iron, the range being nearly three to one in good and bad samples, and even in the same batch of plates such differences exist between one plate and another as to make the testing of a single sample a poor guide; he has noticed a difference of 15 per cent. in samples taken from the four corners of a plate not two feet square. He considers the ballistic method unimpeachable on the score of accuracy, but it is not simple and expeditious. The permeability in transformer iron is quite a secondary matter, hysteresis being of primary importance and high permeability is not necessary or invariably associated with small hysteresis. The basis of the present instrument is the mechanical measurement of the work done in causing reversals of magnetism to take place in the iron under examination; referring to the adjoining figure the iron to be tested is cut in the form of strips three inches long by five-eighths of an inch wide, six or seven pieces being generally sufficient; this bundle of pieces is secured to the carrier which is made to rotate by hand by the friction pulley and the driving wheel; the rotation takes place between the poles of the permanent magnet *e*; the work done by hysteresis tends to revolve the magnet which is supported on a knife-edge at *f* in line with the axis of the carrier, and the angle through which it is deflected serves to measure the work done, this angle being read off upon the scale at the top of the instrument. Since a definite amount of work is done for each reversal whatever the frequency as long as it is not so high as to generate work by inducing currents, the deflection of the field magnet is independent of the speed at which the carrier revolves and no special care need therefore be taken to turn the handle at a uniform rate; the sensitiveness is adjusted by means of the weight *g*; the deflection is very nearly proportional to the hysteresis of the iron even with samples differing very widely in quality; to secure this a considerable air space is left between the magnet poles and the ends of the sample so that the variations in permeability liable to be met with are almost without influence on the total induction; the induction was found to be practically the same in the best and worst specimens; the magnet was so proportioned that the induction was about 4,000; within reasonable limits any value of this intensity may be adopted as the relative amounts of hysteresis in different samples change very little with the induction. Care has to be taken to make the strips always the same length so as not to change the air gaps, but the width requires no particular care; he finds that no nice adjustment of the weight is required and explains the tests made to determine this; he tested different numbers of the strips varying from 11 to 1, giving the results in tables and curves, the latter showing that the scale readings pass through a very flat minimum for about seven pieces, there being no material difference between six, seven and eight, hence if the weight chosen is made equal to seven pieces it will suffice; the nearest whole number of strips will do; in testing armature plates a smaller number of pieces approximating the same weight are used. He describes very careful tests which were made to calibrate the instrument in order to determine the degree of accuracy of these readings as compared with those obtained by the ballistic method, testing the same iron by both methods; the results were found to accord well with one another, the scale reading of the magnetic tester being furthermore nearly proportional to the hysteretic loss; a straight line drawn from the origin to the observed points lies sufficiently near to all of them to allow the assumption of proportionality to be made as far as workshop testing is concerned; more exactly, the straight line passes a little to the right of the origin. It is intended to furnish each instrument with two standard samples of iron, together with a table giving their hysteretic loss as found by the ballistic measurement; in testing other samples the operator first notes the deflection given by the standard pieces, which serves as a calibration. The standard sample induction is taken as 4,000; to find the hysteresis for any other induction he gives a table of factors which he has deduced as a general mean from ballistic tests of many samples. The instrument might have been constructed by making the field revolve or making the axis vertical with a controlling spring, but he believes the form adopted is the best. In the discussion the instrument was greatly praised by Profs. Fleming, Foster, Forbes, Ferranti and Esson. Prof. Ewing stated that although intended primarily for the shop the instrument was also adapted for the laboratory, he used it himself in preference to the ballistic method for all except a comparatively small number of purposes.



EWING'S HYSTERESIS METER.

In discussing the paper the Lond. "Elec." referred to a source of error the elimination of which was not made quite clear in the paper, namely, the fanning which the revolving sample may exert on the delicately suspended magnet and which would not be eliminated by turning the sample in the reverse direction; in this connection it refers to a new apparatus by M. Deprez, of Paris, which appears to be similar except that round discs are used, the use of which might eliminate this error due to fanning.

Platinum Thermometer.—In Mr. Crompton's paper on electric cooking and heating, abstracted above, he describes his platinum thermometer which was used in the measurements. It consists of a spiral of a thin strip of platinum 0.002 in. thick by 0.05 in. wide, of sufficient length to have about five ohms resistance at 0 degrees C.; it is wound in the form of a double spiral on a strip of mica about one-half inch wide by four inches long which is enclosed and held between two similar sheets fastened at their edges, the total thickness of the whole being not more than that of a sheet of paper, and it can therefore be brought to within 0.01 of an inch from the surface whose temperature is to be measured. It is connected in series with a standard resistance of manganin and a small current from an accumulator passes through them; they are so adjusted that the voltage measured by a potentiometer is exactly the same on both when the platinum is surrounded by melting ice; the platinum is then exposed to boiling water and again compared on the potentiometer scale, the distance between the two points being divided into 100 parts each, therefore corresponding to one degree C.

Quadrant Electrometer as a Differential Instrument.—The "Elec. Zeit.," April 25, contains an article by Mr. Eisler in which he states that every quadrant electrometer can be connected like a differential galvanometer and can be used for a zero method for measuring resistances with both direct and alternating currents; for the latter it offers special advantages as it is the only possible zero method for measuring apparent resistances. He gives briefly the theory of the instrument for continuous and for alternating currents; the two resistances to be compared are connected in series, the needle of the electrometer is connected to their junction and each pair of diametrically opposite quadrants are connected to their other ends; the electrometer therefore compares the voltages at the terminals of these two resistances. It has been said even in authoritative books that the Wheatstone bridge can be used for measuring apparent resistances but this he says is impossible and proves it mathematically. As an illustration of the application of his differential method for measuring the apparent resistance, he cites the case of a 1-kw transformer which gave an apparent resistance of 4,010 ohms to an accuracy of 0.1 per cent., the current used being about 0.01 amperes; as the ohmic resistance was very small, the self-inductance is 15.3 henrys; he adds that the results will be correct even if the current is not a truly sinusoidal one.

Absolute Electrometer.—A more complete description of the instrument mentioned in the Digest last week is published in "L'Elec.," April 27, and "L'Ind. Elec.," April 25.

Hot Wire Instruments.—An illustrated description of the Hartmann & Braun ampere and volt meters, in which two wires at right angles are used, is published in "L'Elec.," April 27.

Nalder Ampere Meter.—A well-illustrated description of this instrument is published in "L'Eclairage Elec.," April 13; in principle it resembles the Weston instrument; a registering maximum and minimum instrument is also illustrated.

Sensitive Galvanometer.—A more complete description of the Weiss instrument (see Digest last week) is published in "L'Elec.," April 27, and "L'Ind. Elec.," April 25.

Apparatus for Measuring the Specific Inductive Power of Solids and Liquids.—An Academy paper by Mr. Pellat describing a new apparatus is reprinted in "L'Ind. Elec.," April 25.

Measurements of Self-Inductances.—The "Bul. Soc. Belge," Oct.-Dec., contains a paper by Messrs. Roosen, Colard and Close in which they describe briefly several methods of measurement and give the results of a large number of measurements of telegraphic and telephonic instruments; some of these results were given in THE ELECTRICAL WORLD, April 27, page 507. The method used for measuring discharge deflections is of interest; the scale is provided with a movable pointer with a red line on it, this being placed as near as possible to where the deflection is to be read off, the point being determined by trial; for the final reading it then suffices to read the difference between the deflection reading and the position of the red line, a distance which is always very short; this method is used when the discharge deflections are very rapid.

Researches with Induction in Cables.—Dr. Breisig's long serial is concluded in the "Elek. Zeit.," April 18; he discusses at some length the theory of the circulation of alternating currents in two mutually inductive lines.

Determination of the Spherical Intensity of Lights.—In a continuation of Prof. Blondel's article in "L'Eclairage Elec.," April 13, he gives a summary of the well-known formulas for continuous and alternating current lamps and incandescent lamps; the article is of interest but does not admit of being abstracted.

Measurement of Resistances.—A brief abstract of the article of Mr. Colson on the measurement of resistance by means of alternating currents and the telephone (see Digest, Feb. 16), is published in the "Jour. Inst. Elec. Eng." for April.

New Form of Carey-Foster Commutator.—A new form devised by Prof. Stine for the Armour Institute, is described and illustrated in the "Elec. Eng.," May 8; the leading features are directness of all connections, absolute freedom from liability of short circuits and that all connections may readily be seen.

Simple Electric Chronograph.—The "Elec. Eng.," May 8, abstracts from the "Amer. Jour. of Sc." (no date given) a brief description of a device of Mr. Barus.

Magnetic Tester for Measuring Hysteresis in Sheet Iron.—Prof. Ewing's article abstracted above, is reprinted in full with the illustrations in "El'ty," May 8.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone Induction Coils.—The new and improved form adopted by the German government and devised by Mr. Muench, is described and illustrated in the "Elek. Zeit.," April 25. The two objects to be accomplished were to diminish as much as possible the magnetic inertia of the iron and the electrostatic capacity between the two coils. The core is a small bundle of iron wires which have been shellaced to keep them from coming in contact with each other; the length is 5⅛ in. and the diameter about 1⅛ in.; after covering it with paper, the primary and secondary windings are wound on it, each consisting of about 4,000 windings and 10 layers of a 0.2 mm wire and these are then surrounded by a layer of iron wires about a quarter of an inch thick; the resistance of the primary is about 200 ohms and of the secondary 250; the apparent resistances and the self-inductances under different conditions are given; the electrostatic capacity between the two windings is extremely small, being 0.00185 microfarads; the efficiency is estimated to be about 97 to 98 per cent.

Effect of Traction Currents on Telephone Circuits.—The "Bul. Soc. Belge," Oct.-Dec., contains a long paper by Mr. Boulvin in which he describes in detail experiments made in Brussels with telephone circuits in the neighborhood of traction circuits; he discusses the electrolytic action of a return circuit, the dangers to persons and telephone installations caused by contact with the traction conductors, and disturbances produced in telephonic communications.

Disturbances in Telephone Wires from Neighboring Conductors.—Mr. Pierard's article (see Digest, Feb 9 and 23), is translated in abstract in the "Jour. Inst. Elec. Eng." for April.

Telephony in Japan.—The "Elec. Friend" (Japan) for March describes the telephone system on the Kobu railway; No. 11 B. W. G. galvanized iron wire is used; the system comprises five circuits embracing from two to eight stations each and covering a total distance of 83 miles.

Telephone Set.—The Morlé and Porché form intended for the table, is described with illustrations, including a diagram of the connections, in the "Elek. Zeit.," April 25.

Microphone.—The description of the new Mercadier and Anizan microphone, an abstract of which appeared in the Digest, Feb. 2, is translated in abstract, briefly, in the "Jour. Inst. Elec. Eng." for April.

Telegraphy.—In an editorial in the "Elek. Zeit.," April 18, the systems used in different countries are discussed briefly and it is pointed out that the ordinary system using the sounder is the most reliable, both for sending and for receiving; this was found to be the case in England; in regard to simplicity it far surpasses all others. The Wheatstone automatic is highly spoken of and, it is claimed, should be introduced on long direct lines as soon as there is sufficient traffic to require the laying of a second line.

Submarine Cables.—According to the "Elec. Friend" (Japan) for March a single core cable of 20 knots was laid by the Japanese engineers on the 8th of March between Japan and Corea to replace the faulty one formerly used; three knots at each end are shore-end cables.

Submarine Cables.—The Lond. "Elec. Rev.," April 26, calls attention to the great advantages of nickle-steel wire, which is practically noncorrosive and as strong as the best steel; it suggests that submarine cables be covered with this in preference to galvanized iron or steel wire.

Open Circuit Telephone System.—Amsterdam's system is briefly described and illustrated in the "Elec. Eng.," May 8; the currents are transferred by induction to the main line which has free ends; the advantage claimed is that the circuit is then incapable of transmitting or transferring telegraph signals; (according to the illustration the two wires between which the induction takes place, are run parallel near to the line; what the advantages of this are over an induction coil, like in the phonopore, is not explained).

History of the Telephone.—"Cassier's Mag." for May contains a short article by Mr. Jones, including some diagrammatical illustrations, of each of the prominent systems.

The Telephone and Its Operation.—"Cassier's Mag." for May contains a profusely illustrated article by Mr. Brooks.

Telegraphy as It Used to Be.—"Cassier's Mag." for May contains a well-illustrated article by Mr. Lodian describing some systems of signaling in use in olden times in France.

Time Service System.—A brief illustrated description of the system used in Milwaukee is contained in the "Teleg. Age," May 1.

MISCELLANEOUS.

Application of a Heated Wire.—In an article by Mr. Irish on "Non-magnetic Electric Devices," in the "Elec. Eng.," May 8, he describes and illustrates diagrammatically a large number of devices in which the expansion of a wire heated by a current passing through it, is used to replace the pull of an electromagnet. From a large number of experiments covering a period of several years, he is lead to the conviction "that electromagnets will in the near future be found only as relics of the past in museums." The advantages offered by the heated wire are said to be that it has comparatively no resistance or counter E. M. F. as compared with an electromagnet and that it will give the same results with fewer parts, greater simplicity and higher economy; among the large number of devices are a recording telephone and a "non-magnetic electric motor." In conclusion he states that a weight of ten pounds was repeatedly lifted with the heat derived from a match (but how often or how high is not stated). He remarks that it may be argued that the expansion of the wire is too sluggish for telegraph instruments, etc., and adds that this will be the case if the strip is too large or the current too weak, but the same adjustment applies equally to the electromagnets; (this is the only reference made to the objections which would naturally suggest themselves and which have doubtless been the reason why this well-known principle has been used so little; no references are made to high voltage or shunt magnets nor to the economy, or to the loss of the advantages due to the polarity of electromagnets).

Death from 280 Volts.—The "Elec. Eng.," May 8, contains several suggested explanations of the phenomena referred to in the Digest, May 4. Mr. Lamb says that even 110 volts will kill if applied to a bleeding sore and allowed to remain on a few seconds; the fact that it does not paralyze the nerves and that therefore contact can almost always be broken at once, is the reason why so few deaths have been occasioned by it; he believes that 280 volts in contact with a bleeding sore will kill almost instantly; he quotes Mr. Tesla as saying that 10 volts applied to a bleeding sore on the hand would put a man to sleep; (nothing is said of the second contact, which, it seems, would have to be almost equally good). Mr. Hench believes that the circuit supplying the power was probably broken at the moment that the victim was in contact with the machine and that he therefore received the induction current. Mr. Tyler believes that the cause of the death was from the shock, citing a number of cases in which the effect of an unexpected shock was much greater than that of one which was expected.

Calcium Carbide and Acetylene. The "Jour. Frank. Inst.' for May reprints in full a recent lecture by Messrs. Willson and Suckert giving a good summary of the subject, illustrated with a number of diagrams. They state that extended experiments have shown that one electrical horse-power readily produces 20 pounds of calcium carbide per 24 hours and present indications justify the assumption that with automatic feeding and proper insulation of the heat and the utilization of the waste heat, this can be increased to 30 pounds; they believe that the compound can eventually be produced at a cost of less than $5 per ton; some detailed estimates for a large plant are given; it is stated that arrangements are now being made to apply 1,000 electrical horse-power of the Niagara Falls plant for the manufacture of this material and this is shortly to be increased to 5,000 hp "and eventually we will without doubt see the entire available power the company now possesses converted into electrical energy for the manufacture of this product."

Electric Weed Killer.—The "Amer. Eng. & R. R. Jour" for May contains a brief description by Mr. Armstrong of a method of killing weeds on railroad lines, with which experiments have been carried on for some time. It consists of a 2,000-volt alternator mounted on a car the current of which is transformed up to from 6,000 to 24,000 volts depending on the kind and quality of the vegetation to be destroyed; the current is conducted through a series of fine wires to the tops of the weeds or grass, the other pole being connected to the ground through the rails; it traverses the entire length of the plant including the roots, rupturing the cellular tissues and thereby totally destroying it, especially the root which appears to suffer most; he states that the device is entirely practical; the discovery of the method is due to Capt. Sharp; it is said to reduce the cost of maintenance of right of way about $40 to $80 per year per mile; he believes that it will prove of great benefit for the extermination of the Russian thistle.

Cleaning Ships' Bottoms.—According to the "Eng. Mag." for April, it is reported that a method has been discovered by which the bottoms of sea going vessels may be kept clean with the use of an electrical apparatus and without docking; the process is not explained.

Biographical.—A brief sketch with a portrait of Alexander Graham Bell is published in "Cassier's Mag." for May.

New Books.

A Standard Dictionary of the English Language. Upon Original Plans. Prepared by more than 200 specialists and other scholars, under the supervision of Isaac K. Funk, D.D., Editor-in-chief. Vol. II. New York: Funk, & Wagnalls Co., 1895. 2,338 pages, 5,000 illustrations. Price, complete, $12.

The second volume of this work fulfills in every respect the promise of the first volume. There is the same excellent typography and binding, and the plan on which it was started has been most completely carried out.

This plan covers much more than has heretofore been considered to be lexicography. The work is, therefore, to a large extent an encyclopedia, and, furthermore, in some cases there have been original investigations made expressly for the purpose of settling doubtful points, so that accurate definitions might be given.

This is notably the case with the different shades of color. With the exception of a few important colors, such as red, blue, green, there has heretofore been great uncertainty as to what tint is meant when a particular name is mentioned. The editors have therefore endeavored to establish a standard nomenclature of colors to represent as nearly as possible the average usage of the present day among dyers and others who have occasion to classify colors; and having once established a standard color scale, each color is expressed in terms of certain other colors which are assumed as primaries, by means of experiments with Maxwell's color discs.

There can be but one opinion as to the value of the information derived from this investigation, although there has been some difference of opinion as to the propriety of publishing this class of information in a dictionary. Strictly speaking, this is not, of course, lexicography, and the adverse criticisms of the work so far are mostly based on the charge of too great inclusiveness, but the average purchaser will not be likely to complain because the work contains more than its title indicates.

Another peculiarity of the plan of this work, regarding the propriety of which there has been some difference of opinion, is the method of deciding the correct meaning of a word. The criterion of the Standard is in every case present usage, rather than etymology or scholastic opinion. This method, whether it be regarded as the best or not, is, at least, faithfully carried out, like all other parts of the original plan.

The work contains not only all ordinary words, but a most exhaustive vocabulary of all technical terms, including all the new words in the science of electricity, even "reactance," which is the latest of all. There is a very complete list of synonyms given with all common words, and also antonyms where there are any.

Some idea of the completeness of the scientific vocabulary may be formed from the statement that the space of two columns is devoted to magnetism and allied words. This list begins with "magne-crystallic," which is a rare word even among electricians.

Further on the word "magnetine" occurs (also, alternatively, without the final *e*,) which is defined thus: 1. A hypothetical imponderable substance assumed to be the medium of magnetic phenomena. 2. A compound of cement and some magnetized material, used in magnetic belts, etc. At the end of the magnetic list we find "magnetod," the same as magnetine, and a reference to "od." Looking up *od* we find, as might be expected, that it relates to Baron von Reichenbach's odic force.

This, then, is all that there is of the first definition of magnetine, and as to the second definition, it appears to be only a trade name, and no more entitled to a place in a dictionary than micanite or cuticura, if, indeed, it is not the name of some electrotherapeutic humbug.

Ohmage, as the analogue of voltage, is given. Ohmic is defined, "Of or pertaining to an ohm; measured or capable of being measured in ohms." This is not quite satisfactory, as the practically exclusive use of the word ohmic has heretofore been in the combination "ohmic resistance." In this case ohmic means of or pertaining to Dr. G. S. Ohm's original conception of resistance, that is, true resistance as distinguished from spurious resistance, and has no reference to the unit called ohm. Ohmic resistance is still ohmic, though it be measured in Siemen's units, electrostatic units, or any arbitrary units. On the other hand, the different kinds of spurious resistance, such as that due to self-induction or to electrolytic polarization, may be and usually are measured in ohms. Again, reactance, which is not even a spurious resistance in the ordinary sense, is measured in ohms.

The scientific alphabet of the American Philological Association has been adopted as a key to pronunciation. This is a good plan, as the methods of indicating pronunciation are nearly as numerous as the dictionaries in which they are used.

There is one respect in which the Standard is especially worthy of praise: namely, in the effort to form a consistent rule for writing compound words. A word which is formed by combining two separate words, may be written as a single word, may be written with a hyphen between the components, or as two separate words without any other sign of unity of meaning than juxtaposition. Heretofore it seems to have been purely a matter of chance how such words were written, but the Standard reduces them to a system of rules with as few exceptions as any other rules of English spelling or grammar.

Telegraphers of To-day. Compiled by John B. Taltavall, New York: Published by the compiler, 1895. 384 pages, quarto, 3 illustrations and 661 portraits. Price, $5.

This work has for its object to present biographical sketches of those who are prominent in telegraphic work to-day, or have been during the past 50 years, a portrait of each subject accompanying the sketch. The work is divided into four parts. Part I. is devoted to Western Union men and opens with engravings showing the Western Union Company's New York and Chicago offices. Next following is a magnificent full-page portrait of Gen. Thomas T. Eckert, with over a page of biographical matter.

Part II. embraces the prominent men in the Postal Telegraph service, the first in the list being Mr. A. B. Chandler, of whom there is a fine full-page portrait, corresponding with that of Gen. Eckert. An illustration of the splendid new building of the Postal Company is also given.

Part III. is devoted to "old timers" who have turned aside into other pursuits, but whose names are yet familiar to the telegraphers of the present day, among them being Ezra T. Gilliland, Thos. D. Lockwood, Dr. Wm. S. Morris, Ralph W. Pope, Jas. D. Reid, John Nelson Gamewell, Geo. F. Milliken, Thos. A. Edison, Jesse H. Bunnell, and D. H. Bates.

Part IV. includes men who are connected with the cable companies and press associations, opening with a full-page portrait of Mr. Geo. G. Ward. Some of the most familiar names in this section are those of Walter P. Phillips, P. V. DeGraw, R. W. Martin, Fred Catlin, "Billy" Kettles, and John B. Sabine.

It is unfortunate that many men who are now prominent in telegraphic circles and some who were well known a dozen years back, have been left out, but the scope of the work naturally precluded the possibility of absolute completeness.

The book is printed on heavy plate paper, in large type; the portraits are unusually well reproduced, and the binding is thoroughly tasteful and substantial. The work is of exceeding interest and value as a souvenir to those who are or have been connected with telegraphic work.

American Street Railway Decisions. Vol. II. By Chas. A. Richardson and A. J. Hook. Brooklyn: American Street Railway Association. 483 pages. Price, $5.00.

In the course of electrical progress the laws, while more intimately associated in electrical matters with patent rights, plays no mean part in street railway affairs. Franchise, right of way, speed of cars, injuries to passengers and others often involve a law suit, the decision of which forms a precedent which is of as much importance as the public statutes themselves in the adjudication of similar causes.

The cases in the courts are many and varied, and in order to have them of any value on a record, they must be classified and arranged for ready reference. The special classification that Messrs. Richardson and Hook have endeavored to give cases bearing on American street railways is a work of magnitude, and will prove indispensable to lawyers on street railway matters. The complete work purports to include all reported cases decided by the courts of the United States and Canada down to the present time, and it is estimated that six volumes will be necessary for this purpose.

The second volume has just appeared, and is doubtless a fair sample of the whole. The book appears to be a compilation from various digests, the cases being concisely discussed, with the evidence and whatever else is necessary to make the case intelligible given. Then follows the judge's decision, which really occupies the greater part of the space. The cases are chronologically arranged, and a copious index forms a special feature. A synopsis of each case is given therein, and one can gain a knowledge of the nature of the same without looking it up further. Thus the rapid selection of a case bearing on the matter in hand is greatly facilitated. Moreover, it is impossible to look up any one matter without having reference to all cases bearing at all on the subject. This, of course, involves much repetition of cases and their synopses, but this repetition is fully justified. The index comprises 76 pages and thoroughly reviews the 407 pages of text. To lawyers the work will be of value, and the cases are so clearly and concisely discussed without an excess of legal phraseology, that the layman street railway official can also refer to it with advantage.

Vol. II. includes the cases decided from 1860-64 inclusive, and relates largely to New York decisions. It is safe to say that the succeeding volumes will have a much more general interest to electrical men than is usual with such works. The series is of a standard nature, and its value cannot be disputed.

The well-known treatise on alternating currents, by Drs. Bedell and Crehore, has been translated into French by M. Jules Berthon and published by Georges Carré, 3, rue Racine, Paris, under the title "Etude Analytique et Graphique des Courants Alternatifs, A l'Usage des Ingenieurs et des Eléves des Ecoles."

The Arnold Alternating Current Motor.

A United States patent was issued on May 7 to Prof. E. Arnold, of Zurich, Switzerland, for a self starting, simple alternating current induction motor, the main feature of which, as will be seen below, is the arrangement and control of the field magnet circuits. By the method used the motor becomes self starting and objectionable losses of energy in starting up are obviated.

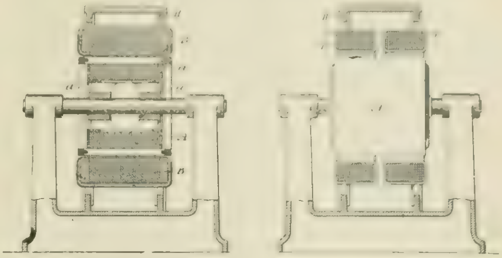
Reference is made in the specification to the manner in which the above difficulty has been attacked, some of the devices employed operating by unbalancing the magnetic field and others by commutating the induced currents in the armature. In the present instance an initial rotation of the magnetic field is effected, through which the armature is started, and when speed has been attained, the connections are changed in such a manner that the machine operates as a simple alternating current motor. At starting, current is supplied to the field magnets in such a manner as to produce one set of poles at certain points and a second series of poles at a different angular position to the first named. In this manner a successive shifting of the magnetic field takes place, which causes the armature to rotate and acquire speed. When sufficient speed has been attained, the connections of one or both of the two field circuits are changed until the poles produced by both of the field currents correspond, and the phases of the two currents are brought into synchronism, either by changing the inductance of one or by connecting the two sets of windings in series. When these changes have been effected the motor operates as a simple synchronous induction motor.

Where short-circuited armature windings are employed it is preferable to sub-divide them and close some of them through a resistance while starting; and then, as speed is attained, successively close the circuits of the other coils. In this manner less current is generated in the armature and heating and waste largely prevented. Where the field magnets are stationary and the armature revolves, it is not always convenient to make such armature connection, but where the field magnets rotate and the armature is stationary the opening and closing of the armature coils may be readily effected by a series of stationary switches.

Referring to the illustrations, Fig. 1 is a longitudinal cross section of one type of motor, showing the form of the field magnet and armature cores and some of the windings, with the electric connections and switches omitted. Fig. 2 is a similar view showing a modification of the form of field magnet cores. Fig. 3 is a diagrammatic illustration of the winding and connections of the field magnets.

Referring to Figs. 1 and 2, the armature is shown at A, the field core at B, and the housing or stationary frame of the machine at H. In Fig. 1 the field magnet core is of the ring type with inwardly projecting pole pieces. In Fig. 2 the field core is formed of two parallel rings carrying the respective field coils b and b', the latter being commutated, to change the position of the poles produced by it in accordance with the invention. In Fig. 1, the armature windings are shown of the permanently closed circuit type, the parallel conductors or bars a terminating in the connecting rings a' at each end.

The field windings and circuit connections are diagrammatically set forth in Fig. 3. The field cores are indicated as above by B. For convenience of illustration two separate field cores are shown, as in Fig. 2, but the two sets of windings may of course be mounted on a single core as in Fig. 1. The field current is supplied from the transformer T, to the secondary coils of which the two field windings b, b', are connected in shunt. Current from the terminal v flows through the inductive resistance M, coils b, switch s and back to the other terminal v' of the transformer. Current also flows from the terminal v through the switch s', brush d, thence through the series connected field windings b', by brush d', resistance R, to terminal v'. The inductive resistance M and the ohmic resistance R cause a difference of phase between the two branches of the circuit from the secondary coils of the transformer. The phases in the branch containing the inductive resistance will of course lag behind those containing the ohmic resistance. The poles produced by the coils b for one impulse of the current are indicated by the letters N and S, respectively. Those produced by the winding b' are indicated in the same way.



FIGS. 1 AND 2.

The winding b' is termed a series connection field winding, and 19 coils and 19 commutator plates C, are shown, numbered 1 to 19, respectively, so that the circuits may be readily traced out. Each terminal of each coil is connected with the terminal of the coil sixth from it, that is to say, separated by five coils. Coils therefore connected in series produce currents in the same direction at the three points of the core approximately 120 degrees apart; and by placing the brushes upon commutator segments separated from each other by two segments, six poles may be produced in the magnet as indicated by the letters N and S, respectively. The brushes may be shifted to alter the position of these poles. At starting, the poles should be about midway between the pole produced by the other winding b and the currents in the two windings should differ by a quarter of a phase. If the currents differ by less, the angular difference between the poles produced by the two windings should be proportionately less. In practice the proper position will be the one in which the greatest torque is produced with a minimum current.

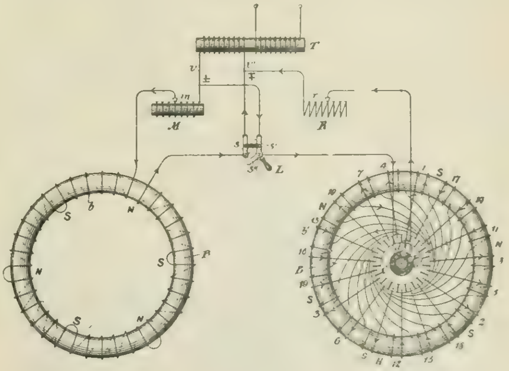


FIG. 3.

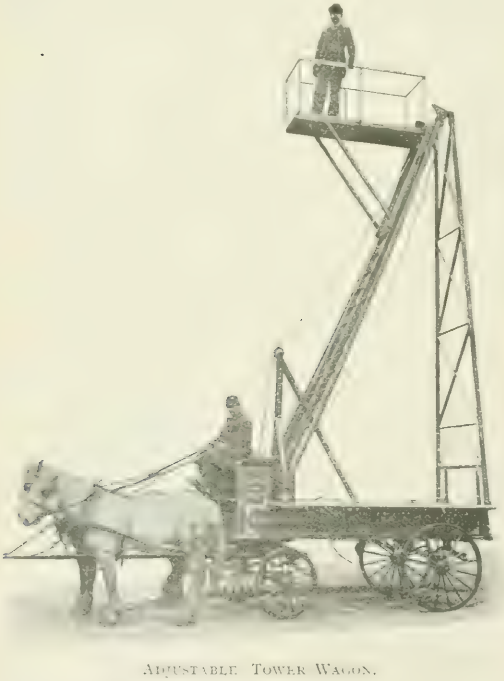
As the armature acquires speed, the inductive resistance M may be reduced by means of the sliding contact m and the retardation of the phases in the winding b thereby decreased. At the same time the resistance R may be cut out by the sliding contact r until the phases in the circuits b' correspond with those in the circuit b. This gradual reduction of the difference in the phase may be effected simultaneously with a shifting of the brushes d, causing the poles produced by the two sets [illegible] to correspond at the instant the phases [illegible] the motor is virtually operated [illegible] The field windings [illegible] and [illegible] may then be thrown in series by means of the switch lever L breaking the circuits of the switches s and s' and closing the switch s''. The series connection will then be as follows:—from terminal v through contact m (with or without any inductive resistance M), field winding b, [illegible] winding [illegible], brush [illegible], contact [illegible] preferably with no ohmic resistance K) back to the other terminal v' of the secondary coils t of the transformer T. Either the ohmic or the inductive resistance may be omitted; and the correspondence of the two phases may be produced solely by means of the switch which connects them in series. In the latter case, field windings b' are preferably commutated to correspond to the winding b before the switch s'' is closed.

An Adjustable Tower Wagon.

The accompanying illustration shows a tower wagon designed for the use of the Allegheny County Light Company, of Pittsburgh, Pa. The object in view was to provide a device which could be so adjusted as to reach the highest arc lamp or to pass under trolley wires and bridges, and still be light enough to be handled by two men

The tower consists of a large step-ladder, hinged at the top and at the foot of the sloping leg. The back leg is adjustable along the wagon floor, enabling the operator to put the apex of the frame at any height above the wagon from the maximum, as shown in the cut, to a position nearly on a level with the wagon floor.

The platform slides up and down guides on the sloping leg of the ladder structure, and is controlled by a winch in the body of the wagon, the handle of which may be seen near the front wheel. The winch has two drums which may be worked independently or simultaneously, by means of clutches on the spindle. One of these drums controls the tower frame and the other raises or lowers the working platform. The latter is provided with hooks which engage with the rungs of the ladder and sustain it at any desired height. The wagon is 5 feet 6 inches wide, 5 feet high, and contains space for all the necessary tools of the line men. The platform is 7 feet long and 2 feet wide and is 24 feet above the ground in the highest position, and 18 feet in the lowest, with the tower up. The whole tower can be lowered to pass under a 13-foot doorway.



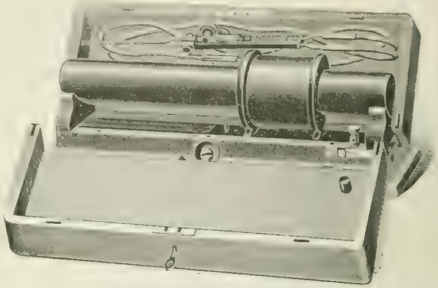
Adjustable Tower Wagon.

Fire Risks in Factories.

A recent dispatch from Waterbury, Vt., to the Boston *Journal* gives an account of the destruction of over $10,000 worth of property by a fire which originated from a hot box in a factory. This would seem to furnish an incentive to the trial of some of the electrical devices for giving an alarm upon the overheating of a journal.

The Kennelly Cautery Transformer.

A very compact, portable transformer has been put on the market by the Edison Manufacturing Company, of 110 East 23d street, New York, the object of which is to enable physicians to use 52-volt or 104-volt alternating current, for electro-cautery and diagnostic lamp purposes. The primary circuit of the transformer is composed of a large number of turns of fine insulated copper wire and is wound around a core of annealed iron wires, the whole being enclosed in a thin cylindrical shell of hard rubber supported by a hard rubber standard at each end. The secondary coil, composed of a few turns of thick wire, is wound on a hollow hard rubber spool and moved by a rack and pinion back and forth over the primary coil. The terminals of the secondary coil are brought out to two pin attachments mounted on one head of the coil, and the cautery cords are connected thereto by split socket connections. On moving the secondary coil to the right, the current is increased and vice versa.



Cautery Transformer.

The apparatus is mounted in a highly polished mahogany box which opens down the middle, as shown in the cut, and is fitted with a switch at the side which automatically cuts off the current when the lid is closed. It is provided with an attachment plug and 10 feet of flexible cord for connecting the instrument to the mains.

A Prosperous Electrical Supply Establishment.

In the business of general electrical supplies Boston may certainly claim at present a very creditable representation, not alone as to quality, variety and cheapness, but as well for spacious and handsome salesrooms in which abundant opportunity is afforded for display. Following the publication of other interior views we present herewith the interior of the salesroom of the Thompson-Brown Electric Company, of Boston, with headquarters at 97 High street, which for general arrangement compares favorably with any supply house in existence. Although but recently organized its management is not by any means new to the electrical field. The entire street floor of the building is used for the salesroom and offices, while the basement is devoted to stock and the shipping department. A most complete and varied stock of electrical supplies is carried, conspicuously and temptingly arranged for customers. In the line of street railway material it presents an assortment (all of which are inventions of Mr. George Thompson, Jr., president of the company) claimed to be second to none in existence, while the line of electric lighting and supply specialties embodies everything needed. The concern started with good business recognition from old friends of the management which it has been able to hold straight along, and hosts of new friends and patrons have been made through untiring and energetic effort. In the view presented the executive and clerical staff conspicuously appear.

Supply House Interior.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, May 11, 1895.

AMERICAN BELL performed a sudden gymnastic feat on Wednesday, jumping from 190 to 193 with practically a single spurt, and it has continued bullish throughout. A director of the company states that if the instrument output continues until May 20 as it has since April 20, the instrument account for the month will show as large a gain as last month, which showed a gross increase of 11 277 instruments, and a net gain of 9,722, and was the largest month in the history of the company. It is claimed by some that the strength of the stock is due to the belief that Judge Carpenter's decision was an unjust one and will probably be reversed. As those who are most closely interested have little to say on this score it would appear that this opinion is confined to the more optimistic and less well-informed contingent of American Bell's friends.

NEW ENGLAND TELEPHONE has made its annual report, which shows a surplus for 1894 of $91,917 as compared with $55,761 for 1893. A sixth issue of $500,000 5 per cent. 20-year bonds has been authorized by the directors.

AMERICAN CABLE displayed rather unusual activity this week, on Tuesday reaching a point where none was for sale, and climbing to par to-day.

ELECTRICAL STOCKS.	Par.	Bid.	Asked
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	100¼	101
" " " Brooklyn	100	..	108
" " " Boston	100	130	..
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	29	..
General Electric	100	34	34
General Electric, pref	100	..	65
Westinghouse Consolidated, com.	50	34½	35
" " pref	50	52	52½
BONDS.			
Edison Electric Ill., New York	100	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co. deb. 5s	100	..	90¼
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	194	194½
American District Telegraph	100	30	40
American Telegraph & Cable	100	95½	100
Central & South American Telegraph	100	117	120
Commercial Cables	100	141	..
†Erie Telephone	100	57	57½
Gold & Stock Telegraph	100	105	.
New England Telephone	100	.	70
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63½	.
Western Union Telegraph	100	93⅛	93½
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	17⅛	17⅝
Binghamton RR. com	100	100	..
Brooklyn Traction	100	11⅛	14
" " pref.	100	..	53
Buffalo St. Ry	100	70	72
Cleveland City Ry.	100	68	70
Cleveland Electric Ry.	100	59	60
Chicago City Ry	100	305	315
Columbus St. Ry	100	48½	..
Consolidated Traction of N. J	..	26	30
Electric Traction, Philadelphia	50	74½	75
Long Island Traction	100	11¼	12½
Louisville St. Ry. com.	100	37	39
" " " pref.	100	87	88
Metropolitan Traction, Philadelphia	100	96¼	96⅝
New Orleans Traction	100	14½	16
" " pref.	100	56	60
North Shore Traction	100	23	28
" " pref.	100	88	93
People's Traction $30 pd.	25	60	60¼
‡Philadelphia Traction	50	83¾	84
Rochester St. Ry	..	38	..
Union Ry. (Huckleberry)	100	112	115
West End, Boston	100	..	69
" " pref	100	90	..
Worcester Traction	100	13	16
" " pref	100	83	87
BONDS.			
Buffalo St. Ry. 1st con. 5s	100	104	105
*Binghamton Railroad Co. 5s	100	99	100
*Columbus St. Ry. 1st 5s.	100	98	..
Rochester St. Ry. 1st. 5s.	100	95	97
*Union Ry. 1st. mtge 6s.	100	105	108
*Westchester Electric 1st. mtge. 5s.	100	98	101

* With accrued interest.

† Ex-Div.

‡ Ex-rights.

WESTERN UNION has been kept down for a week by a block of stock for sale around 89⅛. Traders have run against this stock in their efforts to advance the price and, to some extent, have gone short banking on it. On Tuesday Moore & Schley apparently determined to move Western Union and slowly baled out Mr. Campbell's 2,000 shares. After it had been taken, the price was easily moved to 90 where stop-orders took the stock for sale. Above 90, the buying was more general and by people who have been waiting for a chance to buy Western Union on advancing prices.

GENERAL ELECTRIC, despite the fact that local commission houses had been advised to look for a sharp and sudden rise on Thursday, was only firm. No reason has been assigned for the expectation that the stock is about to develop a pronounced advancing tendency other than the previously exploited fact that the business of the company is steadily improving. The consolidation project with the Westinghouse is said to be in abeyance. Possibly, however, developments in that connection are relied upon to stimulate strength in the stock.

THE TRACTIONS are all on a mild boom, a decided advance being noted all along the list, with the exception of Consolidated Traction of New Jersey.

BALTIMORE TRACTION to-day reached its highest point this year, and the annual report shows an increase in net earnings of $15,712 over 1893.

PEOPLE'S TRACTION also reached the highest point to-day since Jan. The gross earnings on Sunday, May 5, were the largest in the history of the company, aggregating $7,501, an increase compared with the same day last year of $4 717.

WEST END is still doing phenomenally well, the gross gains of $1,000 and $1,500 per day being almost entirely net gains to the advantage of the common stock. It is understood that the company has considerably more than $1,000 000 in bank, no debts, and will soon have to consider the problem of distribution of earnings above the 6 per cent. it is now paying upon the common stock. It is not generally known that West End, by changing its dividend days, made an extra dividend last year. What it will do this year cannot yet be told.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 BROADWAY, NEW YORK May 13, 1895.

THE CONEY ISLAND & BROOKLYN RAILWAY COMPANY has applied for permission to construct a trolley line on Greenwood avenue, from Prospect Park to Greenwood Cemetery.

FRANCHISES DECLARED VOID.—The Nassau & Kings County Electric Railway Companies' franchise for the Union street route, Brooklyn, have been declared void by Justice Smith of the Supreme Court. The court finds that "the franchises were granted for a less sum than could have been obtained from a competing company, and that they were given in bad faith and as a matter of favoritism to the defendant companies." The defendants will probably appeal the case.

THE ELECTRICAL THEATRE SIGNS were all extinguished on Tuesday night of last week, for the first time in many months. The signs had been, in most cases, moved back, but the Bureau of Incumbrances decided that they still infringed the law and ordered them to be left unlighted until they were moved back far enough to conform to the letter of the law. Hence the dismal aspect of the Tenderloin on Tuesday night. Matters were adjusted on Wednesday and the theatre district again rejoices in a blaze of glory, though less advantageously displayed.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, May 11, 1895.

MR. J. S. KEENAN, for a number of years connected with the Holtzer-Cabot Electric Company, has been added to the force of the Thompson-Brown Electric Company as traveling salesman.

THE PETTINGELL-ANDREWS COMPANY has secured an excellent order from the municipal plant at Marlboro, Mass. for wire and line equipment incident to the increase of this plant. It also reports a very gratifying increase in business generally.

MR. H. C. HAWKS, president of the Anchor Electric Company, Boston, has just returned from an extended western trip which included the Pacific Coast. He captured some excellent orders, located several desirable agencies, and was greatly benefited in health by the trip.

MR. P. M. REYNOLDS, the popular treasurer of the Anchor Electric Company, Boston, has been wearing a perpetual cheerful and happy smile all the week because of the appearance last Monday in his charming home of a "bouncing" youngster. If his signature happens to be a little shaky his friends will now know that the many hearty hand-shakes he has received have much to do with it.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON May 6, 1895.

ELECTRIC UNDERGROUND RAILWAYS.—As I reported some time ago a demand for subscriptions fathered by the Great Northern Railway Company, for an electric tunnel railway running into the city, was not responded to by the public. Since then it has been attempted to alter the terms of the franchise and to obtain permission to use steam in place of electricity in connection with this line. The Standing Orders Committee of the House of Commons has, however, declined to accede to this request.

ELECTRICAL EQUIPMENT OF THE LEEDS POSTOFFICE.—It is unnecessary to state that the entire building will be lit by electricity, but in addition thereto electric motors will be made use of for the purpose of working the pumps in connection with the pneumatic despatch arrangements. Perhaps the most important change is the substitution of secondary for primary batteries for telegraphic purposes. It is estimated that about 200 secondary cells will be sufficient to replace the whole of the primary batteries. Accumulators will also be made use of to supply the currents needed for the large telephone room which is being prepared in view of the acquisition of the trunk telephone lines by the State.

ROYAL INSTITUTION.—Prof. Forbes has commenced a short course of lectures on "Alternating and Interrupted Electric Currents" at the Royal Institution. In commencing his first lecture he remarked that if his audience expected to hear anything about his work at Niagara, which he had just completed, he was afraid they would be disappointed.. He restricted his remarks to magnetic analogues of electrical phenomena, which take place when an electric current is reversed or interrupted. Tesla's experiment of lighting a glow lamp in a rapidly alternating electrostatic field was shown to good effect, Prof. Forbes taking the rapidly reversing charge through his own body. He assured his audience that he felt none the worse for this, and remarked that "no man was ever killed by volts, only by amperes." In the latter part of his lecture the professor explained some magnetic analogues of curbing submarine telegraph signals.

MUNICIPAL ELECTRIC LIGHT FINANCE.—In their report for the year 1894 the electric lighting committee of the St. Pancras vestry stated that their total capital expenditure up to date now amounts to £110,000, and that they have connected to their mains 15,500 incandescents, 129 arcs and 22 motors, and that the net result of the year's working, after providing for bad debts, repayment of loan, interest cf loan, etc., is a profit of £1,754, which, they point out, together with the amount set aside for interest and repayment of loans, is equivalent to a dividend of over 6 per cent. on the capital expenditure, and would be available for distribution to the shareholders if the undertaking belonged to a company. An interesting question is raised by the paragraph of the report dealing with the question of creating a depreciation fund. The committee state that they have not set aside anything for depreciation, since they consider that the sums set aside to repay the loan are equivalent to the building up of a depreciation fund. It has however, to be remembered that, so far these loans have been for a period of forty-two years, and it is hardly to be expected that, at any rate, boilers, engines and dynamos, and probably mains, will last anything like that time, so that unless something more is set aside the vestry will find itself shortly under the necessity of raising further loans for the purpose of maintaining the present plant in a proper condition, a not altogether satisfactory result of municipal enterprise.

AGRICULTURAL LIGHT RAILWAYS.—Your readers may possibly recollect that in consequence of a long-continued agitation, the president of the Board of Trade recently called together a conference on light railways, the delegates to which represented all conceivable interests, agricultural and municipal This conference appointed a committee to inquire into the question of cheapening the preliminary expenses, constructional cost and operative cost of railways intended for the purpose of transporting agricultural produce from farms to the nearest market. A report was presented by the committee within a few weeks of the time urging upon the Board of Trade to immediately introduce a bill into Parliament providing for the authorization of such lines by the local authorities, instead of by Parliament, and a radical relaxation of the stringent regulations of the Board of Trade, which they considered were only applicable to lines upon which express trains and heavy traffic is run. On Thursday last a bill, embodying the suggestions of the committee, was introduced by the president of the Board of Trade, and supported by him in a very lucid speech. Owing, however, to the absence of any provision for the subsidization of these lines either by the treasury or by local authorities the bill was received with a chorus of disapprobation. I think, however, that it is not likely that any member representing an agricultural constituency will imperil his seat by factious opposition to this measure, which, although not put forward as a panacea for agricultural depression, may prove, if properly made use of, a decided palliative. Electric traction syndicates, construction companies and what not have lately been forming and reforming in an alarming fashion. It is to be hoped that some one or other of these concerns will take time by the forelock and set to work to educate the English agricultural mind on the marked advantages of electricity for agricultural light railways.

General News.

NEW INCORPORATIONS.

THE WESTERN MARYLAND TELEPHONE COMPANY, Westminster, Md. capital stock $10,000, has been formed.

THE PROCTOR HEATING COMPANY, Chicago, Ill., capital stock $10,000, has been formed to do a general electrical, steam and hot water heating, gas fitting and sewerage business.

THE EMPORIA TELEPHONE COMPANY, Emporia, Kan., capital stock $8,500, has been incorporated by Calvin Hood, L. L. Hallock, S. Strauss, T. H. Dinsmore, David Stone, D. W. Morris and W. R. Irwin.

THE SMITHVILLE WATER & LIGHT COMPANY, Smithville, Tex., capital stock $40,000, has been formed to furnish water and electric light. K. H. McCaskill, R. E. McCoy, L. L. McCoy all of Smithville, are interested.

THE GWYNN'S FALLS RAILWAY COMPANY, Baltimore, Md., capital stock $30,000, has been incorporated by Jos. B. Seth, Henry Clark and others to build an electric road in the western suburbs to Powhatan and Wetheredville.

THE PERRY WATER, LIGHT & ICE COMPANY, Perry, Okla. Ter., capital stock, $150,000, has been incorporated. Wm. E. Caldwell, Benj. J. C. Howe, Indianapolis, Ind., and Edw. S. Gaylord and E. D. Nims are interested.

THE SELLERS MANUFACTURING COMPANY, Chicago, Ill., capital stock $50,000 has been formed to purchase, manufacture and sell railway appliances and supplies. The organizers are James Stillwell, Corwin V. Howell and Frank J. Loesch

THE WESTERN LIGHT COMPANY, Kansas City, Mo., capital stock $30.000 has been formed to do a general electrical and gas business Chas. A. Gray, Lessia A. Hull, Ed. F. Littleton, and John W. Hull, of Kansas City, Mo., are the promoters.

THE SIOUX RAPIDS ELECTRIC LIGHT & POWER COMPANY, Sioux City, Ia., capital stock $8,000, has been formed to establish and maintain an electric light and power plant. The interested parties are H. D. Smith and M. P. Smith, Sioux Rapids.

THE NUNDA ELECTRIC LIGHT COMPANY, Nunda, Ill., capital stock $5,000, has been formed to furnish electric light and power to the residents of Nunda and Crystal Lake. E. C. McColloum, H. H. McColloum and E. E. McColloum are interested.

THE ABILENE WATER COMPANY, Portland, Me., capital stock $125,000, has been formed to manufacture gas and electricity, machinery, fixtures, etc., for gas, water and electric light plants. Wm. C. Eaton, Edw. D. Noyes and Geo. F. Noyes are interested.

THE PAOLA WATER COMPANY, Portland, Me., capital stock $150,000, has been formed to manufacture gas, generate electricity, etc., also to make fixtures, etc., for such plants. Wm. C. Eaton, Edw. D. Noyes, Geo. F. Noyes, Portland, Me , are interested.

THE NEW ENGLAND TURBINE & FUEL COMPANY, capital stock $1,000,000, has been incorporated to generate, apply and use motive power of all kinds. The promotors are I. W. Derby, Boston; Dexter B. Wentworth, and Chas. H. Crane, Somerville, Mass.

THE GRAFTON TRACTION COMPANY, Grafton, W. Va., maximum capital stock $150,000, has been formed to own build, construct and operate an electric street railway from Grafton to Pruntytown, etc. F. A. Moran, H. M. Sommerville and E. M. Morlan are interested.

THE CITY PARK RAILWAY COMPANY, Portland, Ore., capital stock $25 000, has been formed to build and operate electric railways, electric light plants, own property, etc. S. Z. Mitchell, C. N. Huggins and J. A. Cranston, of Portland, Ore., are interested parties.

THE ZANESVILLE & COLUMBUS ELECTRIC RAILWAY, Columbus, O., capital stock $10,000, has been formed to build an electric railway from Columbus to Zanesville. The interested parties are W. J. Dunzweiler, Albert Adams, A. W. Evans, L. W. Doane, and A. A. Patterson.

THE THREE CITIES ELECTRIC COMPANY, Colorado Springs, Colo , capital stock $100,000, has been formed to acquire, manufacture, own, let, lease, sell and supply light, heat, and power. A. A. McGovney, A. L. Lauton and E. J. Eaton, of Colorado Springs, are interested.

THE CRAWFORDVILLE WATER AND LIGHT COMPANY, Portland, Me., capital stock $300,000, has been organized to manufacture gas and electricity, also machinery and electric light plants. Wm. C. Eaton, Ed. D. Noyes, and Geo. F. Noyes, Portland, Me , are interested.

THE CHAPIN-DOUGLAS ELECTRIC COMPANY, New York, capital stock $10,000, has been formed to manufacture and deal in electrical and mechanical apparatus and supplies. The promoters are Chas. E. Chapin, Greenwich, Conn.; J. S. Douglas and F. W. Douglas New York.

THE LAWRENCE WATER COMPANY, Portland, Me., capital stock $200,000, has been formed to manufacture gas, generate electricity, and make and sell fixtures for gas, water and electric light works. Wm. C. Eaton, Edw. D. Noyes, and Geo. F. Noyes, Portland, Me., are interested.

THE HARRINGTON, FREDERICA & DENTON ELECTRIC RAILWAY COMPANY, Denton, Md., with a maximum capital stock not to exceed $350,000, has been incorporated by Robt. W. Reynolds, Ezekiel Fleming, H. Harrington, B. L. Lewis, and others, to build an electric road.

THE KITSEE ELECTRIC COMPANY, Camden, N. J., capital stock $75,000, has been incorporated to manufacture dynamos, motors and electrical contrivances of all kinds. The promoters are John M. Carroll, Camden, N. J.; Robt. A. Balfour and Leo. J. Tierney, Philadelphia, Pa.

THE UNITED ELECTRIC TELEPHONE COMPANY, New York, capital stock $50,000, has been incorporated. Norman C. Raff, Frank R. Gemmon, Henry C. Williamson, Albert L. Richardson, Chas. P. Rowland, Henry A. Tobb and F. C. Toepleman, of New York, are interested.

THE WESTCHESTER & WILLIAMSBRIDGE TRACTION COMPANY, New York, capital stock $60,000, has been formed to build and operate a street surface road 5¼ miles long in Westchester County. Geo. P. Morgan, A. P. Stanford, C. J. Tracy, and J. E. Chandler are interested.

THE CONSOLIDATED GAS COMPANY, Jersey City, N. J., capital stock $750,000, has been formed to buy, build, own and operate gas and electric works. Jos. C. Davis, Maplewood, N. J., and Henry A. Jones, Geo. Place, of New York, and Thomas Ewing, of Yonkers, N. Y., are interested.

THE ELECTRIC SCALE COMPANY, Kittery, Me., capital stock $600,000, has been incorporated by W. H. Doble and H. F. Doble, the former as president, and the latter as treasurer, to manufacture electric automatic weighing machines

THE SHELBYVILLE WATER COMPANY, Portland, Me., capital stock $175,000, has been formed to manufacture gas and electricity, machinery and xtures for gas, water and electric light plants Wm. C Eaton, Edw. D Noyes, and Geo F. Noyes, Portland, Me., are the interested parties.

THE MOUNT VERNON TELEPHONE & MESSENGER COMPANY, Mount Vernon, N. Y., capital stock $40,000, has been formed by Horace Granfield, C. H. Ostrander, F. T. Davis and others to operate an electric telegraph or telephone line to connect the towns of Westchester county.

THE EDGEWOOD & SULPHUR SPRINGS PASSENGER RAILWAY COMPANY, Williamsport, Pa., capital stock $10,000, has been incorporated to build an electric passenger railway. The promoters are W. E. Ritter, South Williamsport; C. L. Crouse and Jno. L. Kelly, of Williamsport.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, Ill., capital stock, $5 000 000, has been formed to equip and operate steet railways to be operated by horse power or electrical devices, or other power excepting steam. Those interested are Robt. P. Parker, Richard E. Breed and Jas. F. Dagley.

THE ELECTRIC PORCELAIN & MANUFACTURING COMPANY, Trenton, N. J., capital stock $50,000, has been formed to manufacture every kind of porcelain insulating device for electrical purposes. Carl F. Adam, Fred. F. Warchter and David Crossley, all of Trenton, N. J., are interested.

THE FAIRMOUNT TRANSPORTATION COMPANY, Fairmount, capital stock $12,000, has been formed to do a general transportation business by railways, motor lines, traction engines and wagons between Eugene and Corvallis. Geo. M. Miller, H. A. Barr and L. L. Shell are the interested parties.

THE COLLINGDALE STREET RAILWAY COMPANY, Collingdale, Pa., capital stock $50,000, has been formed to build an electric street railway. The promoters are Henry P. Collins, 1838 Mt. Vernon street; Henry Delaplaine, 205 South 42d street; J. M. West, Jr., 1524 Swaine street, Philadelphia, Pa.

THE WEAVER AND JACQUARD ELECTRIC SHUTTLE COMPANY, Norwalk, Conn., minimum capital stock $1 000, has been formed to manufacture and deal in looms, textile machinery and accessories, mill supplies, etc. Wm. Weaver, Dexter Hitchcock and Edward H. Matthewson are interested.

THE CLEVELAND & PAINESVLLE RAILWAY COMPANY, Cleveland, O., capital stock, $200 000, has been formed to construct and operate an electric street railway between Cleveland and Painesville, O. The promoters are Jno. J. Shiperd, M. H. Solloway, Nelson Moses, J. S. Casement and C. O. Child.

THE LE ROY & NORTHERN RAILWAY COMPANY, Le Roy, N. Y., capital stock $50,000, has been formed to build and operate by steam and electricity a road in Genesee county three miles long. The promoters are C. F. Prentice, D. C. H Prentice, N. B. Keeney, and C. N. Keeney, Le Roy, N. Y.

THE NORTHERN WATER WORKS & POWER COMPANY, Beresford, S. D., capital stock $75,000, has been formed to build, operate and maintain water works plants, electric plants and milling plants. J. L. Potter, Beresford, S. D.; C. O. Potter, Elmira, N. Y., and F. H. Potter, Mellette, S. D., are interested.

THE MULTIFUSE SWITCH COMPANY, Chicago, Ill., capital stock $100,000, has been formed to manufacture, buy and sell electrical and mechanical devices and instruments of all kinds and also do a general manufacturing business. The promoters are Howard M. Carter, Charles B. Carter and Edwin C Lancaster.

THE CLEVELAND, PAINESVILLE & EASTERN RAILWAY COMPANY, Columbus, O., capital stock $20,000, has been incorporated by I. N. Topliff, A. Everett, Chas. W. Wasson, and others, to build an electric railway through Cutahiga and Lakes counties, and running from Cleveland to Painesville.

THE HENLOPEN ELECTRIC LIGHT & RAILWAY COMPANY, Lewes, Del., capital stock $250,000, has been organized by Hiram R. Burton, Harry V. Lyons, John Barnes, Chas. C. Stockley, Robt. G. Houston, Daniel Burton, and John M. Richardson, to operate a railway from Lewes to Rehoboth or other places.

THE WARSAW WATER COMPANY, Portland, Me., capital stock $90,000, has been formed to manufacture and generate gas and electricity, also machinery and fixtures for same; build electric light plants, etc., in that city and elsewhere. Wm. C. Eaton, Ed. D. Noyes and Geo. F. Noyes, all of Portland, are interested.

THE SHELBY ELECTRIC RAILWAY COMPANY, Shelby, O., capital stock, $10,000, has been formed to construct, operate, etc., a line of electric or other railway in and between Shelby, Annapolis and Olivesburg, in Richmond and Crawford Counties, O. S. S. Bloom, Albert Moore and C. S. Holbrook are interested.

THE MAMMOTH SPRINGS ELECTRIC LIGHT & POWER COMPANY, Mammoth Springs, Ark., capital stock $100,000, has been incorporated by H. G. King, W. D. Cook, M. J. King and M. H. Cook, to maintain and operate a system of electric lights, generate power by electricity and build and operate telephones.

THE WARWICK STREET RAILWAY COMPANY, Philadelphia, Pa., capital stock $50,000, has been formed to build an electric street railway in Delaware County, Pa. Henry P. Collins, 1,838 Mt. Vernon street; J. Mortimer West, Jr., 1,524 Swaine street, and Henry Delaplaine, 205 South 42d street, Philadelphia, are interested.

THE ESMOND ELECTRIC BLOCK SIGNAL COMPANY, Jersey City and New York, capital stock $100,000, has been formed to acquire and own patent rights, etc., relating to block signals, electrical and mechanical. The promoters are Fred C. Esmond, Brooklyn; Chas. C. Dodge, New York, and Henry Seligman, Hastings, N. Y.

THE MAMMOTH SPRINGS ELECTRIC LIGHT & POWER COMPANY, Mammoth Springs, Ark., capital stock $100,000, has been formed to maintain and operate a system of electric lights, generate power by electricity, build and maintain telephone lines, etc. The promoters are H. G. King, W. D. Cook, M. I. King and M. H. Cook.

THE PHŒNIX CONSTRUCTION COMPANY, Crawfordsville, Ind., capital stock $100,000, has been formed to construct and operate telephone exchanges, steam and electric railways, etc.; electric light and gas plants, etc. The promoters are Noah J. Clodfolfer, Crawfordsville; Jacob Frankel, Isidore Crohs, and Jno. W. Paris, of Indianapolis, Ind.

THE UNITED MOTOR COMPANY, Cleveland, O., capital stock $10 000, has been formed to manufacture and deal in electrical instruments, machinery, devices, etc., boats, vessels, vehicles and engines propelled by electricity or other motive power. H. H. McKeehan, Jas. H. Hoyt, A. C. Dustin, H. A. Kelley and Gustav von den Steiner are interested.

THE HERBERT KRAFT COMPANY, Red Bluff, Cal., capital stock $100,000, has been incorporated to buy, sell and deal in real and personal property, etc.; buy and sell all kinds of mechanical power, heat and electric lighting plants and works, etc. The interested parties are Herbert Kraft, Geo. H. Kraft, Edward Kraft and Gustave Kraft, Red Bluff, Cal.

THE ESMOND INTERNATIONAL ELECTRIC CONSTRUCTION COMPANY, Jersey City and New York, capital stock $1,000,000, has been formed to acquire and own patents, patent rights, etc., relating to traction matters of every kind. Chas. C. Dodge, New York; Fred C. Esmond, Brooklyn, and Henry Seligman, Hastings, N. Y., are interested.

THE BONTA MANUFACTURING COMPANY, Hoboken, N. J., capital stock $150,000, has been formed to manufacture machinery, etc., for electrical plants and to do a general electric light business in all its branches, build cars, etc. The promoters are Arthur K. Bonta, Wilbur C. Anderson, Alex. C. Young, Hoboken, N. J., and Jacob Wendell, Jr., New York.

THE KEARNEY ELECTRIC LIGHT & POWER COMPANY, Kearney, N. J., capital stock $50,000, has been formed to manufacture, generate, store and supply, etc., electricity or arc and incandescent electric lights, etc. Geo. F. Woolston, Jr., 40 Wall street, New York; Bertram C. Smith, Brooklyn, N. Y., and William Hanna and Jos. Randall, Kearney, N. J., are interested.

THE CHICAGO & MONTANA MINING COMPANY, Chicago, Ill., capital stock $500,000, has been incorporated to locate and operate mines; operate cable, electric or other roads; erect telephone and telegraph lines; electric and water power plants; also all machinery and appliances necessary therefor. The promoters are Malcolm Dale Owen, Thos. H. Kelley and Edw. Brackett.

THE CHICAGO SUBWAY ARCADE & TRACTION COMPANY, Chicago, Ill., capital stock, $15 000,000, has been formed to construct, own, maintain and operate a system of subways and dummy railways, and to maintain and furnish necessary systems of power, light, heat, ventilation, pavements, conduits and other construction. Chas. F. Griffin, Marvin E. Barnhart and John K. Nelson are interested.

TELEGRAPH AND TELEPHONE.

GREENVILLE, ALA.—The Southern Telephone Construction Company, of Atlanta, Ga., will establish a telephone exchange.

MONROE, LA.—The Monroe Telephone Company has been granted a franchise and will install an exchange plant immediately.

CHATTANOOGA, TENN.—The New Citizens' Telephone Company, of which W. D. Carswell is president, has obtained a franchise to construct a system.

TALLAHASSEE, FLA.—Mr. James D. Randall, of the Telephone & Electric Specialty Company, of Memphis, Tenn., is installing a telephone exchange, for which the Viaduct Manufacturing Company, of Baltimore, is furnishing the switchboard and various other appliances.

ELECTRIC LIGHT AND POWER.

TAMPA, FLA.—An electric light plant is to be established.

LELAND, ILL.—A new electric light plant is to be established.

ST. ALBANS, VT.—A new electric light plant is to be established.

VERSAILLES, KY.—An electric light plant will be erected at Versailles.

ATALLA, ALA.—The electric light plant and water system is to be improved.

HILLSBOROUGH BRIDGE, N. H.—Work on the electric light plant is progressing rapidly.

PALM BEACH, FLA.—An electric lighting plant is to be erected here by Henry M. Flagler.

PULASKI, TENN.—The city will issue $25,000 worth of bonds for the erection of an electrical plant.

MINERS MILLS, PA.—The installation of an electric lighting system at this place is contemplated.

STEPHENVILLE, TEX.—Steps are being taken toward the establishment of an electric lighting plant.

BALTIMORE, MD.—It is reported that a new electric light plant is to be erected on West Pratt street.

ELDORADO SPRINGS, MO.—W. B. Lewis and others have been granted a franchise for an electric plant.

BARDSTOWN KY.—A movement is under way toward the establishment of a $7,500 electric lighting plant.

GRANTSBURG, WIS.—The installation of an electric plant at this place is contemplated by John Ericcson.

McCOMB CITY, MISS.—The installation of an electric lighting plant is contemplated by J. J. Hoyt and others.

BATHGATE, MINN.—The construction of an electric lighting plant at this place is contemplated by G. M. Esterley.

CHERAW, S. C.—The Cheraw Knitting Mills is in the market for an electric light plant for 50 and 100 16 cp lamps.

ENTERPRISE, MISS.—An electric light plant is to be erected by S. H. Gilheman, of Springfield, Ill., and L. B. Bradley.

CARBON, IND.—An electric lighting plant is to be established here by Cox Brothers, who will furnish the town with electricity.

GROESBECK, TEX.—It is reported that an electric lighting plant is to be erected here in the near future by F. Allen, of Kosse.

CHATTANOOGA, TENN.—The mayor may be addressed for information concerning the establishment of a new electric light plant.

WAYNESBORO, GA.—J. J. [illegible] and T. H. Antum are interested in the establishment of an electric light plant and water works.

PENN YAN, N. Y.—At the next village meeting May 21, a proposition to [illegible] lighting the village will be voted on.

GRAND RAPIDS, MICH.—John H. Roberts, of this place, is to erect an electric lighting plant at Mackinac Island in the near future.

ELDORADO SPRINGS, MO.—A 21-year franchise has been granted to W. P. Lewis and others to erect an electric lighting plant in this city.

COLCHESTER, CONN.—The lighting of the streets with electricity is projected. Address City Clerk C. H. Dawley for detailed information.

BALTIMORE, MD.—The extension of the electric lighting system in this city is contemplated. Address Mayor Latrobe for further information.

REVERE, MASS.—It is reported that a franchise is to be granted Arthur Perry to furnish electric lighting to the town for a term of three years.

EUREKA, UTAH.—It is proposed to erect an electrical smelting plant near this city. Col. J. W. Hunt, of Milwaukee, and M. Conover are interested.

MANHEIM, PA.—An ordinance is to be passed granting a franchise to Bailey & Co., of Philadelphia, to establish an electric lighting system in this town.

BALTIMORE, MD.—Sealed proposals will be received at the office of the Bayview Asylum for the erection of an electric lighting plant. Simon I. Kemp is president.

LIVINGSTON, ALA.—An electric lighting plant is to be installed here in the near future. W. K. Smith, secretary of the Commercial Club, can furnish detailed information.

PORTLAND, ME.—The construction of an electric lighting plant on Peaks Island is contemplated at a cost of $5,000. The clerk of the City Council can be addressed for particulars.

ALTOONA, PA.—Work will be commenced soon on the erection of the new building for the Edison Electric Light Company. Engineer Corson can be addressed for particulars.

MARION, ALA.—An electric light plant will probably be established. The same engine which drives the water works pumps will be used to supply the power for the electric plant.

CABLE, ILL.—It is reported that a company has been organized for the purpose of establishing an electric lighting plant at this place. The clerk of the Council can give detailed information.

EAST BRIDGEWATER, MASS.—The question of installing an electric lighting system is being agitated. Address Henry Gurney, president of the Board of Selectmen, for further information.

EVERETT, PA.—A franchise has been granted Percy L. Williams for an electric light plant. The contract for the line construction has been awarded to Williams & Williams, of Middletown, Conn. Water power will be used.

WESTMINSTER, MD.—The Carroll County Electric Light & Power Company has the contract for lighting the city and will put in equipment for 40 arc lights. Communication with manufacturers of arc apparatus is desired.

CHICAGO, ILL.—A. L. Hawley, purchasing agent for the Union Electric Company of Seattle, Wash., will have an office at 255 Wabash avenue after June 1, and will be in the market for a stock of electrical supplies during June and July.

THE ELECTRIC RAILWAY.

FLINT, MICH.—An electric street car line is to be built by Judge John E. Nolan, of Saginaw.

BRUNSWICK, GA.—J. E. Du Bignon and others have applied for a franchise to build an electric road.

BATAVIA, N. Y.—Surveys have been completed for the construction of the Batavia & Northern Railway.

AUGUSTA, ME.—The extension of the Augusta, Gardiner & Hallowell Electric Road is to be petitioned for.

PITTSBURGH, PA.—Oliver Brothers have applied for permission to construct an electric line on Bingham street.

NEW BRUNSWICK, N. J.—A single track trolley road is projected from this place to South Amboy, a distance of 14 miles.

TURNER, ME.—The Lewiston & Auburn Street Railway Company has decided to extend its electric line to this place.

BRIDGEWATER, MASS.—Right of way has been granted the Brockton Railway Company to build a line through this place.

EGG HARBOR CITY, N. J.—It is reported that a trolley road is to be established from Pomona to this place and Manahawkin.

MACON, GA.—The Macon Consolidated Street Railway Company is to extend its line a distance of one mile in the southern suburbs.

NEW ORLEANS, LA.—An ordinance has been passed authorizing the sale of the franchise to operate an electric road on Elysian Field street.

PHILADELPHIA, PA.—The Union Passenger Railway Company has been granted permission to extend its line on certain streets of the city.

WHITESTONE, L. I., N. Y.—The Steinway Railway Company has been petitioned to extend the trolley system to this place and Willetts Point.

LOCK HAVEN, PA.—The Electric Railway Company has been petitioned to extend the line from its present terminus to Main and Fairview streets.

GREEN BAY, WIS.—It is reported that the McCartney Street Railway Company's line is to be extended across the river to the main part of the city.

WORCESTER, MASS.—It is reported that the Worcester & Suburban Electric Railway Company will issue $200 000 worth of bonds to improve its lines.

SPRINGFIELD, MASS.—The Warren, Brookfield & Spencer Electric Railway Company has been granted a franchise to construct a line through this city.

ST. LOUIS, MO.—Permission has been granted the Clayton & Delmar Avenue Railway Company to construct an electric line along Bonhomme avenue to Clayton.

BELLEVILLE, N. J.—A franchise has been applied for by the Newark & Paterson Railway Company to operate an overhead trolley system on Washington avenue.

DOYLESTOWN, PA.—Right of way is being secured for the Bucks County Trolley Company through this place. Frank N. Booz can furnish detailed information.

BLACK ROCK, N. Y.—It is reported that the street railway line is to be extended. The secretary of the Black Rock Business Men's Association can give detailed information.

NEW HAVEN, CONN.—The North Haven Electric Street Railway Company has applied for permission to construct a line on Middletown and Montewese avenue to North Haven.

NEWARK, N. J.—The construction of an electric railway from this city to Paterson is contemplated. B. W. Spencer, of the Passaic & Newark Electric Railway Company, is interested.

EFFINGHAM, N. H.—The construction of an electric passenger railway up the Ossipee Valley, from Cornish to this place, to connect with the Boston & Maine Railway here, is contemplated.

NEW ORLEANS, LA.—It is reported that the Algiers & Gretna Railway is to be converted into a trolley system. The line is four miles in length. W. Holliday is president and can be addressed.

WESTCHESTER, PA.—Work will be commenced shortly on the construction of the Westchester and Downingtown Railway, which is to be built between the points named, a distance of seven miles.

HARRISBURG, PA.—It is reported that the Citizens' Passenger Railway Company and the East Harrisburg Railway Company is to be consolidated under the name of the Harrisburg Traction Company.

NEW BRUNSWICK, N. J.—E. J. and A. Radel have purchased the New Brunswick City Railway and will convert it into a double track trolley road. G. Krueger is to be president and can be addressed.

DANVILLE, ILL.—W. S. Matthias has obtained the privilege of constructing and operating for 20 years an electric railway on the Chicago and Danville Highway, from Danville north to Iroquois County.

BALTIMORE, MD.—Work has been commenced on the extension of the City & Suburban electric line from Point Breeze to St. Helena. Nelson Perine is president and can be addressed for detailed information.

DANVILLE, VA.—The Danville Street Car Company has sold 150 shares of stock and will use the proceeds in extending its lines along Main street to the suburbs. T. B. Fitzgerald and P. R. Jones are interested.

TROY, N. Y.—The construction of a line to Averill Park, to connect with the Troy City Railway, is contemplated. J. K. Averill, or Superintendent Smith, of the Troy City line, can be addressed for detailed information.

SPRINGFIELD, O.—Attorney H. L. Canfield, of Xenia, has secured the right of way for an electric road from Springfield to Wilmington by way of Clifton, Cedarville and Jamestown. The water power at Clifton will be utilized.

GLOUCESTER, MASS.—Work will be commenced soon on the erection of a new power house for the Gloucester, Essex & Beverly Street Railway Company. The structure will be equipped with the most modern electrical machinery.

QUINCY, MASS.—An ordinance has been passed granting the Quincy & Boston Railway Company the right to extend its tracks through certain streets. The general manager of the road can be addressed for detailed information.

SOUTH WILLIAMSPORT, PA.—Surveys are being made for the construction of an electric railway from this place to Sulphur Springs, a distance of 1½ miles. A company has been organized to build and operate the road with a capital stock of $10,000. The clerk of the Council can furnish details.

BUFFALO, N. Y.—The Buffalo, Kenmore & Tonawanda electric road is doing an increasing business. The cars have been equipped with motors calculated to insure a speed, when desired, of 35 miles an hour. These motors are now being replaced by others that will admit of a speed of 50 miles an hour.

NORTH HEMPSTEAD, N. Y.—An application for a franchise to construct and operate an electric surface road connecting the villages of Roslyn, Port Washington and Great Neck will shortly be made to the joint board of town officers and highway commissioners. Good men and plenty of capital are behind the enterprise.

PERSONAL NOTE.

MR. WILLIAM K. L. DICKSON has resigned his position in Edison's laboratory in West Orange, in order to go into business for himself in an electric light and power company, of which Llewllyn H. Johnson is president. Mr. Dickson is now the electrical engineer and H. C. Douglas, secretary. The company's factory will be in New York.

MISCELLANEOUS NOTE.

THE UNIVERSITY OF WISCONSIN, with a view to encouraging and assisting the most meritorious students in engineering and mechanical arts, has adopted the following policy: Nine engineering scholarships, which entitle the holders to the remission of their incidental fees for the period of two years, will be annually thrown open to competition to all students who have been admitted to the freshman class and are registered in courses leading to degrees in the College of Engineering. Seven additional competitive engineering scholarships, which entitle the holders to the remission of their incidental fees for the period of two years, will be annually awarded to students who are registered in courses leading to degrees in the College of Engineering, and who have successfully completed the required work of the first two years of their respective courses It is said that the students in electrical engineering will get a large share o these special scholarships.

Trade and Industrial Notes.

MR. FRANCIS R. UPTON, we are requested to state, is not connected with the company which manufactures the Upton arc lamp

McLEOD, WARD & CO., electrical and mechanical engineers and contractors, formerly at 91 Liberty street, have moved to the Thames Building, corner of Greenwich and Thames streets, New York.

C. HOWARD SCRYMSER has been elected president of the Columbia Telephone Manufacturing Company, of 186 Front street, New York, and will give his personal attention to the management of the company's affairs.

THE CAPO FARAD BATTERY & APPLIANCE WORKS has been established by Jas. J. Pearson, with offices in the Thames Building, corner of Thames and Greenwich streets, in order to meet the growing demand for the Capo-Farad battery.

THE ELSEN & BREWSTER ENGINEERING COMPANY, electrical and mechanical engineers and contractors, have removed their offices from 143 Liberty street to the Thames Building, corner of Thames and Greenwich streets, New York.

W. E. McLAUGHLIN, representing J. H. Bunnell & Co., passed through Pittsburgh last week, and reports business as being on the upward move. He has booked a number of large orders in and around Pittsburgh and is accordingly jovial.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has bought the patents and business of the Donaldson-Macrae Electric Company, of Baltimore. Mr. R. Macrae will be associated with the Electric Storage Battery Company.

THE KNAPP ELECTRIC & NOVELTY COMPANY, 7 Warren street, New York, reports a very satisfactory increase in the output of its battery motors since the advent of the warm weather, and anticipates an increase of 50 per cent. over its last year's business.

EUGENE MUNSELL & CO, 218 Water street, New York are distributing copies of a pamphlet price list of mica, which they handle in every shape and grade. A notable and convenient feature is the cipher code, there being a code word for each grade, shape and size in the catalogue.

THE AUTO-PNEUMATIC SIGNAL COMPANY, of Rochester, N. Y., has just completed the installation of its switch and signal system at the junction of the D., L. & W., and W. N. Y. & P. roads, Mount Morris, N. Y. This is the second plant installed for the D., L. & W., the first being at Buffalo, N. Y.

THE ELECTRICAL ENGINEERING & SUPPLY COMPANY, of Syracuse, N. Y., has removed its New York office from 136 Liberty street to the Thames Building, corner Thames and Greenwich streets. Manager Hawkins reports business as being excellent, a number of large switchboard orders having been recently taken

THE INTERNATIONAL CORRESPONDENCE SCHOOL, of Scranton, Pa., is sending out circulars offering special rebates to those purchasing a scholarship prior to June 1, the rebates ranging from $3.25 to $6.25. There are also several premiums offered with electrical scholarships, consisting of outfits of experimental apparatus.

J. GRANT HIGH & CO., 128 North Third street, Philadelphia, have issued their fourth catalogue of switches and switchboards, which is designated as catalogue D. The book is copiously illustrated and very substantially and handsomely bound and includes in its pages every size and style of knife blade switch, as well as all kinds of switchboard and tablet board fittings.

THE STOW MANUFACTURING COMPANY, of Binghamton, N. Y., has issued catalogue No. 5 of its flexible shaft and portable drills, taps, etc., for use in connection therewith. One of the most interesting specialties described is a combination portable electric motor, flexible shaft and portable drill, by the use of which the drilling and tapping of holes in heavy pieces of work is greatly facilitated.

THE PELTON WATER-WHEEL COMPANY, of San Francisco, in an elaborate new catalogue, describes its water-wheels, which are made to operate under heads of from 20 to 1,000 feet and for all classes of service. Illustrations are given showing Pelton wheels driving dynamos, both by belts and direct coupling. Detail drawings are copiously used to explain the construction and applications of these wheels

THE VANCE ELECTRIC COMPANY has just been organized for the purpose of prosecuting a general electric contracting and engineering business, and has established offices at 136 Liberty street, New York. Mr. A. S. Vance, the president and general manager of the company, has had a wide experience in electrical work, in the course of which he filled important positions with the old Edison General Electric Company and with Leonard, Izard & Co., and H. Ward Leonard & Co.

THE METROPOLITAN ELECTRIC COMPANY, 186-188 Fifth avenue, Chicago, reports a good demand for the Dayton electric ceiling fan, for which it is the Chicago agent. Some nice orders have already been closed for this season The company has secured the exclusive agency for the United States for the Ayer self-locking windlass. This windlass has several important improvements over other makes now on the market, and commends itself on first sight to all practical station men.

R. LEO. VAN DER NAILLDEN has been appointed western manager for the Bordeaux Dynamo Brush Company in Chicago, as a consequence of the success with which the Bordeaux Dynamo Brush Company has met in the East since the opening of the New York office Mr. Hugo Benedix, the general manager of the company, has made his permanent headquarters in New York, in the Postal Telegraph Building. The company, in order to satisfy the every day increasing demands, has been obliged to secure its own rolling mill.

THE GOULDS MANUFACTURING COMPANY, Seneca Falls, N. Y., reports the following recent sales: The Solvay Process Company, Syracuse, N. Y., one 12-inch x 12-inch triplex power pump, with steel ball valves, to be used for pumping waste; New Orleans Railway & Supply Company, New Orleans, La., two 5 inch x 8-inch triplex power pumps, to be direct driven by one electric motor; Freydenburgh Falls Pulp Company, Plattsburgh, N. Y., one 10-inch x 12-inch triplex power pump; Michigan Alkali Company Wyandotte, Mich., three 6½ inch x 8-inch triplex power pumps; Hanlon & Co., New Orleans, La., two 5-inch x 6-inch triplex power pumps; Robinson & Cary, St Paul, Minn., one 4-inch x 4-inch triplex power pump. The factory is very busy on triplex pumps at the present time, and shipped from its warehouse last week the largest tonnage that has ever been shipped in one week from the works of the Goulds Company.

THE BUCKEYE ENGINE COMPANY, of Salem, O., about two years ago installed in the enormous plant of the Hadley Company, at Holyoke, Mass., a triple expansion engine of 1,000 horse-power, but not until recently has there been a chance to test its full capacity. The opportunity was afforded by reason of the recent high water which absolutely "drowned" the water-wheels so that they could not be run to any advantage. Consequently, the steam engine had to take nearly all the load usually carried by the water-wheels in addition to its regular load, and under these conditions Engineer Clifford reports an average showing of 1 300 horse-power, or 25 per cent. above the rated capacity of the engine. It might be well to state that these engines are rated at 900 horse-power, nominal. This record is one of which the Buckeye Engine Company has reason to be proud It also has reason to congratulate itself upon the energy exhibited by Mr. W. D Hoffman, its New England agent, with headquarters at 620 Atlantic avenue, Boston, who is not only quick and keen to bring to the front such important features of its engine, but who is also doing an excellent business for it. Some of the recent sales made for it by him are the Jay Paper Company, Jay, Me.; Morgan Construction Company, Worcester, Mass., and Glen Manufacturing Company, Berlin Falls, N. H.

THE STANDARD ELECTRIC COMPANY, of Chicago, according to the financial editor of the Chicago *Sunday Tribune*, has increased its capital stock from $1,000,000 to $1,500 000 in order to provide increased facilities that will enable it to promptly and properly care for recent orders, and be the bettter prepared to handle future business. It also elected to the presidency Mr. A. G. Spalding, the well-known lover of field sports, who has purchased a large block of stock and will take hold with his accustomed energy. Mr. S. P. Parmly will remain in the directory, but concluded to resign the presidency, owing to the health of members of his family necessitating prolonged absence on his part. Mr. E. E. Crepin will continue to be treasurer, and Mr. D. P. Perry the general manager. The remaining members of the directory are Mr. Gilbert B Shaw, president of the American Trust & Savings Bank of Chicago; Mr. J. P. Whitney, a capitalist of Philadelphia, and Mr. G. A. Rollins, a capitalist of Boston. The Standard Electric Company claims the credit of having defeated the plans to compel the World's Columbian Exposition to pay a price for the electric lighting that would have been practically prohibitive, and of establishing the rate that enabled the exposition officials to secure the 4,000 arc lamps for nearly one-half the sum originally called for. Moreover, the service plant that the Standard Company installed in Machinery Hall not only supplied 25,500,000 arc lamp-hours, or nearly 20 per cent. more than any other arc plant at the exposition, but accomplished all this without the loss of an armature or even an armature coil. As the company has under consideration the leasing of one of the largest factories in the West, manufacturers of machine tools will be interested in this note.

Business Notices.

ELECTRIC LEAGUE.—Meets every Thursday evening, 100 West 24th street. Electrical engineers and electricians cordially invited.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 7, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

538,648. ALTERNATING CURRENT MOTOR, E. Arnold, Zurich, Switzerland. App. filed July 10, 1894. Method of starting and operating motors or alternating and similar currents by supplying current to the field coils in a manner to produce poles at certain points, and current of different phase in a manner to produce poles at an angle with the said first poles, thereby producing a rotary field; and thereafter diminishing the said angle by commutating or changing the field connections.

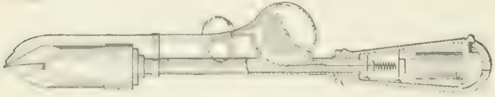
538,649. App. filed April 30, 1894, and 538,650, app. filed June 11, 1894. Closed Conduit Electric Railway; Geo., E. Baird, Chicago, Ill. The combination of a main track and suitable contact devices to carry current from the track to the vehicle and return.

538,651. TELEGRAPH KEY; C. W. Bradford, Clinton, Me. App. filed Feb. 21, 1895. The combination of a base, key lever and a contact post, a stem loosely connected with the inner end of a bar or lever, and a button on the key through which the stem loosely passes, having a disc at the upper end of the stem, and a pin passing through the disc and button to prevent the former from turning independently of the latter.

538,669. SAFETY DEVICE FOR ELECTRIC MOTORS; R. Eickemeyer, Yonkers, N. Y. App. filed July 13, 1892. The combination of a shunt motor connected with the main line, a fusible cut-out between them, so arranged that any disturbance of the circuit will short circuit the motor.

[illegible] ELECTRIC TRANSFER SWITCH; A. Ekstrom, Lynn, Mass. App. filed [illegible] having a set of terminals connected with the [illegible] current, also a corresponding set of terminals connected to the wires of the negative circuits, all of the positive being in the same plane, and all of the negative being in another plane parallel thereto, a switch arm which is adapted to vary the connections between them.

[illegible] ELECTRIC SOLDERING IRON; W. H. Osborne, Prince's Bay, N. Y. App. filed [illegible] The combination of a soldering head, a heating core for it, a hollow shank carrying conductors, and a hollow handle on the shank.



No. 538,695.—Electric Soldering Iron.

538,700. ELECTRIC ELEVATOR; G. H. Reynolds, New York, N. Y. App. filed Jan. 27, 1890. The combination of an elevator, a counter-weight, a cable and an electric motor, adapted to operate the hoisting gear of the elevator, and a cut-out switch adapted to be actuated by the sag of said cable should it slacken, and automatic connection to cut off the cut-out when the pressure is restored.

538,744. SPEED REGULATOR FOR ELECTRIC MOTORS; F. B. Rae, Detroit, Mich. App. filed Aug. 28, 1894. A motor having a rheostatic switch controlling it, a friction drive mechanism for actuating the contact end forwardly, and devices controlled by the pressure of the motive fluid for returning the hand.

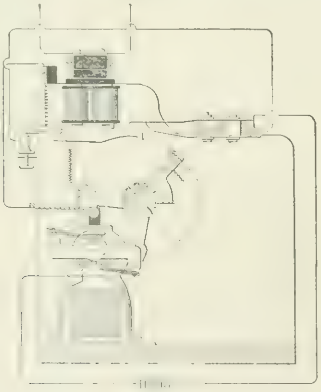
538,757. DYNAMO ELECTRIC MACHINE; A. G. Waterhouse, Pittsburgh, Pa. App. filed Feb. 4 1889. The combination of a field magnet having two poles, each derived through three or more pole pieces, two contact brushes connected with each other through the work circuit and a third brush applied to the commutator in advance of the line of maximum commutation, and connected with a point on the commutator of different potential.

538,758. PREVENTING ELECTROLYSIS OF SHEET PIPES; R. Watkins, San Francisco, Cal. App. filed June 25, 1894. A method of prevention which consists in connecting the pipes with the trolley return conductor by means of suitable conductors, and also connecting the pipes with the power station generator; and also for the use with above combination of plugs screwed into the pipe.

538,764. ELECTROTHERAPEUTIC APPARATUS; F. Borsodi, Magyar-Banhegyes, Austria-Hungary. App. filed Oct. 22, 1888. The combination of plates secured together to form a recess with a volatile pile located in said recess, a ball secured to the plates and electrically connected with the pile by wires.

538,773. ELECTRIC TOWER CLOCK; J. H. Gerry and F. M. Schmidt, Brooklyn, N. Y. App. filed Nov. 15, 1894. The combination of a notched and weighted disc having means for connecting it to the clock train, an armature lever controlling said disc and a local electric clock circuit, including a normally closed pair of contacts controlled by the armature.

538,786. ELECTRIC RAILWAY; H. R. McLean and G. A. Kornetzke, Schenectady, N. Y. App. filed Aug. 3, 1894. A conduit formed adjacent to a rail upon which the vehicle travels and containing an electric conductor in combination with a vehicle wheel provided with a concentric insulated spring mounted metallic disc projecting into the conduit and making electric connection with the conductor therein.



No. 538,773.—Electric Tower Clock.

538,816. TELEGRAPHIC SOUNDER; J. H. Bunnell, New York, N. Y. App. filed April 19, 1893. The combination of an armature provided with adjustable limiting stops, a cradle upon which the electromagnet is mounted, the cradle being pivoted concentrically with the armature, and an adjustable screw near the free end of the cradle.

538,825. COMMUTATOR; J. P. B. Fiske, Alliance, O. App. filed Feb. 9, 1895. The combination of an armature with a sleeve secured to the hub, a flange projecting from the sleeve, a plate or cap, bolts securing the flange and plate together, commutator segments between the flange and plate and interlocking flanges projecting from the cap and sleeve.

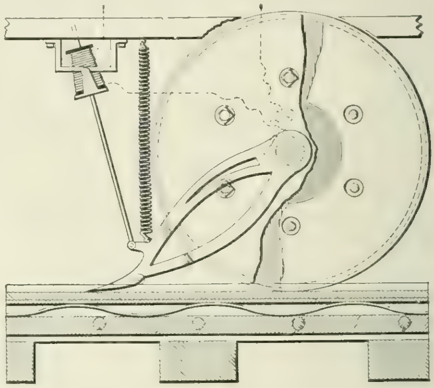
538,838. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS; W. Lawrence, New York, N. Y. App. filed April 28, 1894. The combination of a series of junction boxes each consisting of a rigid wall or casing, and a movable portion as a diaphragm constructed and arranged to support a service conductor, and an intermediate air-tight flexible joint and a superimposed sectional bar service conductor, one box being located near each end of a section of said working conductor and arranged to hold it in normal position or support the same.

538,844. TROLLEY BAR; C. Parker and A. R. Trepagnier, New Orleans, La. App. filed July 18 1894. A trolley bar carrying the lower wheel at its end, a supplemental bar pivoted onto the main bar, the upper wheel at the forward end of the supplemental bar and a spring attached thereto, which tends to bear down the upper wheel on the top of the wire.

538,904. ELECTRICAL CONNECTION; J. M. Faulkner, Philadelphia, Pa. App. filed Feb. 28 1895. The rail ends having wells containing mercury, the bond having its ends driven into and closing said wells with its points entering the mercury.

538,919. ABSORPTIVE MATERIAL FOR STORAGE BATTERIES; E. R. Knowles, Brooklyn, N. Y. App. filed Oct. 15, 1891. A method of forming an absorptive material, which consists in first mixing red oxide of lead and yellow oxide of lead, and then subjecting the mixture to a complete process of sulphation before its application to battery plates.

538,971. CAUTERY ELECTRODE; M. F. Laughlin, New York, N. Y. App. filed March 7, 1894. The combination of a platinum wire loop, a loop handle, a movable resisting bar provided with grooves to take in the cauterizing wire and electric circuit wires to establish contact.



No. 538,786.—Electric Railway.

538,975. TELEPHONE SYSTEM; J. W. McDonough, Chicago, Ill. App. filed May 21, 1891. A telephone system comprising an apparatus provided with circuit wires means for connecting any two of them together, telephonic receivers, a spring connected with the electric current passing through a space allotted to a subscriber and moving over a surface corrugated to correspond with the undulations of a spoken word, and a telephonic transmitting device operated by the same for throwing a signal to a subscriber's station when the spring is moving over the space allotted to such subscriber.

538,983. INTERIOR CONDUIT; O. G. Traphagen and F. W. Fitzpatrick, Duluth, Mich. App. filed Feb. 4, 1895. A flat strip suitable for conveying wires, pneumatic tubes, etc., comprising a channel and a molding secured to each side of it, and a face or plate held in place between the moldings and supporting the wires, tubes, etc., within the channels.

538,999. ELECTRIC ARC LAMP; S. S. Allen, London, Eng. App. filed. Oct. 29, 1894. An electric lamp having its carbon holders connected by a chain passing over guide pulleys and a sprocket wheel geared to an escapement which is governed by a brake, and a lever having its one arm linked to the core of a solenoid mounted on its other arm, the guide pulley from which the chain leads to the lower holder, and another lever secured to the brake lever so that the escapement is released when the lamp is not in circuit.

539,000. ELECTRICAL HOSE SIGNALING APPARATUS; W. Fowler, Colorado Springs, Col. App filed June 20, 1894. The combination of two coupling parts and the conductors carried by the hose, an insulating ring suitably attached to one part and provided with recesses, whose centres lie in the same circle, contact plugs located in said recesses and normally projecting therefrom, their outer extremities being beveled, and the plugs so arranged that said extremities lie in different circles, coil springs located in their recesses, one extremity of each spring being attached to the plug, while the other extremity is carried out of the recess and connected with the conductor carried by the hose.

539,017. ELECTRICALLY ARRANGED HOSE COUPLING; W. Fowler, Colorado Springs, Col. App. filed Nov. 30, 1894. This patent is substantially the same as the above.

539,019. ELECTRIC LIGHTING SYSTEM; R. N. Chamberlain, New York, N. Y. App filed Oct. 22, 1894. The combination of a source of mechanical power, an alternating current generator, a direct current generator, a translating circuit connected to the alternating current generator, storage batteries connected with the direct current generator, means of disconnecting the current generator from the source of mechanical power, and means for mechanically connecting the direct current machine as a motor to the said alternating current generator.

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INVESTIGATION OF ELECTROSTATIC DISCHARGES

In this issue we print a second instalment of the interesting microscopical investigation of Mr Geo. T Hanchett into the nature of electrostatic discharges. While thus far the results have not enabled any definite conclusions to be formed, the data collected are of interest, and subsequent experimental developments may give them a considerable significance, as indicated by the author. It would appear, however, that the effects noticed do not necessarily imply any definite flow, as they can be merely polar phenomena, though by their appearance seemingly indicating a flow.

ELECTROLYSIS OF UNDERGROUND PIPES BY TROLLEY CURRENTS

In another column Mr. Maurice Hoopes contributes an interesting discussion on various systems of connections for reducing or obviating electrolysis of underground piping by trolley ground currents. Owing to a blunder of the engraver, which was discovered too late to be remedied, some of the diagrams are not so clear as they should be, but the explanations in the article will enable them to be understood. As will be seen, the method to be adopted for a particular case is a matter depending upon the circumstances of that case, including a consideration of first cost. Though a system may be selected on general principles and applied to a road while under construction, the actual conditions influencing electrolysis are apt to be so difficult of à priori determination that there is a strong probability of subsequent changes or additions being necessary, the indications for these being furnished by the results of a careful survey under normal running conditions. In most instances at present what protection may be thought necessary is applied when the need has plainly showed itself after the road has been operated; in the future, however, it is probable, as the result of greater familiarity with the question, that a study will determine what system is most likely to meet a specific case, which will then be applied while the road is building, and the necessary changes above referred to made subsequently. Even then the problem cannot be considered definitely solved, as a different distribution of traffic, the opening of other electric lines, or the laying of new lines of piping may necessitate material changes. In fact, the question of electrolysis is one that the street railway engineer may always expect to have before him.

THE INVENTION OF THE ELECTROMAGNETIC TELEGRAPH.

At irregular intervals extending over a period of 40 years or more, the invention of the electromagnetic telegraph has been the subject of controversies, which frequently have been bitter in tone and thus far almost entirely fruitless so far as relates to any permanent settlement of the question. Among the reasons for this unsatisfactory state of affairs has been the intense personal bias of many of those taking part in the controversy, and the disconnected manner in which it has been carried on. With a view to definitely settling as far as that may be possible the relative status of the various claimants to honors in connection with the invention, THE ELECTRICAL WORLD will shortly begin the publication of a series of articles from the pens of recognized authorities, who will treat the matter in a dispassionate spirit and with reference only to the facts involved. Among those who will contribute to the discussion will be the two leading telegraphic authorities of the United States, whose articles will commence the series. Following will be articles giving the English, French and German views of the case, each by a writer of recognized authority in his respective country. The concluding articles, several in number, will be in the nature of expounders and deal with the facts brought out in the main article. The five leading articles have been under preparation for some months, and will contain the results of an exhaustive study of every side of the question, and bring forth for the first time a number of interesting points bearing on the early history of telegraphic invention. The series will be profusely illustrated and will not only form a contribution of permanent value to telegraphic history, but will also, we trust, definitely end a discussion which has given rise to much bitter feeling. It was the intention to begin the publication of the series simultaneously with the Morse Commemoration, but the preparation of the cuts will necessitate a delay of several weeks.

THE BERLINER DECISION.

The reversal by the United States Circuit Court of Appeals at Boston last Saturday of Judge Carpenter's decision annulling the Berliner telephone patent, adds another to the legal sensations that have been so plentiful the last several years in connection with electrical patent litigation. That the action of the Circuit Court of Appeals involves a miscarriage of justice will, we believe, be the verdict of the general public, and there is much apparent reason to sustain this view. The two points made by Judge Carpenter against the Berliner patent were that the delay of 14 years in its issue was a fraud on the public, and that the 1880 Berliner patent, now expired, covered the same invention described in the subsequent patent granted in 1891—either of which considerations, he decided, voided the patent. In support of the former view Judge Carpenter cited at length the history of the numerous delays in the Patent Office, and while the Court of Appeals may not have found technical evidence of design in these delays, yet we fear that the public will be inclined to consider the case as another example of how justice may be perverted, not only in face of the law, but through its very assistance. As the opinion of the appeal judges has not yet been handed down, it is difficult to surmise on what grounds they based their action with respect to the above point, and their reasons will be looked forward to with much interest. As to the probable view of the Court with respect to the second point, an opinion may be hazarded. Assuming that the Court admitted that the Berliner patent of 1880 anticipated the invention for which a patent was granted 11 years later, they yet might not admit that the government had therefore a right to annul the second patent. If it were considered that Berliner had prosecuted diligently and within legal bounds his application for the later patent, it might be held that the government had no right to annul that patent when once granted, upon the grounds that it had made a mistake in consenting to its issue. This view, of course, is based upon the supposition that no fraud were proved by the government, as in any case fraud would be a sufficient reason for annulment. A very important consequence of this point is that while it would prevent the government from pleading prior invention, it would not prevent an alleged infringer from doing so. There is, therefore, a hope that though the government is powerless through the recent decision to annul the patent, the second point made by Judge Carpenter may yet be availed of by the public to have it declared invalid. In this latter case a suit might soon be brought to a hearing and a speedy decision reached. Otherwise the only chance of relief is through the Supreme Court sustaining the view of Judge Carpenter, should the case be taken before that body. This appeal cannot be claimed as a right, but it is probable, owing to the great public interests at stake, that the case will nevertheless be brought before the Supreme Court, and at the earliest possible day. In the meantime, the Berliner principle, which is claimed to cover every form of battery transmitter, is again in force, and the American Bell for the time being is as secure in its monopoly in certain respects as it was in its palmiest days. This monopoly would extend to the year 1908 provided the expiration of no foreign patent intervenes to shorten the term, and at present there is no knowledge, as far as we are aware, of the existence of such a patent.

The Work of the Cooper Union Night Schools.

The night schools of the Cooper Union have for 25 years furnished to the men and women of New York City who are unable, through lack of means or time, to pursue a collegiate course elsewhere, an opportunity to acquire a mathematical and scientific education such as would fit them to find employment in engineering, architectural or other professional work.

Hosts of ambitious men and women have availed themselves of the opportunity thus offered to educate themselves while engaged in earning a livelihood, and many of the graduates of this school have taken high rank in the engineering profession, and are to-day filling responsible positions because of the help they obtained in the Cooper Union classes.

Generous as was Peter Cooper's gift to the working people of New York, however, and encouraging as are the results obtained, more could be accomplished with larger funds.

Progress has been so rapid in science and the industrial arts that it has been impossible to keep the facilities for instruction abreast of the times, hence an addition to the present collection of apparatus could materially enhance the usefulness of the school, particularly as regards the department of electricity. There is an entire lack of all apparatus for making electrical measurements, and, in fact, of anything to demonstrate electrical progress during the past 40 years.

The Cooper Union night school can do considerable toward meeting the pressing demand for instruction in physical and electrical science, the fact that Prof. W. A. Anthony is professor of physics being sufficient evidence as to the sterling character of the course, but it is beyond human ability to make the school fully effective without the aid of more modern appliances. Is there not some one interested in promoting the welfare of the seekers for scientific knowledge, who will help the cause by assisting to provide the latest types of apparatus and appliances for instruction?

The Court of Appeals' Berliner Decision.

The United States Circuit Court of Appeals at Boston, on May 18, handed down a decision in the American Bell telephone case, declaring the Berliner patent valid. Judge Carpenter, of the Circuit Court, on December 1, 1894, decided that the Berliner patent was invalid and ordered it to be delivered up for cancellation. The American Bell Company appealed, with the above result, which extends the life of the patent to 1908.

As will be remembered by our readers, the United States relied upon two grounds to show that the patent was void. The first was that there was illegal delay in its issue. The second was that a prior patent was granted upon the same application to the same applicant for the same invention. This prior patent referred to was one granted to Berliner in 1880. The decision of Judge Carpenter sustained these two grounds of attack made by the government against the patent, and held that it was void and should be delivered up to be cancelled.

The government has on file a motion to amend the bill, and alleging that in addition to the illegal delay in the prosecution of its application for a patent, the Bell Company had a tacit understanding with the officials of the Patent Office not to issue the Berliner patent pending the determination of the suits then pending over the Drawbaugh patent, which latter patent was claimed to be an interference. In view of this motion to amend, the government is given until May 25 to file its brief as to the form the judgment should take, while the Bell Company is given until May 31 to file its brief upon the same subject.

The opinion of the Court, which consisted of Judges Colt, Putnam and Nelson, will probably not be ready until about June 10, and therefore no one but the Court knows as yet what the grounds of the decision are. It is surmised that the reason the decision of the Court was rendered so unexpectedly was to prevent a premature knowledge of its conclusions getting out.

Lawyer Causten Browne, one of the counsel for the United States in the case, said that the case will be carried to the Supreme Court of the United States.

Some More Charges of Bribery.

Officials of the Westinghouse Company made a public statement on Thursday of last week to the effect that they had unearthed a conspiracy on the part of agents of the General Electric Company to obtain valuable information relating to the manufacturing business of the Westinghouse Company by bribing employees. The specific charge was that an employee of the Westinghouse Company named J. M. Van Cleve had been paid $25 for furnishing certain information to agents of the General Electric Company, and letters were shown addressed to E. G. Waters, the Pittsburgh manager of the latter company, which, it was claimed, substantiated the charge.

One of these letters is from the Philadelphia office of the General Electric Company, and signed by E. D. Mullen, manager. It states that the Schenectady office desires to find out "in any manner possible, even approximately," the Westinghouse output, weekly or monthly, of street railway motors, alternators, etc., and asks that the matter be taken up "promptly and energetically," and that every means within the Pittsburgh agent's power be used to secure said information. Another letter from the same source acknowledges the receipt of some information in regard to output and trouble with men in the Westinghouse Works, and adds "you have started well, and if you continue in like strain it will be a matter of a great deal of satisfactory information." A third letter is signed by William S. Beatty, and asks for a draft of $25 to pay Van Cleve for Westinghouse data.

Mr. Westinghouse, in discussing the question, said his company had not decided what steps to take in the matter, but the question was under consideration. He did not know what would be the best plan to pursue, but he felt that the matter ought to be called to the attention of the directors of the General Electric. He could not believe that they were aware of such actions on the part of their employees. "The tampering with employees, especially young men, at our works," he continued, "results in great harm. It is bribery to get information from them in this unfair way, and a violation of trust on the part of the employees to give out information about our works. When the conspiracy suit was up it was asserted that we were doing just what we charged the other people with doing. That was false. I will say this, that there is no place in our concern for a man who is susceptible to bribery for information, or who will adopt such methods as the General Electric people have used, to gain information for the benefit of our company. We wish to conduct our affairs in a business way without endangering the morals of the young men, who are allowed to get so much valuable training in electrical work in our shops. I think it a shame that young men should be subjected to such temptation. If they fall they cannot expect to get responsible positions with any business concern."

Mr. Waters replies to the above charges as follows:

"There is no manufacturing concern in this country that is not more or less interested in the capacity and output of its competitors. The Westinghouse Company has recently completed a factory for which some extravagant claims have been made as to capacity and output. These claims are the subject of common report among business men, as also are descriptions of considerable detail which have appeared, presumably with the authority of the Westinghouse Company, in various electrical trade journals. Having learned by previous experience that such reports and descriptions are not always the most reliable, it is true that some inquiries have been made to either prove or disprove these claims, as to capacity and output. This is positively all there is in the report, and I wish to state that absolutely no attempt has been made to obtain any information from the Westinghouse or any other company which could be considered of a secret or confidential nature, and nothing other was done than to verify reports as to capacity and output of the Westinghouse plant as published.

"In connection with Mr. Westinghouse's remarks in regard to tampering with employees, and the publication by him of letters which were surreptitiously removed from our files, it is a singular coincidence that upon arriving at the office this morning, I find upon my desk a letter from a heretofore trusted employee of this office stating that he left last night for the East, having accepted a lucrative position. We have known for some time that prices and other information valuable to our competitors have been escaping from our office here, but have been unable heretofore to place the responsibility."

Notes on Pipe Electrolysis.

BY MAURICE HOOPES

Much has been said and written, recently, regarding damage to underground pipe systems by the action of electric railway currents. This has been mainly in the line of abstract theorizing as to the best means to adopt in order to arrest the damage to the pipes, although some contributions of a more practical nature have discussed concrete cases, giving analyses of the relative potentials throughout the rail and pipe systems, with comments regarding the probable actions that the currents were causing, and suggestions for, or statements of, alterations in the distribution systems with a view to lessening these actions. From no source, however, has there been information to show the results of changes made, and such information would consist, at best, of negative proofs of cessation of damage. In view of the existence of this condition of affairs, theorizing seems pardonable. The writer has found a graphical investigation of the subject to present the various phases in a clearer way than any other, and gives his analysis here, with the hope that it may result in discussion that will throw more light on the subject. The curves given are drawn arbitrarily, and not to be mathematically correct for any particular conditions.

Fig. 1 covers the general case of any simple distribution system. The ordinary system includes lines radiating in various directions from the generator. As these lines may be considered independently, and as each is similar to the others, it is only necessary to analyze the conditions existing in one. Furthermore, the consideration of the positive side of the system may be neglected, and attention given only to the negative conductors, consisting of rails and track wires. Figs. 2 to 9, therefore, contain only lines representing potentials in this part of the system. In these figures the point *P* represents the neutral point, at which pipes and tracks are at equal potentials, as determined before any connections have been made. The lines have the following values:

AB ———— Potential of track.
CD " pipes.
—·—·—·—·— " — feeders.
·························· " track and pipes, coincident.
·····-····-····-···· " wires and pipes.

In Fig. 1, consider *R* the armature of a generator, with the points 550 and 0 its positive and negative terminals; the line 550 to 500 the positive part of the distribution system of an electric railway, consisting of feeders and conductors; *r*, *r*, *r*, etc., armatures of car motors; *AB* the track circuit; *BO* the negative or track feeders. The potential of each point in the system is represented by its vertical distance above the point 0. The latter point is assumed to be at 0 potential, inasmuch as its potential is the lowest in the system. The other figures, 550, 500, 50, and 20, are assumed potentials of the points indicated. The arrows indicate the directions of current flow. *B* is the point where the feeders connect to the track. The pitch of the various lines indicates the fall of potential, and hence the current, in the conductors at the various points throughout their length, assuming cross sections of each, at all places, to be equal.

Fig. 2 presents a simple case where resistances of track and pipes are uniform throughout, and also that of the earth connecting them. Under these conditions, the areas *PCA* and *BDP* are equal, since the former represents the current flowing into, and the latter out of, the pipes. The line *CD* increases in pitch from *C* to *P* as the pipes get more current, and decreases from *P* to *D* as they lose current, being horizontal at *C* and *D*, where no current flows. *AB* increases from horizontal at *A* to maximum pitch at *B*. Obviously, track and pipes may be connected at *P* without affecting the potential relations, since no current will flow.

Fig. 3 represents conditions where the resistances of pipes and tracks vary, due to imperfect joints, the intervening earth also varying. This introduces additional neutral points. Practice shows these points ordinarily to be comparatively close to each other, and usually included within relatively small lengths of track. As in Fig. 2, track and pipes may be connected at *P*, *P′* and *P″*, without effect.

In the following figures it will be assumed, for convenience, that there is but one neutral point, *P*, and that curves are regular. Fig. 4 shows the effect of connecting pipe to wires at 0 and at no other points. These curves would be modified by changes in pitch of the track feeders, *OB*. Fig. 5 shows effect of connecting pipes, rails, and wires, at all points from *P* to *B* and *D*. Fig. 6 shows effect of connecting pipe to wires at all points from *T* (formerly *P*) to 0. Fig. 7 shows effect of connecting rails, pipes, and wires, only at point P. Fig. 8 shows effect of connecting rails and pipes at P, and feeders from 0 to PB, arranged to maintain constant potential along PB. Pipes and rails might be connected at all points from P to B and, without altering conditions. Fig. 9 shows effect of feeders from 0 to AB, arranged to maintain constant potential on AB. Pipes and rails might be connected at all points without altering conditions.

In the following discussion are considered both actions from current leaving pipes, and from current flowing in pipes, doing damage at high resistance joints.

From an inspection of the various curves shown it will be noted that Fig. 9 shows the ideal system, since the track is at a uniform potential throughout. With this, there is no current flowing to, from, or in, pipes. This could only be approximated in practice, however, and then only by means of the use of an enormous amount of copper (or heavy drops), and very careful feeder calculations. In this the capacity of the rail to carry current is not utilized, and hence its value as a return conductor is nothing.

Fig. 8 shows a method whereby current flow out of the pipes may be confined to the one wired connection at P, and flow prevented through pipes between P and the station, where the internal flow is usually heaviest. This demands a feeder system for uniform potential to that part of the track inside the neutral point; that is, between it and the station. In this there is no benefit derived from the current carrying capacity of the rail within the point P.

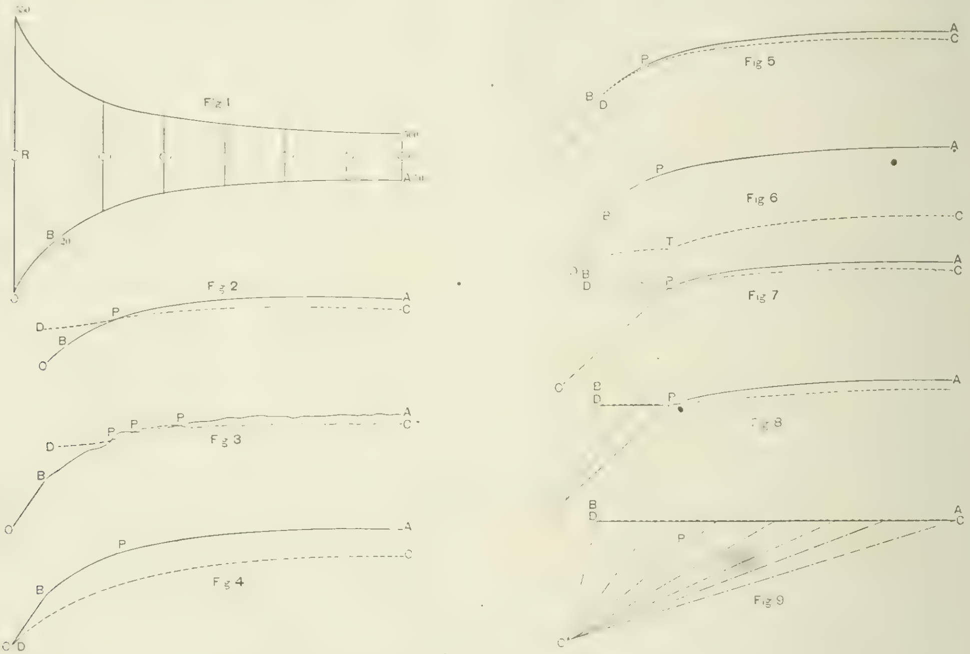
Fig. 7 shows the result of running track feeders to P only, and connecting there both to rails and pipes, and to neither, elsewhere. The result of this is to take all of the current from the pipes at P and to avoid any heavier internal flow than that normal in the pipes approaching P.

Fig. 4 shows that connecting the pipes to the station bus bar, at station, may accomplish the taking off of all the current through the wired connection, but that it then increases the amount of current in the pipes, since it depresses the potential of the pipe throughout its length, and makes it receive more current. As stated, the introduction of heavier track feeders, making OB, have less pitch, might throw part of CD above AB, and introduce the case of pipes positive to rail. This is a case for especial study, for each particular system.

Fig. 6 shows the effect of running special negative feeders to the pipes not connected to the tracks. This plan protects the pipes against action of currents leaving them, but greatly increases amount of current flowing into and through them. This method of connection is one that has been recommended as being the best one. Its disadvantages are obvious, however, and there seems to be no reason for its use. Fig. 5 shows the usual method of connecting rails and pipes to the same negative feeders. This protects the pipes from currents leaving, and gives greater or less trouble from currents flowing, as the drop from P to 0 is greater or less.

To determine, in general, the best method to use, it will be necessary to have data on the amount of damage ordinarily done to pipes by current flow in them, where the current is shunted round high resistance joints through the surrounding earth. If this is not greater than there is good reason to suppose it to be, it will be best, in ordinary cases, to use the method of connections shown in Fig. 5, since this utilizes the conductivity of the rails throughout their whole length. Should, however, the action at the joints be found to be considerable, it would be better to resort to the arrangement shown in Fig. 8. Fig. 7 shows a method that accomplishes everything that that in Fig. 8 does, excepting that there is a flow into and in the pipe from D to P in the former case, whereas there is none in the latter. This would be suitable where the track feeders were too few to allow uniform potential distribution to PB.

It has been held that any wired connection between pipes and rails or feeders necessarily increases current flow in the pipes, since it reduces the resistance of the pipe circuit; and hence is undesirable. A connection at the neutral point has no effect on the current flow, except that the neutral point shift and leave the connection where it will receive current. The latter contingency may arise with altered conditions of load and resistance of wires, rails, or pipes. It is probable, however, that the neutral point may be regarded as fixed, under ordinary conditions.



FIGS. 1 TO 9.

Electricity in Mills.

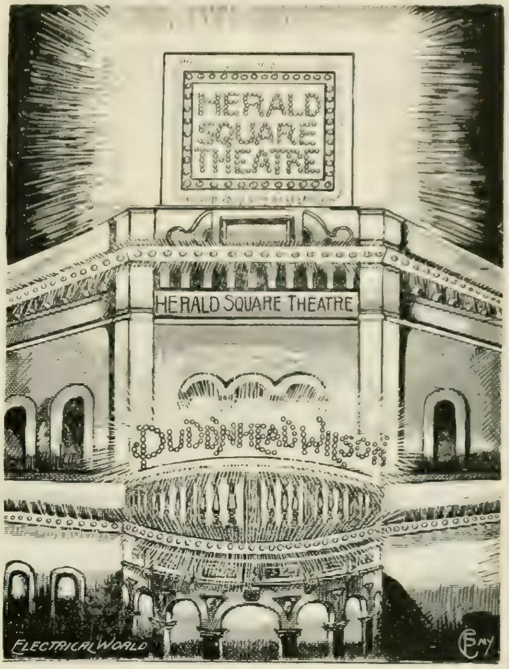
At Blies-Schweyen, near Saargemünd, says the London *Electrician*, a water-power generating station has been erected for the purpose of supplying current to adjacent works. The plant has a canal about a mile long, which supplies about 500 cu. ft. per second. The fall is 13.1 ft. There are three turbines of 200 horsepower each, which drive a main shaft. From this latter two 135-kw "drehstrom" generators of the Oerlikon type are driven by belts at 375 revolutions and give a potential of 2,900 volts. The exciters are coupled direct to each machine. The first consumer is a paper mill at Ensheim, about four miles from the power house. Here three 30-kw transformers are employed to reduce the E. M. F. to 120 volts, driving four motors and lighting the mill.

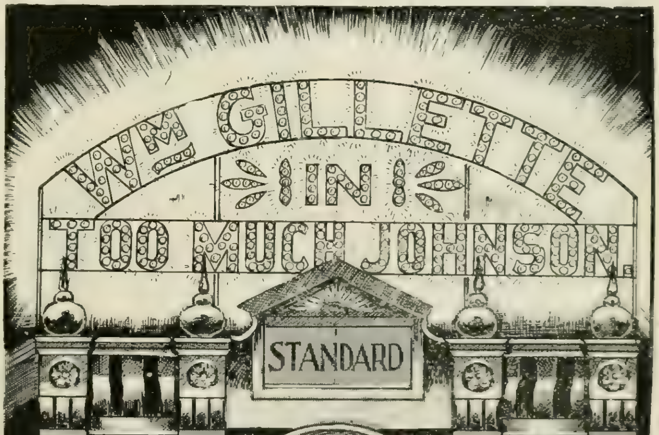
Signs of the Times.

THE recent ordinance which decreed that all the New York City theatres should remove their electric signboards from where they projected beyond the house line has very appreciably altered the nightly aspect of Broadway. To the observer standing on the 33d street "L" station, it used to seem as though a small bit of the Paris boulevards had dropped into New York. Innumerable specks and streaks of flame lighted up the street toward the south. The houses were outlined in light and the perspective distance was for once not lost in traditional darkness, but there converged to a centrally illuminated point. The genius of electricity might here have walked in triumphal procession along a fitly prepared highway. On all sides would have been evidence of his power. No other place in New York equalled it in effect.

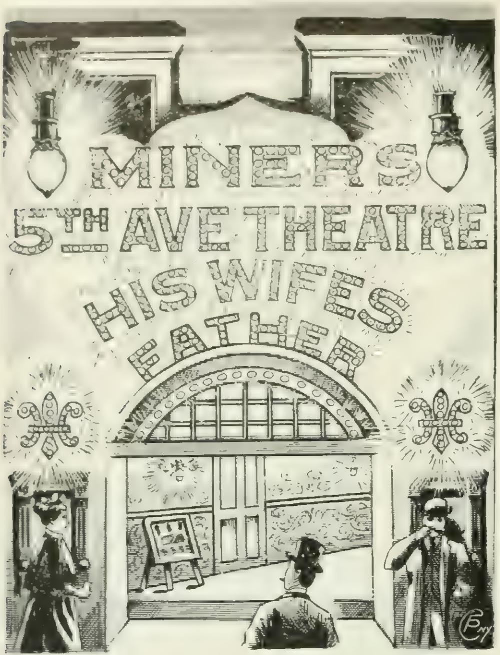
But the Bureau of Incumbrances thought otherwise, and the projecting signs have all been swung in close against the house fronts. While this has altered the perspective view, yet if we walk along the thoroughfare we shall find enough evidence to convince us that electric house front decoration is the most valuable element in theatre advertising.

The Herald Square Theatre, formerly the Park Theatre, when remodeled had especial provision made in the way of electrical illuminated signs. A semi-portico or stationary awning, as it were, forms a part of the façade, the principal portion of which is on a corner. Running completely around the building on the upper edge of the portico is a line of 32-cp lamps, and a similar line runs along the edge of the roof. The peculiar formation of the eaves of the house offers an unusual chance for the beauties of light and shade to display themselves in the twistings and turnings of the architecture. The name of the theatre is highly wrought in painted letters below the upper line of light, but as though this were not enough to attract attention, an immense gilt frame studded with lamps adorns the roof. "Herald Square Theatre" is the flame picture displayed within the frame, and no one can pass it by without being impressed with the brilliancy of the display. In spite of the fact that the very name of the play conveys a warning of the sufficiency of "Johnson," the public gives the positive lie to the statement by demanding to see and hear the man in question over and over again. Hence "Too Much Johnson" is having a phenomenal run at the Standard Theatre, which seems to be very fortunate in the matter of long runs, so its electric signs are not so often changed as they might otherwise be. Every roof garden devotee in town knows of the long reign of "Johnson," for high above the roof of the Standard is an immense arrangement of incandescent lamps, spelling out the name of the play and that of its author and principal actor, Mr. Wm. Gillette. Mr. Miner was one of the few managers who did not have to conform to the ordinance. This was because he had long ago discarded a swinging transparency. People who pass his theatre, however, fully realize that it is there where Mr. Crane nightly depicts the weaknesses, foibles and other idiosyncrasies of the too loving parent in "His Wife's Father," for large and brilliant across the house front is the flaming truth made manifest. "Miner's 5th Ave. Theatre. His Wife's Father," is the precise wording of the sign. It is located above the doorway, just where it will give you a sufficient foretaste of what you may see within. Geometrical *fleur-de-lis* flank it on either side, and the incandescent lamps thereon add to the strength of the general effect. Located above the general sign are two arc lamps. From the doorway itself comes a flood of light, the long corridor of the theatre projecting it out to the sidewalk with a concentration worthy of a search lamp.

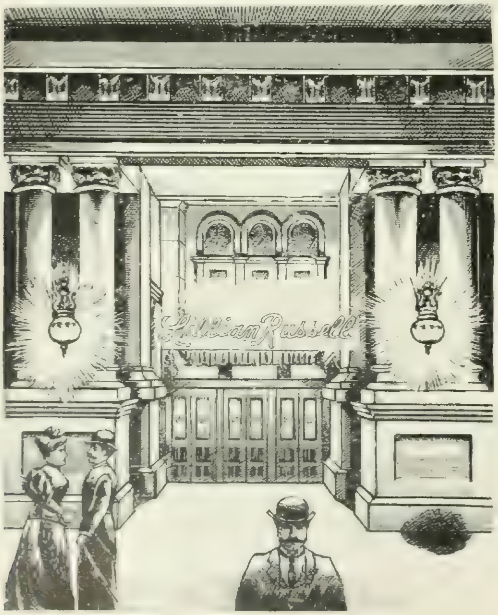




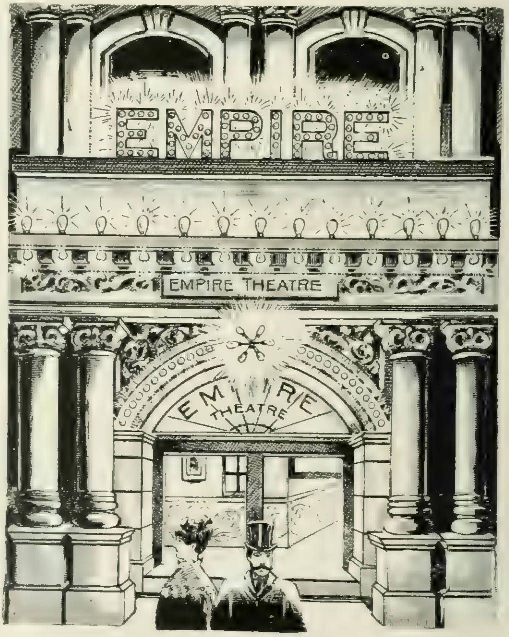
Perhaps it is because of the near proximity of the former "Queen of Brilliants," but certainly the front of Abbey's Theatre, where Lillian Russell is singing "The Tzigane," is artistic in its effect, and with an extremely small amount of glare. The name of the songstress is "written" in Spencerian characters with incandescent lamps. With the exception of two arc lamps with fancy globes, this is the only decoration. It is the peculiar architecture that really shapes the effect. The façade is complicated, the door sets deep into the wall, and heavy stone pillars stand in pairs at each side of the doorway. The arc lamps hang directly in front of the latter, the front surfaces of which are, at night, as light as day, while deep within their recesses is the blackness of night. The capitals of the columns catch up the light or reject it, as may be, until the most artistic rendering is produced.



Something on the same order is the Empire Theatre, except that here the effect is much heightened because there is more of it. The columns are beside the doors, as at Abbey's, and the arc lamps are not here, incandescent lamps playing the whole part. A closely placed arch of them adorns the doorway, a line of them is arranged on the façade, while others intersperse the cornice of the second story. The name of the theatre, "Empire," is spelled out in light above this cornice. The light from them flares upward and loses itself among the pillars above, reproducing in smaller measure the effect of the Abbey arrangement. Directly above the door "Empire Theatre" is to be seen in large letters fixed into the transom. In line with the arch of lamps is an ornamental bunch of lamps—a six-pointed star. Altogether the effect is very good.



But if these theatres are gorgeous in their raiment of light, there are others which, if more modest in their display, are yet worthy of mention. There is the Casino with its beautiful sign, or the American with two huge incandescent names across the roof. Every west sider has seen them from the "L" train. There is Tony Pastor's with its two rows of lamps leading out to posts on the side walk. Koster & Bial who use the top of a portico to support the frame on which the lamps rest, have a sign of light, showing the name of the hall. In the way of electric effect, Keith's Fourteenth Street Theatre is well supplied. The front of the building is a huge transparency. Blue glass predominates, and behind it are bunches of lamps. But in front are rows of lamps arranged so as to particularly set off the architecture. The façade of the theatre is a kind of modernized, mongrel Moorish style, with various attempts at producing mosque-like formations and turrets.

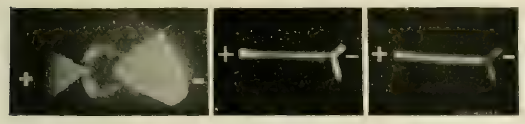


Of course, Hoyt has a sign, and so has the Imperial Music Hall. The Eden Musée has surrounded an oblong granite slab, containing the name of the museum, with incandescent lamps, while a line of incandescent lamps runs across the building up near the roof. Proctor's Theatre is as fortunate as Keith's in its electric display. An extension of the lobby, or entrance, is built out on the sidewalk, which is full of lamps, and is utilized to display frames full of photographs of the performers within.

Microscopical Research in the Electrostatic Discharge.

BY GEO. T. HANCHETT.

In the last article on this subject, the writer spoke of an attempt to see whether the terminals between which an electrostatic discharge took place has a sensible loss or gain in weight. Since then the experiment has been repeated several times, and no difference can be detected even with a balance sensitive to $\frac{1}{100}$ mg. In one case the powdered tin foil lay about on the slide quite profusely, but no change in the weight of either terminal could be discerned. Fig. 1 shows the two terminals of this case. The dust must have been of the most subdivided nature in order to be so apparent to the eye, and yet be of negligible weight. It is interesting to note that this dust appears to be symmetrically laid, and most profusely at the positive pole.



FIGS. 1, 2 AND 3.

As stated in the previous article, the discharge seems to be composed of two portions, one a fine blue line, and the other a red line, more hazy in its nature. When the discharge is very weak, scarcely able to jump the gap, the red line disappears. As the discharge strengthens and more current passes, the red line appears twisted in among the blue lines and jumping completely across the gap. As the current continues to be strengthened, the spark as a whole becomes more stationary. The red line, however, undergoes a peculiar change. It flattens out, becomes less distinct, and stops short before it reaches the negative terminal. In short, it forms a kind of red mist surrounding the fine blue line of discharge, as shown in Fig. 2.

Covering the spark with a thin plate of glass has a marked effect. The blue portion of the discharge almost entirely disappears, while the red portion shines with increased brilliancy, and stops short before it reaches the negative terminal as before. The red portion of the discharge is also much more sharply outlined and less like a mist or glow. Fig. 3 shows the spark of Fig. 2 covered. The difference of the two is not nearly so apparent as in the object itself. The bright white centre of Fig. 2 is bright blue, while the surrounding haze is red. In Fig. 3 the entire discharge is red, except for a fine blue line in its centre running clear across the gap, and the purple light of the negative terminal.

In order to investigate the nature of this red discharge further, a minute strip of tin foil was laid between the two terminals, as shown in Fig. 4. When the discharge was feeble, the strip received current on its left side and delivered it on its right, as would naturally be supposed. The red line appeared and could not be distinguished from the blue, except by its color. See Fig. 5. As the current was strengthened, the red took on its customary form of a hazy glow, interrupted just before it reached the negative terminals in each of the two discharges. If, however, the current was still further strengthened, the red glow shot completely over the conducting strip and stopped short before the farther negative terminal. The strip of tin foil being a negative terminal on the left side was largely bathed in purple light, but the red discharge was clearly defined against the purple background. Fig. 6 is somewhat imperfect, due to the fact that the red portion of the discharge was in rapid motion, and the gap between it and the negative terminal, which can be plainly seen in the spark itself, does not show in the photograph.

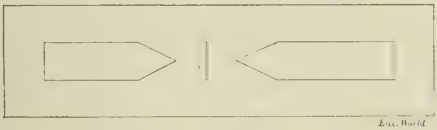
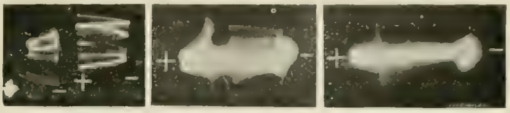


FIG. 4.

By covering the discharge with a thin piece of glass, it was much steadied, and the red glow much more sharply defined. The gap between the red glow and negative terminal can now be distinctly seen. See Fig. 7. The blue portion of the discharge seems to be the essential portion, for it is the first to show when the discharge is within striking distance.

To briefly recapitulate. As the discharge increases in strength, the blue line seems to spread out over the negative terminal as if it were a blow-pipe flame, and the red line appears. The red line as the current increases seems to exactly reverse the action of the blue. Instead of spreading out all over the negative terminal, it stops short before it gets there. It also has this property of preferring to cross over a conductor, while its blue mate utilizes it as a path. Further than this, it is enlarged and made more definite by being confined, while the blue line is weakened by this treatment. A faint and broader band of light green forms a background for this type of discharge. The edges of this band parallel to the spark are remarkably well defined, but it is too faint to show in the photograph.



FIGS. 5, 6 AND 7.

The introduction of a variable capacity in the circuit has the effect of strengthening the blue line and turning it whiter as the capacity increases. A continued increase of capacity causes the red haze to turn to a yellow, which completely envelops both ends and sides of the discharge and lacks the node so noticeable in other discharges. The blue line seems to be the essential portion of the discharge through which the current flows. The colored haze surrounding the spark may be due to either vibration, provoked by the rapid oscillation of the discharge. The fact that the haze changes color when the capacity, and hence the frequency of oscillation is changed, seems to clinch this theory. It remains to be said that the yellow light emitted by the spark whose current has the greater capacity, has a shorter wave length and hence a greater frequency of vibration than the red light of the spark, the capacity of whose circuit is less. This is directly against Maxwell's formula, which states that increased capacity means slower vibration.

A card pierced by the electrostatic discharge from a coil without the insertion of a capacity in multiple, shows a much greater blackening around the edge, and is larger than the hole made by the oscillatory discharge of the Leyden jar. The simple direct discharge seems to burn a hole, while the oscillatory discharge punches one. The appearance of the card is the same on both sides in either case. The oscillatory discharge leaves a burr. The simple direct discharge does not.

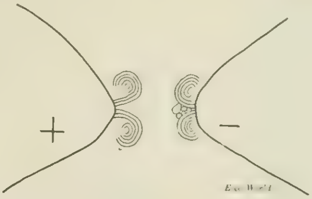


FIG. 8.

The action of the discharge on liquid shellac was accidentally noticed by the writer on a pair of covered terminals which had been flooded with this substance which was used as an adhesive. The appearance of shellac under the microscope reminds one of blood corpuscles. The action of these corpuscles around the terminals of the direct discharge is somewhat peculiar.

Starting from the centre of what is apparently the point of discharge, they proceed outward and return in a circle, their paths being very similar to the lines drawn on the terminals of Fig. 8. The negative terminal emits bubbles which enlarge and finally spring across the gap, leaving a clear space through which a blue line of discharge takes place.

One of the objects of this research has been to investigate the subject of direction of flow. Some new polar phenomena are all that have been found, and the fact that these disappear when capacity is introduced and the discharge becomes, as our theorems say, oscillatory, confirms the supposition that there is a flow of something from positive to negative, or vice versa. This may be a wave of molecular or ether vibration, and is probably something of that nature. The fact that polar phenomena exist and reverse with our reversing switches says as plainly as nature can say it, that the flow is there, and the writer believes that an earnest study of these polar phenomena will result in a complete solution of the problem. If electricity is a wave or vibration, is it longitudinal, transverse or torsional? What is its frequency, and is that always the same, and most important of all, in what direction is the impulse propagated?

Electrodynamic Machinery.—XXXVI.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

228. In all commercial circuits electro-receptive devices require to be operated either at constant current or at constant pressure. The majority of such devices are designed for constant pressure; such, for example, are parallel or multiple connected incandescent lamps and motors. Some devices, however, require to be operated by a constant current; and of these the arc lamp is the most important example. Series connected incandescent lamps and a few forms of motors also belong to this class.

229. In order to maintain a constant pressure at the terminals of a motor with a varying load, it is necessary in order to compensate for the drop of pressure in supply conductors that the pressure at the generator terminals either be kept constant or be slightly raised as the load increases. With shunt wound machines this regulation requires to be carried out by hand, a rheostat being inserted between the field and the armature as shown in Fig. 163.

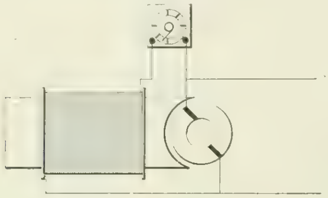
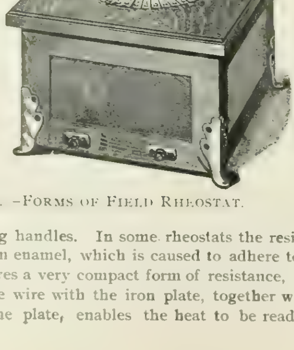


FIG. 163.—SHUNT FIELD AND RHEOSTAT.

230. Various forms are given to rheostats for such purposes. They consist, however, essentially of coils of wire, usually iron wire, so arranged as to expose a sufficiently large surface to the surrounding air as to enable them to keep within safe limits of temperature under all conditions of use. The resistance is divided into a number of separate coils and the terminals of these are connected to brass plates usually arranged in circles, upon an external surface of a plate of slate, wood or other non-conducting material, so that by the aid of a handle, a contact strip can be brought into connection with any one of them. The coils being arranged in series, the movement of the handle in one direction adds resistance to the field circuit and in the other direction cuts resistance out of the circuit. Figs. 164 and 165 show different forms of field rheostats, with wheel controlling handles. In some rheostats the resistance wire is embedded in an enamel, which is caused to adhere to a plate of cast iron. This gives a very compact form of resistance, for the intimate contact of the wire with the iron plate, together with the large free surface of the plate, enables the heat to be readily dissipated and prevents any great elevation of temperature from being attained. Two of such rheostats are shown in Fig. 166.



FIGS. 164 AND 165. —FORMS OF FIELD RHEOSTAT.

231. Compound-wound machines can be made to regulate automatically, and do not require the use of a field rheostat. For this reason they are very extensively used in the operation of electric motors.

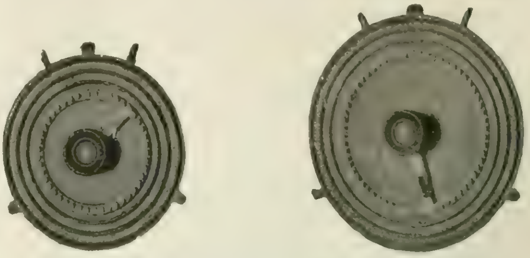


FIG. 166.—ENAMEL RHEOSTATS.

Series wound machines are invariably used for operating arc lamps in series, and, since the load which they have to maintain is apt to be variable, such machines must possess the power of varying their E. M. F. within wide limits. Two methods are in use for maintaining constant the strength of current. The method in most general use is to shift the position of the collecting brushes on the commutator so as to take off a higher or a lower E. M. F. according as the load in the external circuit increases or decreases. The effect of this will be evident from an inspection of Fig. 152, for, if the diameter of commutation be shifted to the right or left, the E. M. F. in some of the coils will be opposed to that in the remainder, the difference only being delivered at the brushes. In practice the diameter of commutation would never reach the position of maximum E. M. F. represented in Fig. 152, and might, on the other hand, rotate through a sufficiently large angle to produce only a small fraction of the total E. M. F.

232. In all cases where the brushes are shifted through a considerable range over the commutator, care has to be taken to avoid the sparking that is likely to ensue if a certain balance is not maintained between the M. M. F. of the armature and the magnetic intensity in the air gap. The fact that the current strength through the armature coils is practically constant at all loads enables this balance to be effectually maintained, when once it has been reached at any load.

233. Series wound arc light generators have their armatures wound in two ways; namely, closed coil armatures and open coil armatures. In the former, all the armature coils are constantly in the circuit, while in the latter, some of the coils are cut out of the circuit by the commutator, during a portion of the revolution. The ordinary continuous current generator for producing constant pressure is, therefore, a closed coil armature. Fig. 167 represents diagrammatically a form of open coil armature winding. The three coils shown are connected to a common or neutral point, *o*, and in the position represented the coil *A* is disconnected from the circuits, the coils *B* and *C* remaining in the circuit of the brushes *b b′*.

234. In closed coils, series wound, arc light generators, the brushes are given a forward lead; *i.e.*, a lead in the direction of the rotation of the armature, and the amount of this lead controls the E. M. F. produced between the brushes. It is essential, in order to prevent violent sparking, that the coil under commutation should be running through an intensity sufficient to nearly reverse the current in the commuted coil during the time of its short circuiting. Since the current strength in the field, and also in the

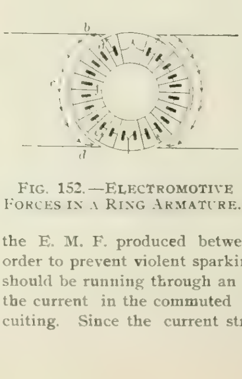


FIG. 152.—ELECTROMOTIVE FORCES IN A RING ARMATURE.

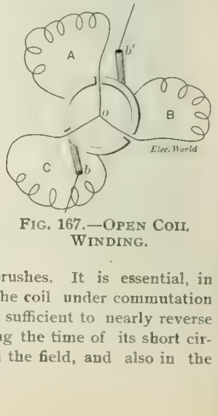


FIG. 167.—OPEN COIL WINDING.

armature, is maintained constant at all loads, it is necessary that the intensity of flux, through which the commuted coils run, should be uniform, or nearly uniform at all loads, and of the proper degree to effect current reversal. The M. M. F. of the field magnet is constant and the M. M. F. of the armature is also constant, but the flux produced by the M. M. F. of the armature varies with the position of the brushes and the number of active turns in the armature, covered by the pole piece, on each side of the diameter of commutation. The pole pieces are usually so shaped that as the number of active turns in the armature covered by each pole increases; *i. e.*, as the load and E. M. F. of the machine increases, the trailing pole corners become more nearly saturated and by their increasing reluctance check the tendency to increase the flux from the armature, so that an approximate balance between the field flux and the armature flux is maintained at all loads. The armature flux always opposes the field flux at the diameter of commutation, and the magnetic circuit has to be so designed that the armature flux shall never quite neutralize the field flux at this point, but shall always leave a small residual field flux for the purpose of obtaining sparkless commutation.

235. The other method, which is employed for maintaining the current strength constant, introduces a variable shunt around the terminals of the field coil, in such a manner that when the current through the circuit becomes excessive, the shunt is lowered in resistance and diverts a sufficiently large amount of current from the field magnets to lower their M. M. F. to the required value. In order, however, to avoid the necessity for making this regulation by hand, it may be effected automatically as follows: namely, an electromagnet, situated in the main circuit, is caused by the attraction of its armature, on an increase in the main current strength, to bring pressure upon a pile of carbon discs. This pile of discs offers a certain resistance to the passage of a current, the resistance of the pile diminishing as the pressure upon it increases. The pile is placed as a shunt around the field magnet, so as to divert from the magnet a portion of the main current strength. When the pressure from the armature of the electromagnet increases the pressure on the pile, the resistance of the shunt path is diminished, and less current flows through the field magnets, as represented in Fig. 168, where *S* is the series winding, shunted by the carbon pile *P*, and *M* is the controlling magnet inserted in the main circuit.

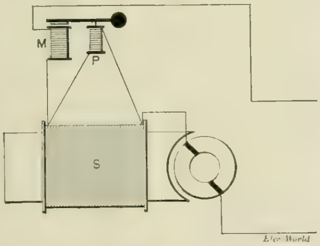


FIG. 168.—DIAGRAM OF AUTOMATIC REGULATOR CONNECTIONS.

236. Both the above methods are capable of compensating not only for variations in the resistance or C. E. M. F. of the circuit, but also for variations in the speed of the driving. In this respect the compensation is more complete than that of constant pressure machines; for compound wound generators can maintain a constant pressure under variations of load, but not under variations of speed.

237. When a system of electric conductors is supplied from a central station, it is evident, that if the load on the system was constant, a single large generator unit would be the simplest and cheapest source of electric supply, except, perhaps, on the score of reserve, in case of accidental breakdown. In practice, however, the load is never constant, and, therefore, the generating unit is always considerably less than the total activity that has to be supplied at the busiest time. Moreover, engines and generators are necessarily so constructed, that while they may be comparatively very efficient when working at full load, they are far less efficient when working at a small fraction of their load, so that it is desirable to maintain such units as are in use at full load under all circumstances. This consideration of wasted power, in operating large units at light loads, applies with less force to plants operated by water power, but even in this case it is usually found uneconomical to operate a large generator, for many hours of a day, when a smaller one would be quite competent to supply the load.

238. The generating units in a central station are, therefore, so arranged that they may be individually called upon at any time to add their activity to the output of the station. Electrically these generators must be connected either to separate circuits, in series or in parallel.

The first method, so far as continuous current circuits are concerned, is only employed for arc lamps operated in series. When a large number of arc lamps have to be supplied over a given district, they are usually arranged in different circuits, each circuit containing approximately the same number of lamps; each such circuit is then connected, as full load, to a single arc-light generator. When, however, some of these lamps are cut off, so that the load on individual arc generators is considerably reduced, two or more of these underloaded circuits may be connected in series, at a specially designed switchboard, and supplied by a single generator.

239. Generators are connected in series when it is desired to employ on the external circuits the sum of the pressures of those generators. For example, in cases of the transmission of power to considerable distances a high pressure in the conducting circuit is economically necessary. Whenever this pressure is greater than that which can be readily obtained from a single continuous current generator it is possible to connect two or more generators in series, so as to obtain the sum of their pressures. Thus, five generators, each supplying 500 volts pressure, will, when connected in series, supply a total pressure of 2,500 volts.

240. As a modification of the above plan, which is rarely adopted, five-wire and three-wire systems, employing respectively four and two generators in series, are in use. The five-wire system, although employed in Europe, has not found favor in this country. The three-wire system, however, is extensively employed. In this system, two generators of equal voltage, say 125 volts, are connected in series so as to supply a total pressure of 250 volts. Such a pressure is capable of operating incandescent lamps in series of two. To enable single lamps, however, to be operated independently, a third or neutral wire is carried through the system from the connection point of the two generators, and the distribution of lamps, on the two sides of the system, is so arranged that the equalizing current, passing through the neutral wire, is small, and nearly as many lamps are operated at any one time on the positive, as on the negative side of the system. A pair of generators connected for three-wire service, therefore, constitutes a generating unit in a central station.

241. It occasionally happens in the case of series arc circuits that owing to some accident that may occur to a line wire, it becomes necessary to connect two lines together, so as to form an extended loop, in order to maintain the supply of the disabled line. This often requires that not only two lines but also the two generators for those lines be connected in series.

242. Series generators are never, in practice, connected in parallel. Shunt wound and compound wound machines are capable of being connected in parallel, and most central stations arrange the generators in such a manner that they may be connected to or disconnected from the mains according to the requirements of the load.

243. Central stations, supplying incandescent lamps in parallel, usually employ shunt wound generators, for the reason that the efficient and economic operation of the lamps require a uniform pressure at all lamp terminals.

Not only does the uniformity in the amount of illumination from an incandescent lamp depend upon the uniformity of the pressure supplied at its terminals, very small variations in the pressure markedly varying the intensity of illumination, but also such variations of pressure materially affect the life of the lamp. Thus a 50-watt, 16 cp, incandescent lamp, intended to be operated at a pressure of 115 volts, would have its probable life reduced by 17 per cent., if operated steadily at 116 volts, and reduced by about 33 per cent., if operated steadily at 117 volts pressure. For this reason the pressure in the street mains supplying the lamps requires constant careful attention. Since it would be impossible to obtain at the mains a sufficient uniformity of pressure, under all conditions of load, by compound winding, and hand regulation would still be required, there is an advantage in dispensing altogether with compound winding, and resorting to hand regulation, with shunt winding, for the entire adjustment.

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(To be continued.)

Rope Driving.—XVII.

BY J. J. FLATHER.

An abnormal degree of slack side tension has a direct effect upon the wedging of the rope in the groove, for if sufficient sag is not allowed, and the slack side tension is therefore needlessly great, it follows that the power transmitted will be reduced, since the driving force P is equal to the difference of the tensions in the two portions of the rope $= T_1 - T_3$; on the other hand, the force drawing the rope into the groove will be increased, since this force equals

$$T_1 - F + T_3 - F = P + T_3 + T_3 = P + 2\,T_3.^*$$

It is obvious, therefore, that the slack side tension should be no greater than just sufficient to give adhesion to the ropes and prevent undue slip at the desired speed.

As to the best angle for the groove in the pulley, opinion is still somewhat divided, but in England the general practice seems to favor an angle of 45° as the most suitable.†

In the earlier installations a more acute angle was used, as evidenced by the discussion of Mr. Durie's paper on "Rope Driving" presented to the British Institute of Mechanical Engineers.‡ Grooves having an angle of 30° had been tried, but it was found that the wear on the rope was altogether too great; 40° was a very satisfactory angle, and is still preferred by many engineers, while others use as large an angle as 60°. Occasionally half round grooves are used, but with semi-circular grooves on cast iron pulleys either the tension in the rope must be increased or a greater number of ropes must be employed; in any case the advantage seems doubtful. With wooden rimmed pulleys, however, the semi-circular groove is the better form, for since the coefficient of friction on the wooden pulley is from 30 to 50 per cent. greater than for a similarly shaped groove on an iron pulley, it follows that the tension in the rope need not be great; moreover, wooden pulleys that have been in use several months would indicate that the semi-circular groove is better adapted to the work, as, with anything but very light loads, the angular groove is soon cut out by the rope, producing a rim somewhat similar to the one shown in Fig. 44, which represents an angular grooved wooden pulley that had been in use but a few months.

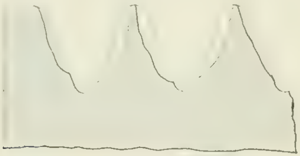

Fig. 44.

With a semi-circular groove in the first place, the pulley will retain more nearly its original form, and the wear on the rope will be greatly reduced.

The pliability of the rope has considerable influence on the shape of the groove; while a 30° angle may give the correct shape for a soft, loosely twisted cotton rope, a harder twist may require an angle of 40° or even 50°; in the same way a 40° groove may be all right for some makes of manilla rope, while others of a less yielding nature would give better results if an angle of 50°, over even 60° were used.

At the present time there are very few pulleys used in this country, except for machine bands, having grooves with an angle less than 40°. Formerly the Yale & Towne Manufacturing Company employed grooves of 30° for small cotton ropes (about ¾ inch in diameter), driving their traveling cranes, but these subsequently were changed to 50°, and at the same time larger ropes, 1¼ inch, were adopted. For manilla rope drives one large manufacturer uses an angle of 60° on all his pulleys; this angle was arrived at after much trial, and represents an experience with manilla rope transmission covering a great many years. The most suitable angle of groove is that which affords the greatest frictional adhesion without undue slip, and at the same time offers the least resistance to the rope in leaving the groove; with much slip the rope is rapidly worn out, while with an excessive grip the wear is also rapid and a relatively large amount of force is absorbed in overcoming the wedging.

The usual practice in this country for both cotton and manilla ropes is an angle of 45°; in many cases the section of the groove is formed by arcs of circles having a radius equal to from 3 to 4 diameters of rope, in which case the included angle is constantly changing, and the coefficient of friction, and hence the grip, will vary with the diameter of rope used. Thus, in Fig. 45, if A, B, and A', B' represent two ropes of slightly different diameters running over a grooved pulley, the one which sinks deeper into the groove will include the greater angle of contact A, B, C, and hence the lesser coefficient of friction; this will hold true of two ropes having the same diameter but different degrees of twist; the harder rope will not sink as deeply into the groove, and its coefficient of friction will be greater than that of the smaller rope—other things being equal—on account of the lesser angle in the groove.

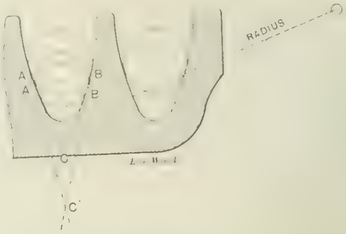

Fig. 45.

With the excellent ropes that are now being made for transmission purposes, this form of groove possesses many advantages, even with the continuous wound system. In this system the tension is assumed to be the same in each wrap, but there is unquestionably a variation of pull due to momentary fluctuations which must either be absorbed by the elasticity of the rope or transmitted through the rope until the strains are equalized. If the rope used is uniform in structure that portion which receives the greater strain will be drawn more deeply into the groove, and if the latter be of the curved form, the coefficient of friction will be reduced so that the resultant adhesion produced in this portion of the rope will be less than that in some other part, which, under a lighter strain, occupies a position on the pulley such that its coefficient of friction and consequent adhesion is greater, for a given back tension.

With the usual arrangement of pulleys, namely, that in which the larger wheel is the driver, the tendency of an increase in tension is to increase the velocity of the driven pulley. If several wraps of a series occupy positions in the grooves such that with a given ratio of pulley diameters the velocity of the smaller pulley is twice that of the driver, any decrement, x, of the effective radii of another wrap which is drawn more deeply into the grooves of the two pulleys will alter the velocity ratio from $\frac{2}{1}$ to $\frac{2 - x}{1 - x}$, a quantity which must of necessity be greater than 2. The tendency of this wrap, then, is to produce a greater velocity in the driven pulley, which cannot occur without some slip in the other wraps; but these wraps have a greater adhesion, and, therefore, tend to drive the pulley at a less number of turns per minute which will produce slip in the more heavily strained member; hence the effect of any change in position due to sudden increased strain on one wrap will tend to quickly adjust the tensions in all portions of the rope, and neutralize any inequalities in driving effort. This form of groove, as we shall show subsequently, is even more desirable for the individual rope system where the evils of differential driving are frequently so pronounced.

As noted in a previous paper, the frictional grip depends both upon the arc of contact of the rope with the pulley and the coefficient of friction, which latter varies with the angle of the groove. In order, therefore, to produce the same friction on each pulley the product of the arcs of contact by their respective coefficients of friction must be equal. If, as before, we take the coefficient of friction of a lubricated rope on a smooth, flat metal pulley equal to 0.12, the coefficient for the same rope in a groove whose angle is θ degrees will be $\phi = 0.12 \operatorname{cosec} \frac{\theta}{2}$; hence with arcs of contact a and a' we should have for an equal grip on each pulley

$$\Phi a = \Phi' a' \text{ or}$$

$$0.12 \operatorname{cosec} \frac{\theta}{2} \times a = 0.12 \operatorname{cosec} \frac{\theta'}{2} \times a',$$

---

[*] Although the centrifugal force increases the tension in the rope its tendency is to cause the latter to leave the pulley, and therefore should be deducted in this case.

[†] "M. E." in *American Machinist*, Nov. 10, 1892.

[‡] See Proc. Inst. M. E., 1876.

assuming that the multiplier 0.12 will give the correct coefficient of friction on each pulley, since the percentage of slip is to be the same. As the numerical value of the cosecant of an angle varies inversely with the angle, it will be obvious that the pulley having the lesser arc of contact should also have the more acute angle in the groove; this property of rope friction is frequently taken advantage of in designing a plant, and it is not uncommon to find the grooves in the large wheel more obtuse than those in the smaller—especially when there is considerable difference in the diameters of the pulley.*

From the above equation there is obtained

$$\text{cosec}\,\frac{\theta}{2} = \text{cosec}\,\frac{\theta'}{2} \times \frac{\alpha'}{\alpha}$$

in which θ and α represent the angle of groove and arc of contact, respectively, on the larger pulley; and θ' and α', similar values for the smaller pulley. With the least angle of groove equal to 35°, 40°, or 45°, the corresponding angle in the larger pulley should be as indicated in Table XVI., when the ratio of the arcs of contact is known.

TABLE XVI.

ANGLE OF GROOVE FOR EQUAL ADHESION

$\frac{\text{Arc of contact on small pulley}}{\text{Arc of contact on large pulley}} = \frac{\alpha'}{\alpha}$	0.9	0.8	0.75	0.7	0.65	0.6
Angle of groove in large pulley when groove in small pulley = 35°.........	40°	44°	47°	51°	55°	60°
Angle of groove in large pulley when groove in small pulley = 40°.........	45°	50°	54°	58°	64°	70
Angle of grove in large pulley when groove in small pulley = 45°.........	50	55°	60	66°	72°	80°

Of course, an idler or binder pulley may be used to increase the arc of contact on the smaller pulley, and thus maintain an equality of grip on each pulley, but this device produces an objectionable reverse bend in the rope which should be avoided as much as possible in rope transmission. Both of these arrangements, as well as the winder pulley, previously discussed,† are intended to prevent slip, and at the same time obtain the maximum adhesion for the least amount of back tension, without increasing the losses due to wedging in the grooves, journal friction, and wear in the rope.

As pointed out by Mr. W. H. Booth,‡ although there may be some loss and wear due to wedging in the grooves, by far the greater loss is occasioned by the deeper wedging of one rope as compared with another, so causing them to grip upon a different circumference, in which case each rope tends to impart a different velocity to the driven pulley; the actual resultant velocity will be a mean of the several velocities of the individual ropes, so that slipping and wear of some or all of the ropes must occur, due to the differential driving thus set up.

With the continuous rope transmission this effect is not so apparent, although it exists to a certain extent on account of inequalities in the rope and various mechanical imperfections in the system; but in the English or independent rope transmission its effect is very marked, and is generally considered as the principal source of loss of efficiency in this system.§

While there is undoubtedly a considerable loss which may be charged to this cause, it is also true that its effect may be greatly reduced by a careful study of the requirements of the problem, and an intelligent application of correct principles to the case in hand.

(To be continued.)

Definition of Polyphased Systems.

To the Editor of The Electrical World:

SIR:—To me the definition of a polpyhased system is very simple: "poly" means several, consequently a polyphased system is, in the words of Prof. Hospitalier, the creator of the term, "a system comprising the employment of several alternating currents of different phase."

I do not see why, for the sole sake of pleasing Mr. Steinmetz, we should modify a definition so clear and one so universally admitted during the last four years. Mr. Steinmetz himself—coming from whom the new definition is still more to be criticised—would doubtless never have thought of advocating the change if the accepted definition did not have for him an entirely special inconvenience—that of causing the monocyclic system to fall into a known category.

The monocyclic system is, in fact, nothing else than a *polyphased system* by means of which two phases are transformed (for what reason we do not know, unless it is to avoid the patents of another company), into three phases or into one, according to whether the motors are starting up or working under load. To wish to modify the definition of polyphased currents in order to avoid this conclusion is evidently a radical proceeding, and one which will not be countenanced by those having no ulterior interest in the matter. By applying the same method of reasoning, we can, in fact, just as well show that a dog which can momentarily support himself on his hind legs is not a quadruped. If I may be permitted to make a trivial comparison, the monocyclic system may be defined as a two-phased animal which dispenses with one of its phases when the motors are running under load.

It is, without doubt, from the considerations referred to that Mr. Steinmetz rejects the word polyphase; the ordinary public, however, which calls a spade a spade, is, unfortunately, not apt to lend its attention to such subtleties, and will not be pleased by having its supposed credulity thus imposed upon.

As to the system which has been the subject of this curious discussion, it is certainly very ingenious, as is everything which comes from the same capable source. I confess, however, not having been able, any more than Mr. Scott, to see its advantage over a properly designed two-phased system, while I do see very well that it is inferior to such a system, both in the power and efficiency of its machinery. One may assign it the finest name in the world, and change all known definitions—this will avail nothing.

PARIS, FRANCE. A. BLONDEL.

Electrical Cats.

To the Editor of The Electrical World:

SIR:—The explanation suggested by Mr. Balcom, in your issue of May 11, 1895, to account for his getting a spark on releasing a cat from his grasp, as stated by him in the words "I am of the opinion that the cat may possess on a small scale an organ, etc.," is much further from the truth than the explanation the child gave for certain other feline peculiarities, which was that she had "tacks in her feet." The fact that a cat when dry will, as a whole, become electrified by stroking or handling *ought to be familiar enough.* The charge remains "bound" and of low potential until the release or removal of the outer conductor (the arms of the person holding it) when with a great increase of potential, due to diminished capacity of Mr. or Mrs. Cat, a spark strikes through the fur just as the release is effected. This is all well known as applying to every cat without any special electrical organ or gymnotic affinities.

If Mr. Balcom will study the cat as an example of that old and most instructive instrument, the electrophorous, neither he nor the Professor of the Buffalo Electrical Engineering School would need to call upon you to disseminate his facts. I sometimes think it would be useful for any observers of electrical phenomena to take a course of reading of the books extant in the latter part of the century 1700-1800, when cats and other familiar things formed an important class of electrical apparatus submitted to experiment.

LYNN, MASS. ELIHU THOMSON.

To the Editor of The Electrical World:

SIR:—I notice in your issue of May 11 a letter suggesting that the cat may possess an electrical organ similar to the electric torpedo. I am always interested in anything of this kind, and as I am the possessor of nine pet cats, and have made a great many electrical experiments, I beg to differ with Mr. Balcom's theory in regard to any organ or muscles of an electrical nature in connection with a cat. I think when you come to investigate closely you will find that the shock experienced is caused simply by the friction of the cat's fur. I have experienced quite strong shocks from my cats, but, of course, obtained the best results in cold, dry weather. However, I should be pleased if any of the readers of THE ELECTRICAL WORLD have any additional information on the subject, and in case it is found that the cat is capable of producing electricity we might connect up a few of the felines in series and utilize the current for gas lighting, etc. CHAS. E. HERRIMAN.

GIRARD, KAN.

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*Mr. T. Spencer Miller, of the Lidgerwood Manufacturing Company, has been granted a patent upon the application of this principle to continuous rope transmissions in which with sheaves of different diameters more obtuse grooves are used in the larger wheel.

† ELEC. WORLD, Dec. 23, 1893.

‡ *American Machinist*, Dec. 8, 1888.

§ See *American Machinist*, Dec. 1, 1892.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors, or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 927 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French, or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Pre-Determination of the Loss of Voltage in Transformers.—A brief paper on this subject by Mr. Kapp is reprinted in full in the "Elec. Zeit.," April 25. He calls attention to the difficulties in determining the loss of voltage by direct measurement, especially with large transformers, as a large amount of power and a resistance which will absorb it, are necessary, the phase shifting in the secondary circuit must be known, and even then the result will be correct only for that phase difference. He describes the following method which makes it possible to predetermine the voltage for all loads and phase differences, the method being based on a very simple experiment requiring very little power and no resistance. The principle of the method is as follows: in the adjoining Fig. 1 let $O\ A$ represent the vector of the current in the secondary coil, $O\ 2$ the vector of the secondary voltage at the terminals and ϕ the phase difference produced by the induction in the external circuit; if the external circuit had a capacity instead, this angle would be negative and would lie to the right of that line. The E. M. F. induced in the secondary must contain three components, first $O\ 2$, secondly a component representing the ohmic loss of voltage, which is in the same direction as $O\ A$, and thirdly, a component which balances the self-induction in the secondary coil and which in the diagram would be represented by a horizontal line to the left; let $C\ E$ and $2\ C$ represent the two latter, then $O\ E$ is the vector of the induced E. M. F. The same construction could be applied to the primary coil starting from $O\ E$, but in order not to increase this in the transformer ratio, it can be supposed that the primary is divided into groups of m parallel wires; the primary voltage would then be reduced to $1 \div m$, the primary current increased m times and the resistance diminished $1 \div m^2$ times; the vector $O\ E$ will then give the induced E. M. F. in the secondary as well as in the primary; the primary voltage is then divided into three components like the secondary; in modern transformers with closed magnetic circuits the vector of the primary current is almost exactly in the continuation of that of the secondary current, as the ampere windings required for magnetization are negligibly small as compared with the others; this vector can therefore be assumed to be vertical as also that corresponding to the ohmic resistance, while that due to self-induction is horizontal; let the latter be $E\ D$ and the former $D\ 1$; this gives $O\ 1$ as the vector of the primary voltage at the terminals; the relative position of the points 2 and 1 depends only on the secondary current, the resistance of the coils and the E. M. Fs. generated in the coils, but not on the phase difference or the terminal voltage in the external circuit; the distance 1 2 is directly proportional to the current, while the inclination depends upon the resistance and the inductance; if $O\ B$ is made equal and parallel to 1 2 then $B\ 2$ is the primary terminal voltage and $O\ 2$ the secondary, for that current for which $O\ B$ represents the E. M. F. for the resistance and the inductance. This E. M. F. can be easily determined by the following method: the secondary terminals are short-circuited through an ampere meter and a sufficient voltage, at the proper frequency, is applied to the primary to produce the normal current in the secondary, the amount of energy required being extremely small; if the primary voltage, as obtained, be divided by m it will give the length $O\ B$. To determine the inclination of $O\ B$, calculate the loss of voltage due to the ohmic resistance and lay it off as $O\ F$, then $F\ B$ is the E. M. F. of self-induction, at the observed current. As $O\ B$ is proportional to the current, then for no load B and C coincide, likewise 1 and 2; that is, the primary and secondary terminal voltage are then the same. If from O and B circles are drawn (as shown in Fig. 2) whose radii represent the secondary terminal voltage at no load, then on any vector the portion between the circles, shown at a, is the loss of voltage corresponding to the phase shifting represented by the angle of that line, be it positive or negative. For other currents the point B must be moved correspondingly, the radii of the circles remaining the same. If a liquid resistance is used in testing the transformer, then the circuit has a capacity and the direct measurement will give a loss of voltage which is too small; there can then under certain circumstances even be an increase in voltage, therefore giving quite incorrect results. The graphical construction, Fig. 2, can also be used to show the effect of the frequency; for small leakage and resistance the point B will approach F for an increasing frequency, and if the transformer is used with inductive circuits then the voltage loss will become smaller by diminishing the frequency and *vice versa;* the frequency should therefore be as small as possible. In order to define the allowable loss of voltage in ordering transformers, he suggests that the primary voltage be given which will generate the normal secondary current when the secondary is short-circuited; this is easily verified and suffices for characterizing the transformers.

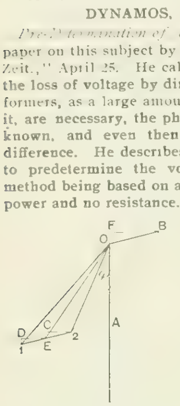


FIG. 1.

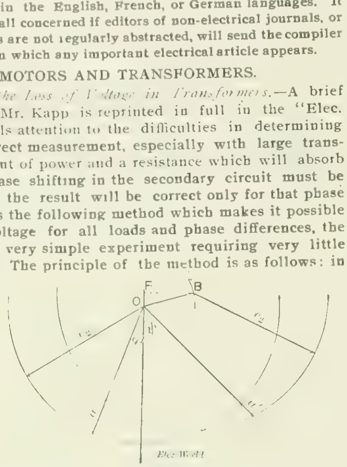


FIG. 2.

In the discussion which followed Mr. Dobrowolsky spoke very highly of this method which he says is of great practical value; he has applied it and gave the results of carefully made measurements which prove the correctness of the method. Mr. Goerges also gave some experimental data; he adds that he noticed that with no load the transformer ratio does not agree with the theoretical; with high voltages the two coils in a transformer must be farther apart, and in that case he noticed an interesting phenomenon, namely, that the air space between the primary and the core contains practically no magnetism, while that between the two coils is traversed by a very strong field; in the space between the core and the coil the two magnetic fields must be subtracted while in the other space they must be added; this method was used to determine the leakage. Mr. Dobrowolsky in reply claimed that it was not necessary to separate the two coils by such a large space; he also stated that 18 to 20 sq. cm. per watt lost, provides a sufficient surface to radiate the heat. Mr. Goerges stated that his company (Siemens & Halske) has constructed transformers for 10,000 volts and for 1,500 kilowatts in which the distance between the two coils was about three-fourths of an inch.

Iron in Transformers.—The mean results obtained by Prof. Ewing, of the hysteretic losses for the iron made by a certain London firm, are published in the "Elek. Zeit.," May 2; the hysteretic loss is very small.

Transformers.—Some tabular data for the single and three-phase transformers of the General Electric Co., of Berlin, is published in the "Zeit. fuer Elek.," May 1.

Theory of the Synchronous Motor.—A paper on this subject was read by Mr. Rhodes before the Physical Society of London, a very brief abstract of which is given in the Lond. "Elec. Eng.," May 3; the object is to give as simple a treatment as possible of the mathematical part of the subject and to give theoretical proofs of some experimental facts. Prof. S. P. Thompson stated that the mathematical part was much simpler than that in previous investigations on this subject; the part of the paper relating to armature reactions and phase relationship was quite new; two results deserve special attention, first, with the maximum current at zero the power was the same as if the circuit was non inductive; secondly, with the maximum current at zero the power was double the current corresponding to the maximum output.

Calculation and Construction of Continuous Current Dynamos.—A short lecture by Mr. Picou is reprinted in "L'Eclairage Elec.," April 20; it is devoted almost entirely to an explanation of the method of calculating a 75 kw machine for 300 amperes and 250 volts. Regarding the different types of dynamo he says that in principle there is no superiority of one over the other, but that each type is specially adapted for different purposes. He states that experience has shown that up to about 80 kilowatts it is best to use 2-pole machines and above that, multipolar.

Simple Graphical Interpretation of the Determinental Relation of Dynamos.—A Physical Society paper by Mr. Bryan is abstracted very briefly in the Lond. "Elec. Eng.," May 3; the paper appears to be mathematical in character.

Performance of the Tesla Motor.—"El'ty," May 15, publishes a number of curves of the performance of a 50-hp motor which is running at the Westinghouse works, on the regular two-phase circuits at 220 volts, 3,000 alternations and 750 revolutions. The maximum starting torque of which the motor is capable, is a little over 2.5 times the full load running torque but this starting torque is not required in ordinary practice, as a resistance in the secondary of the motor has such a value that the starting torque is about 1.5 times the full load running torque; with this resistance the current taken by the motor at starting is about 50 per cent. more than that at full load; when running unloaded the motor takes 18 apparent horse-power; the speed falls less than 2 per cent. from no load to full load; the apparent and true efficiencies rise very rapidly as the load increases; at one quarter load the former is 57 per cent. and the latter 84 and at full load they are 81.5 and 89.5, respectively; the latter is said to be better than that ordinarily attained by direct current machines of the same output, and the light load efficiency is much better; the all-day efficiency will therefore be higher than that of a direct current motor if the power required is variable; the ease with which it can be controlled both "as to speed" and as to direction of rotation make it superior to the ordinary motor.

LIGHTS AND LIGHTING.

Tests of Incandescent Lamps.—A long Physical Society paper by Prof. Ayrton and Mr. Medley on "Tests of Glow Lamps and a Description of the Measuring Instruments Employed" is published in full with numerous illustrations and curves in the "Phil. Mag." for May; a reprint of the paper is begun in the Lond. "Elec. Rev.," May 3; an abstract of this paper appeared in the Digest, Feb. 23. The authors begin with a discussion and comparison of previously published papers on this subject including those of Ayrton and Perry, Fleming, Howell, Feldmann, Thomas and Hauptman; in the light of the knowledge obtained from the experiments described in those papers the formula in the first of these papers requires to be changed and must now be written: cost per hour per candle equals the product of the price of one watt-hour and the average watts per candle, added to the quotient of the price of a lamp divided by the total candle-hours. From the experiments of Prof. Thomas (in America) he deduces curves, the ordinates of which are the total costs per hour per candle and the abscissas are the life in hours, which curves, as is well known, show a minimum point sometimes termed the "smashing point"; that is, the point at which it would seem to be economical to discard the lamp. The present tests, which were begun at the end of 1892, were made with Edison-Swan lamps (English) of 100 volts and 8 cp, and were intended to find out experimentally what was the most economical voltage and the length of their economic lives for different prices of the energy. The apparatus, which appears to have been quite elaborate, is described in detail with the aid of some illustrations; the lamps were run from storage batteries so arranged with an adjustable resistance in circuit and an automatic regulator, that the voltage did not vary as much as one-tenth of a per cent. and if a lamp broke the exact time of breaking was indicated automatically; a 2-cp Methven screen with pentane gas was used as a standard in connection with a 10-cp low voltage incandescent lamp; the latter was mounted so as to gently swing backward and forward in the direction of the bench, the effect thus produced being found to be an improvement on that usually obtained by moving the photometer screen first a little to one side and then to the other. The photometric measurements did not differ from the other more than 0.3 per cent. It was noticed that after starting the tests, the candle-power, current and the candles per watt, all rose as the lives of the lamps increased; a number of tests were made to satisfy them that this unexpected result was correct; curves showing the results of the tests are given for four groups of lamps run at 100, 101, 102 and 104 volts, respectively, both the candle-power and the current being indicated; the lamps which were tested showed hardly any blackening, even when the filaments lasted for over 1,300 hours. Although the rise of candle-power was always accompanied by a rise of current, yet the former was proportionally much greater than the latter and the consumption of power per candle was therefore less after the lamp had run for 50 hours than it was at the beginning, and the power per candle did not rise seriously during the whole life of the lamp. The following is a summary of the results: for the first 500 hours and for the 100-volt lamps the consumption was 4.0 watts per candle; for the second 500 hours it was 4.36 watts and for the third 4.55 watts per candle, the average for the whole being 4.35; for the 101-volt lamps the candle power rose 15.5 per cent. in the first 150 hours and the current rose 4.72 per cent., the watts per candle falling from 4.80 to 4.32 with an average of 4.68; for the 102-volt lamps the rise in candle-power in 120 hours was 14.4 per cent., the watts per candle diminishing from 4.22 to 3.82, the average consumption of energy during the first 500 hours being 3.9 watts per candle, during the second 4.06, and during the third 4.2, with an average for the whole of 4.12; with the 104-volt lamps the breakages were very frequent, the initial rise in candle-power was 19.8 per cent. and the average watts per candle were 3.6. They found that when first started the light varied approximately as the seventh power of the voltage when the latter is something like the normal; but after they have been used for 100 hours it varies about as the fourth power. Among the conclusions from their tests it was stated that when a group of these lamps is run at 100 volts and each broken lamp is replaced by a new one it may be expected that the light given out by the group will never be as small as it was at the beginning; that such lamps, marked 8 cp, will give an average illumination at 100 volts, during their whole life, of about 10 candles and will absorb an average power of about 4.3 watts per candle; that during a large portion of their life they may give as much as 11.7 candles. They show that this rise in candle-power at the start was also shown in the curves of Feldmann, in which, however, the greatest rise was only 14 per cent. while they had noticed 45 per cent., and in the former the candle-power at the end was always much less than at the beginning, while with the latter the light given out by a group of lamps was never as low as it was when the lamps were new; in their tests the power per candle not only diminished considerably during the early life, but never rose again as high as it was when the lamps were new; this remarkable rise during the earlier part of the life of these lamps has a very important effect on the economy of lighting with incandescent lamps. The next point considered is the way in which the cost of lighting with these lamps depends on the voltage; several interesting curves are worked out giving the cost per hundred candle-hours for different times in hours, replacing the broken lamps with new ones; these total cost curves show that there is nowhere any such rise in cost of producing light as was shown in similar curves for American lamps, except when the cost is 18 cts. per kilowatt-hour in which there is a slight indication of a turning up of the curve; with these lamps there is, therefore, no point to indicate that the time has been reached when it would be good economy to discard the lamps before the filaments break. Owing to the extent to which individual lamps vary among themselves, it is difficult to say which of the four voltages would be most economical to use; at nine cents per kilowatt-hour, the lamps tested at 100 volts gave the cheapest light, and at 18 cents there is not much to choose between the cost of producing light at the different voltages; they therefore conclude that no marked economy can be gained by forcing this type of lamp.

The original paper was read Dec. 14 and an addition read Jan. 25 follows the present article; in this they discuss the cause of the rise in candle-power; Mr. Howell at the American Institute of Electrical Engineers, stated that such a rise was due to the vacuum of the lamp improving, and they therefore made some experiments to test the validity of this by applying the induction coil test to new lamps and again after 80 hours, finding that in every case the vacuum has apparently improved, but the conclusion that the explanation was correct has been modified by tests made since in which they find that the improvement in the vacuum is not accompanied by the great rise in candle-power which they found in the first tests which were the subject of their paper; the apparent increase in the vacuum in a set of lamps purchased recently was produced slowly, and not suddenly on the first application of the voltage; they give the results of the test of this batch of lamps from which it appears that in some lamps there was practically no change either in the light or in the power absorbed during the first 80 hours and in the remainder the increase was comparatively small; as the vacuum appeared to improve steadily with all the lamps it was not the sole cause of the rise in the candle-power; they suggest that it may have been due to the change in the surface of the filament causing the emissivity for heat to decrease but whether such a change occurs they have not yet found out; at present they say it is impossible to give the most economical voltage, as the lamps differ too much among themselves; they conclude, however, referring to the first test, that the best voltage is that which corresponds to four watts per candle during the larger portion of its life; to calculate this they give the equation that this voltage is equal to a constant multiplied by the watts per candle raised to the minus 0.285th power.

Products of Combustion of the Electric Arc.—An Academy paper by Mr. Grehant is reprinted in "L'Elec.," May 4. He describes tests which he has made, in which the lamp was enclosed in a box and a dog was made to breathe the air surrounding the arc for half an hour, after which the blood of the animal was tested for carbon monoxide; in the first experiment it was found that the air contained one part carbon monoxide in 1,400, in the second it was one in 3,000 and in the third one in 2,500; in the second there was one part of carbonic acid gas in 57 and in the third one in 62. He concludes that it is certain that carbon monoxide is produced in the electric arc in small quantities and that in small rooms this poisonous gas is therefore formed in sufficient quantities to cause the serious diseases among workmen which have been noticed; it is therefore necessary to have sufficient ventilation.

In referring to the paper editorially the Lond. "Elec.," April 26, states that it may be regarded by some as indicating a latent danger in arc lighting, but it adds that the carbon burnt per unit of light is certainly smaller in the case of the arc light than in any other comparable method of illumination; ordinary ventilation, if sufficient for carrying off the products of combustion of the human being, will suffice for the disposal of the products of combustion of the arc lamp.

Decorative Electric Lighting.—The Lond. "Elec. Rev.," May 3, contains a long article with a very large number of half-tone illustrations of lighting effects in installations in England.

POWER AND HEAT.

Heating and Cooking.—The Lond. "Elec. Rev.," May 3, gives a brief abstract of Mr. Crompton's paper (see Digest last week) including some deductions made from it, one of them being that the efficiency of the larger tea kettle was 63 per cent. and of the smaller one 71.5 per cent., which shows that the time taken is a very important factor in determining the heat lost and therefore the economy of the operation; the smaller one is most efficient, doing its work in two-thirds of the time. In some deductions concerning the radiators it appears that the current increased with the heat, although naturally one would suppose that it would decrease. In an editorial note it is believed that the advantages of electrical cooking to the central stations have been overrated; belief is expressed that the use of these domestic appliances will be to extend and develop the business of supplying, rather than flatten the load curve; the valley to be filled up is so deep that it would require a very general use of electricity for culinary operations to do much in this direction.

[illegible] Operation.—The "Elek. Anz.," April 28, reprints a lecture by Mr. Brettschneider giving in detail the cost of operating the electric plant on his large estate. The power, about 18 horse-power, is generated by a neighboring waterfall; there is a battery of accumulators in connection with the plant; the list of lamps and motors is given in detail showing a total output of 34,000-hp-hours per year; the first cost and cost of operation are given, the former being $7,500 and the latter $1,500 or 4.4 cents per horse-power-hour; he could have obtained double the power at the same cost if he had had use for it, and the cost would then have been reduced one-half; he compares this with the cost of operation of the former installation in which the power was generated by steam and horses, which was $1,800, to which several other items should have been added. The objection to the installation is that he is dependent on the water supply and in winter is troubled with anchor ice.

Applications of Electric Power.—A brief description of some of the applications at the large Crewe railway works, is given in the Lond. "Elec.," May 3, including illustrations of some of the apparatus; one of them is a 20-ton Gantry crane manipulated entirely by a man on the level with the work; a locomotive boiler tube cutter is illustrated.

Mechanical Applications.—"L'Eclairage Elec.," April 20, gives in Mr. Richard's long serial a well-illustrated description of the telemotors of Mr. Williamson for operating the rudder of a vessel from a distance. He also describes other applications of electric motors operated from a distance.

Belt and Rope Transmission Tests.—An article from the French by Mr. Dubreuil is translated in abstract in the Lond. "Elec.," May 3; it gives results of tests in which the power was measured; in the conclusion it is stated that ropes and belts when well fitted absorb practically the same amount of power. In the leading editorial the tests are commented on unfavorably.

Refuse Destructor.—Lond. "Lightning," April 25, contains an illustrated article by Mr. Brookman describing the Rochdale Corporation Manure Works; high pressure steam is raised by means of fuel consisting of unscreened refuse unmixed with coal; the temperature and the amount of steam raised per pound of fuel are said to be remarkable.

Three-phase Power Plant at Winooski.—A brief illustrated description of this plant for supplying the city of Burlington, Vt., with electric power, is given in the "Elec. Eng.," May 15; the distance is about 2.5 miles and the capacity about 150 horse-power.

Electric Gold Dredging Plant.—The brief description of this plant in New Zealand, which was mentioned in the Digest, March 30, is given in the "Elec. Eng.," May 15.

Cooking and Heating.—The paper of Mr. Crompton, abstracted in the Digest last week, is being reprinted in full in "El'ty," beginning with the issue of May 15. A short abstract including the tables, is published in the "Elec. Eng.," May 15.

TRACTION.

Canal Boat Traction.—In a description of the well-known de Bovet system in which magnetic clutches are used, published in "Zeit. fuer Elek." May 1, it is stated that this system will probably be introduced on the Danube.

Light Railways.—An abstract of the Parliamentary discussion of the Light Railways bill, is published in the Lond. "Elec.," May 3.

Electric Railway Block System.—A system patented by Mr. Langen is illustrated and described briefly in the "Elek. Zeit.," May 2; it is an automatic block system which prevents more than one car from receiving current in a block.

Lausanne.—A report by Dr. Palaz on a project for overhead trolley lines in that city, using Dowson gas, gas engines and accumulators, is published in detail in the "Elek. Zeit.," May 2, including a table comparing this with several other electric roads in Switzerland.

Gmunden.—An illustrated description of the railway in this Austrian city, installed by an Austrian firm, is published in the "Elek. Anz.," May 2.

Nantasket Beach Railway.—The truck for this line (on which electric power is to replace steam power) is illustrated in the "Elec. Eng." and "Elec. Rev.," May 15. The former journal also gives the following information: No. 0000 copper trolley wire is to be used on iron arms bolted to wooden poles; the feed wires are bare; the poles are between the tracks; the equipment will consist of six motor cars, each with two motors of 100 horse-power; they are expected to draw a trailer; the cars are 50 feet long and entered from the side; in addition there will be four baggage cars 30 feet long two of which will have two motors and two others four motors; by loading these baggage cars the engineers intend to determine the efficiency of special motors.

Series Parallel Motor Control.—"Elec. Eng.," May 15, calls attention to a recent Patent Office decision from which it seems that this method of coupling street railway motors is public property.

Financial Value of Street Railway Franchise.—The "Elec. Rev.," May 15, reprints a short paper by Mr. Stevens.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Switch.—"La Nature," May 4, publishes a good illustrated description of a small switch consisting of a short tube of insulating material closed at both ends and pivoted so that it can be moved in a vertical plane, the two metallic pivots entering into the interior which contains a globule of mercury connecting the two pivots electrically when the tube is in one position and breaking the connection when the position is reversed; the construction is simple, the form is very convenient and the contact is a perfect one; there is no oxidation of the mercury as the tube is completely sealed; as the spark is produced in the interior of the tube this form of switch can be used to advantage in mines and other places in which there is an explosive atmosphere; the switch is very highly recommended by a well-known electrician.

Budapest.—The "Elek. Zeit.," May 2, begins the publication of a report by Dr. Kittler on one of the stations at Budapest; the report consists of a very long description accompanied by a large number of illustrations.

Darmstadt.—The "Elek. Zeit., May 2, extracts at some length from the report on the operation of this accumulator station for the year 1893-4.

Electric Distribution in Office Buildings.—Mr. Pierce's article (see Digest, April 27), is continued in "Elec. Eng'ing" for May; he deals with the mistakes in the past, calls attention to the importance of the fact that the architect should confer with the electrical engineer and discusses the three prime considerations: safety, reliability and economy.

Chicago Stock Yards Lighting Plant.—A brief illustrated description is given in the "Elec. Eng.," May 15.

WIRES, WIRING AND CONDUITS.

Wiring Done by Central Stations.—The company operating the Leicester station has organized an electric light fitting department carrying out the greater portion of the wiring and the fitting in the town; the Lond. "Elec. Rev.," May 3, states that this has caused much indignation among the local electrical firms and in its opinion the proceeding is most unjust and impolitic, if not absolutely illegal.

Fuses.—According to the "Elek. Zeit.," May 2, Dr. Muellendorff and Mr. Vorreiter have overcome some objectionable features of the ordinary fuses by using lead or an alloy which may be oxidized but which does not separate into its constituent metals, and covers the wire on the outside with a thin coating of nickle or other oxidizable metal.

Underground Mains in Berlin.—The "Elek. Zeit.," May 2, contains a communication by Mr. Erhard forming a part of the discussion of the recent paper of Dr. Kallman (see Digest last week).

Conduits vs. Casings.—Lond. "Lightning," May 2, contains the conclusion of the discussion of Mr. Bathurst's recent article.

Kelvin's Law of Economy in Conductors.—Dr. Perrine's mathematical article is continued in the "Elec. Eng'ing" for May; among his deductions he shows that no maximum of economy is attained below the highest practical values for power and E. M. F.; the remaining possible cases of transmission, he states, may all be solved "by determining the current by considerations foreign to the question of the most economical cost of transmission, using the line to carry the current so determined, as given by the conditions of Kelvin's law." Various solutions are admissible on other bases of economy than those which he has used; the lowest possible cost will in general give a different result than that obtained by determining the maximum net revenue, while a maximum value might be obtained for the percentage which the net gain bears to the amount of capital used in the installation, or the maximum value of the ratio of the net gain to the total amount of capital annually used in the transmission, might be determined; he shows how each case may be represented in the equations.

Wiring Table for Motors.—A convenient table for small motors for 110 and 220 volt circuits prepared by Mr. Barriett, giving the size of wire for various distances and powers, is published in the "Elec. Eng.," May 15.

Fastenings in Walls.—The one described in the Digest, Jan. 19, is illustrated in the "Elec. Eng.," May 15.

ELECTRO-PHYSICS AND MAGNETISM.

Effects of Electric Currents in Iron on Its Magnetism.—A Royal Institution paper by Dr. J. Hopkinson is reprinted with a large number of illustrations in the Lond. "Elec. Eng.," May 3. He describes interesting experiments made with test coils encircling portions of the iron at different depths of a solid core, showing that it takes considerable time for the magnetism to penetrate the interior of a solid core; the subject matter is similar to that in a recent paper by the same author in connection with Mr. Wilson (see Digest, March 16, 23 and 30). He shows that the slowness of changes of induction depends on the largeness of the ratio of induction to the magnetizing force and therefore when this ratio is small the changes will occur comparatively rapidly while when it is large they occur more slowly; these phenomena concerning the times at which changes of inductions occur in the cores of electromagnets, have a close analogy to the retardation of signals in cables; in order to compare these the curves for the cables should show the rate of change of current and not the currents themselves, and there will then be a remarkable similarity with the magnetic curves. He shows some applications of these phenomena, a very practical one being to the cores or transformers, in which the variations of inductions diminished greatly toward the centre, the induction there being but little affected by the changing current in the magnetizing coils. The results of certain experiments showed that in practice manufacturers have laminated the iron about enough and not too much. In conclusion he indulges in what he calls a wild speculation; suppose a magnet as large as the earth surrounded by a coil having a magnetizing force of 2.5 in which the current was reversed, it would take some thousands of millions of years before the rate of disturbance at the centre attained its maximum value; he then asks if it is not "conceivable that the magnetism of the earth may be due to currents in its material sustained by its changing induction but slowly dying away."

Effect of Extreme Cold on Magnets.—In an abstract of Prof. Dewar's lecture on the scientific uses of liquid air published in the Lond. "Elec. Rev.," May 3, a brief description is given of a series of experiments on the magnetic moment of small magnets cooled to 182 degrees C.; from this it appears that every magnet has individual characteristics that may either result in no change on cooling or the addition or substraction of from 12 to 24 per cent.; a repetition of the cycle of heating and cooling brings the magnet to the steady state in which cooling always causes an increase in the magnetic strength of from 30 to 50 per cent. and the reheating brings about no loss in the original magnetic moment; he believes that such a marked alteration of magnetic strength might be used as a thermometer in low temperature research. He intends to make accurate observations of the permeability and susceptibility of the magnetic metals at the temperature of boiling liquid air.

Deviation of the Compass.—An abstract of a Society of Arts paper by Prof. Reinold is published in the Lond. "Elec. Eng.," May 3; he considers the action on the compass of the magnetism induced in the iron of the ship, and describes the methods of correcting the errors.

Alternating and Interrupted Currents.—Prof. Forbes' lecture is concluded in the Lond. "Elec. Eng.," May 3. Among some further analogies he showed a disc of paper loaded with shot around the circumference and rotated at a rapid speed; if the edge of this is bent down it appears that it retains the shape continuously for a long time. An elastic string fixed at the bottom and twisted at the top is given as an analogue of a cable of large capacity which is insulated from the earth, the twist representing the E. M. F.; the capacity is said to be a yielding and the charge is the amount of that yielding. In another case he showed a string suspended from a spring with a set of vanes and two nozzles blowing against the vanes; the string passes down through glycerine and water in a tube and at the bottom there is a mirror for reflecting the beam of light; the spring acts as a condenser and the air blowing on the vanes, takes the place of the battery, a spring below taking the place of a condenser; this is given as an analogy to the Atlantic cable. (Some of the analogies are of interest but the descriptions are not as clear as might be desired.)

Discovery of the Induction of Electric Currents.—In a Physical Society paper by Prof. S. Thompson on "A Neglected Experiment of Ampere," reprinted in the Lond. "Elec. Eng.," May 3, he stated that in 1822 Ampere made an experiment which if it had been properly followed up would have led to the discovery of the induction of electric currents nearly ten years before the publication of Faraday's results.

Contact Resistance of Metals.—The Lond. "Elec.," May 3, abstracts briefly an article by Mr. Branly from the "Comptes-Rendus," April 22; the abstract was reprinted in THE ELECTRICAL WORLD last week, p. 578.

Scientific Uses of Liquid Air.—The Lond. "Elec. Rev.," May 3, abstracts at some length, with illustrations, a recent interesting lecture by Prof. Dewar; the only portion of special interest to electricians is abstracted above under "The Effect of Extreme Colds on Magnets."

Complex Quantities and Vectors.—"Elec. Eng'ing" for May contains a short article by Mr. Dummerque on "Elements of Complex Quantities and Vectors with Reference to Their Use in Alternating Current Work," in which he gives a brief introduction and shows how such quantities are added, subtracted, multiplied and divided. An editorial in the same issue gives a brief insight into the subject of vector quantities.

Pressure in Dielectric or Magnetic Media.—The "Amer. Jour. of Mathematics" contains a long, highly mathematical article in French, by Prof. Duhem.

Slow Changes in the Magnetic Permeability of Iron.—Mr. Mordey's paper, which was abstracted in the Digest, March 16 and 23, is summarized briefly in the "Elec. Eng.," May 15.

ELECTRO-CHEMISTRY AND BATTERIES.

Ozone Bleaching Installation.—The "Elek. Anz.," April 25, gives an illustrated description of the installation at Greiffenberg; it is of interest as it is the only one of its kind and as it has been in operation for over a year; the process used is that of Siemens & Halske, and in the present installation it is used for bleaching yarn. Three-quarter bleaching is accomplished in seven hours while complete bleaching requires two or three such operations; after the bleaching the yarn is treated with chloride of calcium as usual, except that the solution is much weaker; ozone is made from the air in 60 tubes, the power being obtained from an alternator requiring three horse-power; the appearance of the bleached product is the same as when the bleaching was done by the sun and the strength of the threads was in some cases even greater; the cost is not appreciably less than that of the ordinary process; the time is much less being about one-third in summer and 1-14 in winter; the chief advantage is that the work may be done in a building, that less time is required and that the process is independent of the weather.

Purification of Sugar.—In the "Elektrochem. Zeit." for May Mr. Dammeyer gives comparative results obtained by the ordinary process and by his electric process, showing advantages in favor of the latter; in the Ottleblen factory where he made experiments with his process it has since been introduced; it is also used in a factory in Russia.

The process of Messrs. Gawalowski and Hoenig for the application of electrolysis in the manufacture of sugar, is briefly described in the same journal.

Reduction of Highly Electro-positive Metal.—According to Lond. "Engineering," May 3, Mr. Pyke at the recent Royal Society soiree showed the "Hydrogen Wall" the object of which was to obtain a greater efficiency in the reduction of the highly electro-positive metals such as potassium, from aqueous solutions; he produces an amalgam by placing the mercury in a porous vessel; the amalgam is richest at the top which is farthest removed from the liquid; the action of the device is said to be the prevention of the liberation of hydrogen at the electrolytic contact surface; in the ordinary arrangement hydrogen is liberated by local action at the contact surfaces of the mercury and the amalgam, and the full extent of the current and the direct action of the depositing current is negatived; no further description is given.

Deposition of Cuprous Oxide.—According to the Lond. "Elec. Rev.," May 3, Dr. Hammerl pointed out that the deposit from a solution of copper sulphate raised to the boiling heat, is composed almost entirely of cuprous oxide and it is suggested that probably a useful and handsome preservative coating might in this manner be applied to certain metals.

Remarkable Electrolytic Phenomenon.—The Lond. "Elec. Rev.," May 3, offers the following explanation for the phenomena noticed by Mr. Reed and described in the Digest, April 20; it is doubtless that, in case of metals possessed of little tenacity, particles are torn from the electrode by the hydrogen gas violently disengaged from its surface.

Electro-metallurgy.—A paper of some length by Mr. Moissan, read at a recent congress in Paris, is reprinted in "L'Elec.," May 4; it consists of a summary of his recent interesting researches with his electric furnace.

Antidote for Prussic Acid.—According to the "Elektrochem. Zeit." Dr. Autal has found that cobalt nitrate is the best antidote for potassium cyanide or similar compounds used in many electrolytic baths; it is given in the form of a subcutaneous injection of a five per cent. solution in quantities of 20 to 30 cb. cm., as also in internal doses.

Electrolytic Extraction of Natural Dyes.—The first part of an article by Dr. Foelsing is published in "Elektrochem. Zeit." for May.

Chemometer.—A paper with this title by Dr. Ostwald from the "Zeit. f. Phys. Chem." is translated in the "Chem. News," March 22, 29, April 5 and 11; he suggests measuring chemical energy by finding the electrical potential accompanying it by means of an electrometer; this electrometer will serve as a chemometer under certain conditions, one of them being the presence of an electrolyte.

High Voltage Cell.—According to the Lond. "Elec. Rev.," May 3, Mr. Fitzgerald made a cell the positive plate of which was of aluminum in a solution of caustic potash and the negative was a carbon plate in strong nitric acid contained in a porous pot; the voltage was 2.8; it is not adapted for ordinary use on account of the cost of working it, but is of interest from a theoretical point of view.

Tin-Chromic Chloride Cell.—The Physical Society paper by Mr. Skinner, abstracted in the Digest, March 9, is published in full with the illustration in the "Phil. Mag." for May.

Thermo-Chemical Carbon Cells.—A German translation of the recent paper of Mr Kordt abstracted in the Digest, May 4 (see also May 11), is published in the "Elek. Zeit.," May 2.

[illegible] Extracting Process.—The following new process recently patented by Dr. Gaze, of New Zealand, is described in "Eng. and Min. Jour.," May 11. The solution is chloride of bromine; a number of porous cells filled with water and containing carbon rods, are placed in a large vessel which is filled with a strong solution of chloride and bromide of sodium, with carbon rods immersed in it; on passing a strong current through this, chloride of bromine is formed; this is drawn into a vat containing the crushed ore in a close vessel under a pressure of 50 pounds to the inch and left there for one or two hours, during which time the whole of the gold is dissolved; after filtering, it may be used again until it is rich in gold or weak in solvent power; it is then run into an electrolytic cell similar to the one described above and a strong current passed through it, producing chloro-bromic acid which liberates the gold in the form of a purple powder; the solvent tends to split up as the solution becomes charged with hydrochloric and hydrobromic acids; this he neutralizes with caustic soda which produces the original salts; any gold in this solution is recovered by electrolytic deposition.

Electro-Metallurgy of Gold.—A second letter by Mr. Andreoli on "Is the Use of Cyanide Potassium for Gold Extraction, Public Property?" is published in the "Eng. and Min. Jour.," May 11; it refers to the recent litigation in England.

Electrolysis of Gold.—A brief abstract of Dr. Keith's recent paper (see Digest, April 6, 13, 27, May 4), is published in "Elec. Eng.," May 15.

Local Action in Accumulators.—A translation of the article by Mr. Darrieus which was abstracted briefly in the Digest, Dec. 15, is reprinted in the "Elec. Age," May 4; (the translation is the same as the one in the Lond. "Elec. Rev.," Jan. 11, mentioned in the Digest, Feb. 2, although no acknowledgment is made).

High Voltage Battery.—According to "El'ty," May 15, the following cell has recently been described (but where, is not stated): metallic magnesium is placed in a solution of ammonium chloride, and a plate of copper in a solution of cupric chloride and hydrochloric acid; the E. M. F. is three volts and the internal resistance quite low; the current is said to be constant for long periods; no further information is given.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Specific Resistance of Brasses.—"Elek. Zeit.," May 2, contains an article by Dr. Haas in which he gives the results of very carefully made tests to determine the specific resistance and the temperature coefficient of a large number of alloys of copper and zinc; he was prompted to make these researches as existing data was scant and unreliable. He made 28 alloys with different proportions of zinc; the copper and zinc were very pure and were carefully melted so as not to introduce impurities; of these alloys only those containing less than 50 per cent. of zinc could be drawn out into wires, the others could not be worked on account of their hardness and brittleness; 32 tests were made with each wire; the proportion of the constituents was determined by analysis. The results are given in the following table:

Reference number.	Percentage of zinc.	Specific resistance in ohms.	Temperature coefficient.	Specific conductivity.
1	0	0.01576	0.004316	63 45
2	0	0.01592	0.004328	62 81
3	0.71	0 01833	0.003725	54.56
4	1.56	0.02133	0.003185	46 88
5	3 07	0 02372	0 002913	42.16
6	5 51	0.03010	0.002583	33.22
7	9.08	0 03638	0.002044	27.49
8	18 02	0.04763	0.001691	21 00
9	20 29	0.05064	0 001639	19.75
10	22.71	0.05424	0.001607	18.44
11	28.16	0.05826	0.001581	17.16
12	34.23	0 06302	0.001579	15.87
13	40 28	0 05789	0 002116	17.27
14	42 55	0 05307	0.002376	18.84
15	45.19	0.04712	0 002851	21.22
16	46 85	0.04314	0.003105	23.18
27	99 54	0.05883	0.003847	17.00
28	100.00	0.05683	0.004029	17.60

The resistance of the alloys was found to be a linear function of the temperature; curves constructed from the data in the table showed that the specific resistance increases rapidly at first with the percentage of zinc, up to about 5 per cent., reaches a maximum of 34 per cent. after which it diminishes again; alloys containing 14 and 47 per cent. of zinc have the same specific resistance; the curve, if continued still farther, would have another point of inflection, ascending again. From the curve representing the temperature coefficients, the latter falls rapidly at first with increasing amounts of zinc up to 5 per cent., then gradually being nearly horizontal between 17 and 30 per cent. after which it rises quite rapidly; the mimimum is at about 33 per cent. With 34 per cent. of zinc it will therefore be seen that there is a maximum of the specific resistance with a minimum temperature coefficient; this proportion corresponds to a molecule of two atoms of copper and one of zinc, from which he concludes that copper combines chemically with zinc in that particular alloy.

Magnetic Tester for Measuring Hysteresis in Sheet Iron.—The discussion of Prof. Ewing's paper (see Digest last week) is published in full in the Lond. "Elec.," May 3. Dr. Fleming thought it would be simpler to revolve the magnet. Prof. Ayrton questioned whether it was right to assume that the ratio of the hysteresis of different irons with different inductions, was the same; he describes an instrument which he made some years ago for obtaining the B-H curve quite quickly; it consisted of a small separately-excited dynamo, the specimen to be tested forming the yoke having a coil of wire encircling it; the armature was rotated by a small motor at a fixed speed, a voltmeter being connected to the brushes; an ammeter inserted in the circuit of the coil around the yoke piece, gave the magnetizing current and the voltmeter the corresponding induction in the iron; by merely alternating the resistance a series of points on the curve was easily obtained; it has the disadvantage that if the hysteresis is to be determined the area of the curve has to be taken, but it enabled the permeability to be measured at the same time. Prof. Forbes stated that one could not trust to hysteresis being proportional in different specimens of iron at different intensities; he thought that the eddy currents in the iron itself might possibly be quite perceptible; he recalled an apparatus made by Prof. Elihu Thomso some years ago in which the sheet iron was cut into circles which were piled up into a small cylinder mounted on a pivot and retained in position by a spiral spring; a field was then rotated around the cylinder and the deflections produced by the torsion due to hysteresis were measured, the deflection being proportional to the force required to overcome that. Mr. Siemens stated that it was very necessary to avoid as much as possible all handling of the pieces to be tested; he did not think that the state of the iron could be gotten back again by annealing; the only drawback to the instrument was that the pieces required filing which would at once make the results quite different; he preferred to continue to use the ballistic method in his shops. Mr. Bailey suggested that there would be a certain amount of demagnetization of the specimen under test. Mr. Trotter thought that the hardening of the edges by shearing ought to be allowed for. In reply Prof. Ewing stated that the reason why the specimen and not the magnet was made to revolve was that if the specimen be made the stable body it should always have precisely the same amount of mechanical stability, which is hard to secure in practice; regarding the fanning action he stated that there was no material effect produced by the carrier when wood was substituted for iron; he gave sufficient proof of the unimportance of eddy currents; regarding the annealing, his experience was that if the annealing was done in the same way it produced the same results each time; regarding Prof. Ayrton's instrument he stated that for the B-H curve was obtained after a great deal of work, the results had to be reduced to absolute values, the curve drawn and the area measured; in practice the pieces would probably be stamped like the transformer plates themselves.

The same issue contains a communication by Mr. Addenbrooke in which he mentions some experiments of his own confirming the unexpected results of Ewing, namely, that the readings of the instrument were not affected materially by variations in the number of sample sheets used; 45 strips of armature iron were tied in a bundle fixed between the poles of a U magnet, leaving an one-fourth-inch air gap between the ends of the samples and the other pole; a pull of four ounces was required to detach the magnet from the armature (the pull being in the direction of the laminations, that is, perpendicular to the pole of the magnet and apparently tended to detach the iron from one pole and pull it toward the other); they were then removed and one sheet substituted for them reducing the section to $\frac{1}{45}$ and the pull was then eight ounces or double what it was before; the greater coercive force with the fewer sheets increased the hysteresis as the section of the iron is diminished and so secures a balance over a certain range.

Submarine Cable Testing.—The Lond. "Elec.," May 3, continues the serial by Mr. Wilkinson on "Notes on Submarine Cable Work" the first parts of which were published in that journal about two years ago; he intends to consider electrical tests for the localization of faults and breaks, adhering to the practice and methods in common use to-day; in the present portion he describes the earth overlap tests and the earth overlap as a loop.

Apparatus for Testing Lightning Rods.—A brief description of an apparatus is published in "L'Eclairage Elec.," April 20.

Portable Testing Set.—An illustrated description of a complete set, made in England, for testing installations is given in "L'Elec.," May 4.

Conductor Materials.—"Elec. Eng'ing" for May contains an article by Dr. Perrine in which he gives the general elementary formulas for the resistance of wires and discusses the specific resistance of copper, calling attention to the effect of impurities, most important of which is the suboxide of copper; the brittleness of electrolytic copper he accounts for by the presence of hydride of copper formed in the deposition, and the brittleness and low conductivity of over-refined fused copper is due to the presence of carbide of copper formed in the presence of carbon as soon as the suboxide disappears; the electrolytic copper which has been carefully melted or which has been so deposited as to avoid the formation of the hydride, invariably has a conductivity several per cent. above the Matthiessen standard; he gives a table of the relative conductivities of copper alloyed with other substances showing that a very serious reduction of conductivity is produced by even a small percentage of alloyed material.

TELEGRAPHY, TELEPHONY AND SIGNALS

Carbonelle Microphone.—According to the Lond. "Elec. Eng.," May 3, some tests were recently made by the Belgium Government under the direction of Mr. Banneux who considers that they have not proved the superiority of the Carbonelle system (described in Digest, Jan. 12), over the transmitters such as Hunnings, Grunewald, etc.

Telephone Service in England.—The Parliamentary inquiry is reprinted in the Lond. "Elec. Rev." and Lond. "Elec.," May 3.

Telephony in Denmark.—A brief description is given in the "Elek. Zeit.," May 2.

Domestic Telephone Apparatus.—An illustrated description of a German system is given in the "Elek. Zeit.," May 2.

Switzerland.—The "Elek. Zeit.," May 2, abstracts some general statistics regarding telegraphy and telephony in Switzerland for the year 1894

Comparative Telegraphic Statistics for 1893.—The "Jour. Teleg.," April 25, publishes its annual table of statistics.

History of the German Telegraph Department.—The "Elek. Zeit.," May 2, in an editorial reviews briefly the development in this department for the last 25 years during which time it was under the direction of Dr. von Stephan.

Laying a Cable from Zara to Pola.—A description of the laying of this cable is published in "Zeit. fuer Elek.," May 1.

Semaphore Signals.—The Fiedler signal, which is operated electrically, is described in the "Elek. Zeit.," May 2, by Mr. Kohlfuerst.

Electrolysis of Underground Telephone Cables in Milwaukee.—"Elec. Eng'ing" for May reprints a recent paper by Mr. Dexter giving a sketch of the conditions found in the subways of the Wisconsin Telephone Company a year ago, and the measures taken to alter these conditions in order to prevent damage to the lead cables through electrolysis; a complete map of the system was made showing the voltage between the cables and the earth in each manhole; the results of a number of these measurements are given; in one case a current of 27 amperes at five volts was found flowing from the water main to the cable; out of 144 manholes the cables in 35 were positive to the earth while in the majority they were negative with a maximum of six volts, in which the current flowed from the earth to the cables; at these points there is nothing to fear but at the points where the current was leaving the cable to the earth it was destroying the covering. The cables were cleared and covered as much as possible with asphalt paint and number 0 copper wires were run from a number of manholes connecting the cables with the negative bus bar at the railway power house; this changed the readings from a positive to a negative value; this system of wires carries a current of 210 amperes back to the station; in all of the manholes the cables are at present negative with regard to the earth and there is now no point in the system where the current leaves the cables except by the copper conductors; no destroying effect is therefore taking place.

Telephone for Mines.—A brief illustrated description of a set made by the Bell Company adapted especially for mines, is published in "Eng. and Min. Jour.," May 11; in this it is claimed that the difficulties due to the corroding action of dampness and gases have been overcome; as few metal parts as possible are exposed; wood was found to be the best material to use; it is thoroughly creosoted and covered with waterproof paint.

Chicago Telephone Company.—"Elec. Eng'ing" for May contains an editorial by Mr. DeLand stating some facts correcting a recent article in a contemporary.

Genesis of the American Electric Telegraph.—An abstract of a recent paper by Mr. F. L. Pope including portraits of Morse and Vail is published in "Elec. Eng.," May 15.

Fire Alarm System.—The "Universal" system is described and illustrated in the "Elec. Eng.," May 15.

Fire Telegraph.—That used in Brooklyn is described and illustrated in the "Elec. Age," May 11.

MISCELLANEOUS.

Superficial Carburation of Armor Plates.—According to "L'Eclairage Elec.," April 20, Mr. Garnier suggests an application of electricity for facilitating the operation of superficially hardening armor plates; in the well-known Harvey process the plates are covered with charcoal and then heated. Mr. Garnier suggests to facilitate the operation by making the plate the cathode and covering it with a thin coating of charcoal over which is placed a plate of sheet iron which latter forms the annode; a current of 50 amperes at three or four volts is then passed through this while the whole is heated to a red heat; the action takes place sufficiently rapidly that there is no fear of burning the metal. The method has not yet been tried in practice but the researches have established the fact, which he says is not generally known, of the possibility of transporting carbon by means of electricity from the positive to the negative pole. He is now making experiments to use the electric current in conjunction with heat to eliminate from metallic baths the objectionable metalloids such as sulphur or phosphorus and also to separate the alloyed metals; the results already obtained applied to nickle showed that this method has a future.

Laboratory Apparatus for Producing Calcium Carbide.—A simple form of apparatus is described and illustrated by Dr. Krueger in the "Elektrochem. Zeit." for May. A current of 75 amperes and 40 volts is said to be sufficient, although 90 to 120 amperes is preferable; the furnace consists simply of a graphite crucible holding about one pint, around the outside of which is fastened a closely fitting iron ring which serves as a contact for the leads; the second electrode is an ordinary carbon rod as used for arc lamps; 56 parts of burnt lime and 36 parts of coal are finely pulverized and well mixed; after the arc is established this is introduced little by little into the crucible; 100 grams of the carbide can be produced in a short time; he prefers mixing the pulverized material with a dilute solution of sugar and working it into small lumps which are then introduced into the crucible. He describes a lamp for burning acetylene and the process of making alcohol with the aid of this gas.

Torpedos.—A lecture by Mr. Stehlik is briefly abstracted in the "Zeit. fuer Elek.," May 1.

Royal Society Soirée—Very brief descriptions of a number of interesting exhibits at the first annual soirée of the Royal Society are published in the Lond. "Engineering," May 3; most of those referring to electrical subjects have already been described in these columns.

Patent Law.—The "Forum" for May contains a well-written article by Prof. Thurston on "Our Debt to Inventors: Shall We Discourage Them?" in which he points out that the modern material advancement practically dates from the time of the general recognition of the inventor's rights and shows that a spirit diametrically opposite to the one in which the patent system was conceived, has sprung up within a few years, referring in particular to the recent decision in the Bates case which he says must inevitably result in the repression of the inventive spirit; the law as it stands he says is an insult and a direct injury of enormous magnitude to the inventor. A portion of this article is reprinted in the "Elec. Age," May 11.

Patents.—"Elec. Eng'ing" for May contains a short article by Mr. Smith on "International Agreements about Patents."

Biographical.—The "Amer. Mathematical Monthly" for January contains a portrait and biography of Dr. Macfarlane.

New Books.

STREET RAILWAY INVESTMENTS.—A Study in Values. By Edward E. Higgins. 102 pages, with folding table, 16 x 48 inches, in pocket. New York: Street Railway Publishing Company, 1895. Price $2.

This book is designed to give information to those who have money to invest, as to the safety of street railway investment, and the probable returns therefrom. As the author is not in the position of a promoter and has no axe to grind, he has endeavored to strip the mask from ingeniously arranged accounts, and show the prospective investor just what he may expect of his money if he bestows it in this field.

The author has rejected all accounts that seem to him unreliable, and has arranged all those that he approves in a shape to admit of easy interpretation. He brings to the front one of the great evils of street railway systems—over capitalization. Organizers capitalize a system for what they think it will bear, and not for its true value. In the case of street railways, values have so greatly depreciated, and ignorant planning, management and construction, together with enormous cost of remodeling, have combined to make the cost and the true value of a railway system widely different.

As a general thing the prospective investor will find it more difficult than any one else to obtain bottom facts. Managers and organizers frequently tell the truth, a less number tell nothing but the truth, and those who tell the truth, the whole truth and nothing but the truth to the prospective investor are rare indeed. Hence such a discussion as Mr. Higgins presents seems to be of special value.

The work is a financial history of the street railways of the United States. It divides them into seven classes and, taking a chapter for each class, discusses specimen cases therein. The author has crowded a great deal of information into the 102 pages of the book, and has drawn clear and concise conclusions from his discussions.

Street railway investors can be guided by what has been done only by judicious reasoning. The remodeling of horse railways has been nearly completed and the construction of new roads with a full knowledge of how to proceed presents a very different case. This point is also ably discussed by the author. The prospective investor will have little difficulty in selecting parallel cases to that which he is considering for two reasons; first, the case is there, and, second, it is so classified that it may be readily found. The author has added to the book itself the financial statistics of 145 different roads. These statistics he has divided into two parts—capitalization and operation. The roads are arranged in the order of the population they serve, those of the least populous cities coming first. Interurban roads have a separate classification.

Organizers and promoters should have this book as well as the investor. Financial enterprise has been full of blunders that can be avoided by a study of previous cases and wherein and how they succeeded or failed.

POPULAR SCIENTIFIC LECTURES. By Ernst Mach. Translated by Thomas J. McCormack. Chicago: The Open Court Publishing Company, 313 pages, 44 illustrations. Price, $1.50.

Prof. Mach has the rare faculty of treating the most abstruse scientific subjects in a popular style, without in the least sacrificing scientific accuracy or philosophic breadth of view. The range of his subjects is also extremely wide, in the present work there being chapters on the principles of the conservation of energy, on instruction in the classics and the mathematico-physical sciences, on the fibres of Corti, on the fundamental concepts of electrostatics, "Why Has Man Two Eyes," and other topics similarly varied in character.

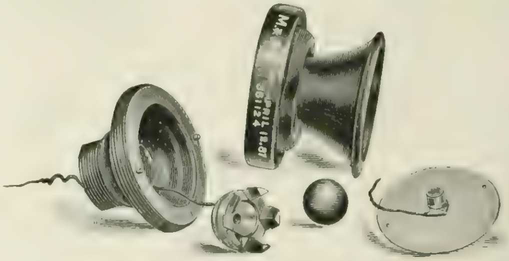
The chapter on the "Principles of the Conservation of Energy" is made of unusual interest from its method of treatment, which is based upon the evolutionary plan, the various ideas being taken up at their origin, and follows to their full development. In tracing the growth we are brought into human contact with those who contributed to it, the personal element being always kept well to the fore. The system employed by Prof. Mach has indeed much of the human in it, for the manner of development of an idea reminds one of a real process of growth; we see the infant pass into boyhood and through youth to maturity, and note the influence of the various great minds that presided at different stages of growth.

The chapter "On the Fundamental Concepts of Electrostatics" is a lecture delivered in 1883 at the International Electrical Exhibition at Vienna, and while rather elementary in extent yet teaches clearly and soundly the fundamental principles upon which electrostatics is based.

A Novel Telephone Transmitter.

The accompanying illustration shows the construction details of the telephone transmitter made by the United States Telephone Construction Company, of Philadelphia. It will appear at a glance that it is neither a Blake nor a Hunnings, nor yet a granular carbon (solid back) transmitter; in fact, it is not exactly like any of the most familiar types.

The diaphragm is of India mica and has attached to its centre a small aluminum cup holding a carbon or other suitable point. In front of the black rubber shell is shown the basket or runway of aluminum. The sphere shown in the cut is made of carbon and is $\frac{11}{16}$ of an inch in diameter; this ball normally lays in the aluminum basket or runway, which is so constructed that no matter which side of the transmitter is up, the sphere rests on a plane which is always inclined toward the diaphragm. When the parts are assembled the point on the diaphragm comes about on a level with the centre of the carbon ball which, owing to the angle of the side of the basket or runway, is kept against this point by gravity. The distance between the point on the diaphragm and the back of the basket is about three fourths of an inch, allowing the carbon ball a maximum movement of not quite one sixteenth of an inch. It is said that with every vibration of the diaphragm the movement of this carbon ball breaks the battery current, hence the trade name of the instrument, "M. & B," which signifies "Make and Break."



NEW TELEPHONE TRANSMITTER.

The features claimed for the transmitter are clearness of articulation, great volume of sound without any sputtering or similar disadvantages, long distance transmission and simplicity of construction.

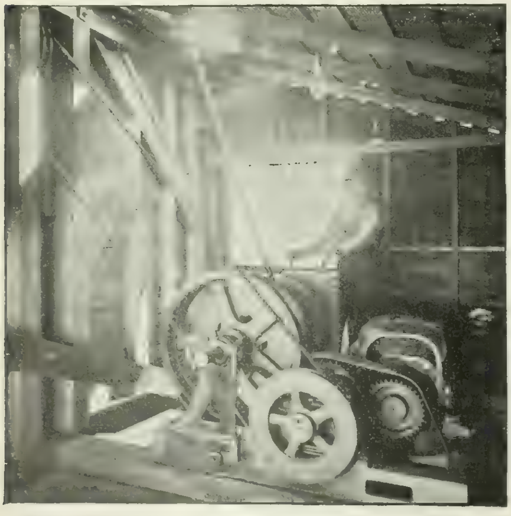


FIG. 1.—ELECTRIC DERRICK.

Electricity in Coal Handling.

An extensive coal handling plant, operated entirely by electricity, has been running in San Francisco for the past few months with much success. The plant is of the most modern character in every respect, and is the second important coal handling plant operated by electricity installed in this country. The owners, R. Dunsmuir & Sons, being confronted with the problem of how to unload coal rapidly from steamships and colliers at the wharves and distribute it to the wholesale and retail trade, most economically, found the solution in the adoption of electrical apparatus.

The plant consists of an electric hoisting and haulage system for unloading the coal-carrying ships and steamers and distributing the coal into wharf and house bunkers for local and wholesale distribution. The wharf bunkers are built out upon a pier by the side of which colliers are moored for discharging, and the house bunkers are located in the main yard and connected with the wharf bunkers by means of a trestle and bridge 204 feet long, and 35 feet above the level of the street.

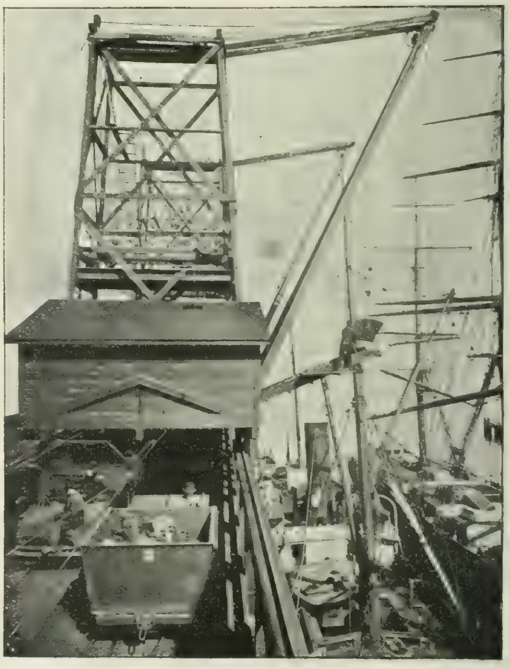


FIG. 2.—VIEW OF ELECTRIC DERRICK AT WORK.

The power house is a frame building 81 feet long by 88 feet in width, and contains a 300-hp boiler plant and two tandem compound McEwen high speed engines, rated at 135 horse-power each, belted to two 90-kw, 250 volt multipolar General Electric dynamos, running at 700 revolutions and over-compounded 10 per cent.

The hoisting plant consists of three special electric hoists, each having a capacity of 2,000 pounds lifted at a maximum rope speed of 800 feet per minute. An excellent view of one of these hoists is given in Fig. 1. The motor is of the General Electric L. W. P. 2-type and the armature shaft is geared to an intermediate shaft by special gears with a very slight reduction in speed. The intermediate shaft is in turn geared to the winding drum shaft by means of eight-groove friction drums. On the end of the intermediate shaft is also a single groove wheel driving the hauling-in drum which serves to haul the bucket in over the chutes when it has been raised to the proper height. The hoists are controlled by means of KR controllers of the usual type and are mounted in derrick houses, as shown in the illustration. Fig. 2 shows a derrick at work unloading a steam collier lying alongside of the bunkers. The bucket is just about to be unloaded into the chute along which the coal will pass into the cars. These buckets have a capacity of 1,200 pounds of coal each and are raised from a depth of 60 feet to 80 feet, according to the state of the tide and the portion of the hold from which coal is taken.

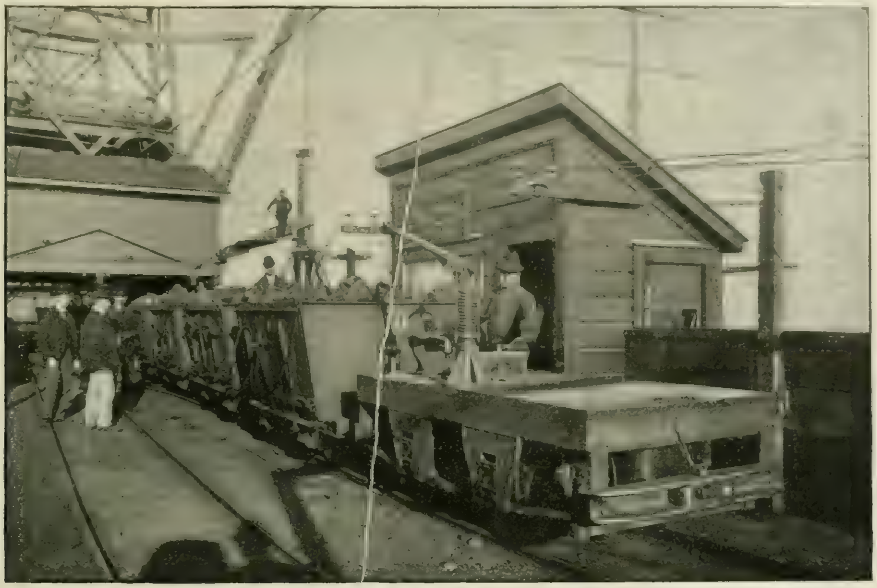
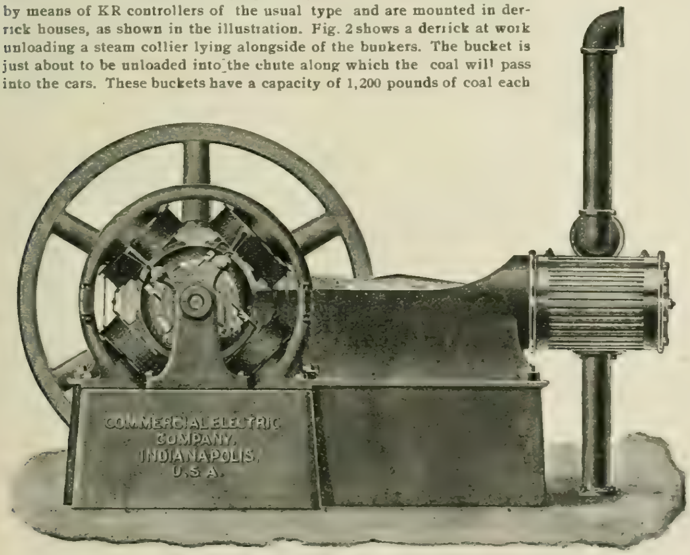


Fig. 3.—Electric Locomotive and Coal Train.



Direct Connected Multipolar Dynamo.

The derricks are mounted on a track raised about six feet above the floor of the bunkers, and are so arranged that they can be moved along the wharf to accommodate themselves to the position of the hatches of the ships. The capacity of each derrick is 400 tons in nine hours, although they have, under favorable conditions, worked up to 450 tons in nine hours.

A portion of the coal is unloaded by the derricks directly into the bunkers on the wharf, but the larger portion is discharged into cars and hauled to the house bunkers by electric locomotives. Fig. 3 shows one of the electric locomotives, of which two are used for this haulage work, with a train of four cars being weighed on the scales before delivery to the house bunkers. The locomotive is of the T. M. F. type and is equipped with General Electric motors. It has a draw-bar pull of 800 pounds and is required to haul from four to six loaded cars, each car weighing 3,600 pounds and having a capacity of 4,700 pounds of coal. The tracks are perfectly level and on the return trip the locomotive frequently brings back 8 to 10 empties.

On the bridge the usual overhead railway construction has been adopted, while on the wharf a special construction was rendered necessary on account of the limited head-room underneath the derrick.

The firm's bunkers handle about 250,000 tons of coal per annum and the adoption of electrical apparatus for hauling and hoisting under these conditions is significant.

Direct Connected Generator.

We illustrate herewith a direct connected generator manufactured by the Commercial Electric Company, of Indianapolis, Ind. The dynamo is of the familiar multipolar type, and has massive soft cast steel field magnets. The armature is of the smooth core, Gramme ring type, it being claimed by the makers that this type gives the most perfect regulation, greater freedom from sparking and less tendency to heat than the iron-clad type commonly used. The maximum rise in temperature at full load is guaranteed to be less than 75 degrees Fahr., and the regulation within one volt, from no load to full load.

The armature is mounted on the shaft extension of the engine, and the magnet frame is bolted upon the extension to the engine sub-base. The armature and commutator are mounted on the same spider, so that the complete armature may be removed from the shaft without disturbing any of the connections.

The machine illustrated is a 40-kw incandescent lighting dynamo, connected to a Ball engine.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, May 18, 1895.

AMERICAN BELL practically monopolized what attention the electrical list received during the week, the balance of the stocks displaying no particular activity. Although the bulls declare that the decision of the circuit Court of Appeals, reversing the decree of Judge Carpenter, was only to be expected and simply confirms their predictions, it is highly probable that the decision came as something of a surprise to the most sanguine Bell adherents, and it was certainly a bomb to the majority of traders as well as to the electrical fraternity at large. The stock, of course, is on a boom just now, as a consequence of the decision.

GENERAL ELECTRIC is said to have lost some of its best friends by reason of the G. E.-Westinghouse fizzle. The objection attributed to some of the General Electric directors that the deal would have resulted in more benefit to the Westinghouse company than to the General Electric is given as the explanation of the failure to carry the deal through. The resignations of Messrs. Mills and Twombly have had no apparent effect upon the stock, and the selection of the gentlemen elected to succeed them would seem to imply that the control of the General Electric has been transferred to Boston.

ELECTRICAL STOCKS.	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	99	100½
" " " Brooklyn	100	..	108
" " " Boston	100	130	..
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	29	..
General Electric	100	34	34¼
General Electric, pref	100	..	65
Westinghouse Consolidated, com.	50	34¼	34¾
" " pref	50	52	52½
BONDS.			
Edison Electric Ill., New York	100	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co. deb. 5s	100	..	90¼
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	198	199
American District Telegraph	100	30	40
American Telegraph & Cable	100	92	..
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
†Erie Telephone	100	57	57⅛
Gold & Stock Telegraph	100	105	
New England Telephone	100	69½	70
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63½	..
Western Union Telegraph	100	92¾	92⅞
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	18⅜	18½
Binghamton RR. com	100	100	..
Brooklyn Traction	100	11½	14
" " pref.	100	..	53
Buffalo St. Ry	100	70	72
Cleveland City Ry.	100	68	70
Cleveland Electric Ry.	100	59	60
Chicago City Ry	100	305	315
Columbus St. Ry	100	48½	..
Consolidated Traction of N. J	..	26	30
Electric Traction, Philadelphia	50	73½	74
Long Island Traction	100	9½	10
Louisville St. Ry. com.	100	37	39
" " " pref.	100	87	88
Metropolitan Traction, Philadelphia	100	95	96½
New Orleans Traction	100	14½	16
" " pref.	100	56	60
North Shore Traction	100	23	28
" " pref.	100	88	93
People's Traction $30 pd	25	59½	60¼
‡Philadelphia Traction	50	82½	82¾
Rochester St. Ry	..	38	..
Union Ry. (Huckleberry)	100	112	115
West End, Boston	100	..	69
" " pref	100	90	..
Worcester Traction	100	13	16
" " pref	100	83	87
BONDS.			
Buffalo St. Ry. 1st con. 5s	100	104	105
*Binghamton Railroad Co. 5s	100	99	00
*Columbus St. Ry. 1st 5s.	100	98	
Rochester St. Ry. 1st. 5s.	100	95	97
*Union Ry. 1st. mtge 6s.	100	105	108
*Westchester Electric 1st. mtge. 5s.	100	98	101

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* With accrued interest.

† Ex-Div.

‡ Ex-rights.

BALTIMORE TRACTION is showing considerable strength, though not a great degree of activity, which is most likely due to steadily increasing earnings and a more conservative expense account The floating supply of the stock has been considerably diminished, but a further advance is scarcely probable until a further absorption takes place.

PHILADELPHIA TRACTION shows signs of an advance in the near future despite its present sluggish appearance. It is more than likely that the stock has been held down deliberately to accomplish the accumulation of holdings which has recently been observed.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 BROADWAY, NEW YORK May 20, 1895.

ALBERT L. CLOUGH, general manager of the Brodie Electric Company, Manchester, N. H., was in New York last week and called at the office of THE ELECTRICAL WORLD.

THE SUBWAY MONOPOLY BROKEN.—Judge Follett of the Supreme Court, has affirmed the lower court's judgment against the Empire City Subway Company in its suit to restrain the Broadway and Ninth Avenue cable companies from placing telegraph and telephone wires in their cable conduits.

THE POSTAL BUILDING LEASE.—The Trinity Church Corporation has leased to John W. Mackay the property at Broadway and Murray street on which is the Postal Telegraph building, for a term of 20 years, at an annual rental of $52,500. Mr. Mackay got a lease on this land in 1892 for a period of three years, in which it was specified that he should erect a building, and having fulfilled this condition the term is now extended for 20 years.

BROOKLYN TROLLEY TROUBLES.—The conductors and motormen of the street railways in Brooklyn are now complaining because the schedules require them to run so slowly that they cannot earn fair wages. The demand upon the city government to make the movement of street cars safer was so importunate that the rate of speed in the busiest part of the city was ordered reduced to six miles an hour, and this makes the through time slower than is customary where horses are used.

THE MORSE CLUB will give its first annual dinner at 7 o'clock, p. m., on Friday, May 24, at Jaeger's corner, Madison Avenue and Fifty-ninth street. Addresses will be made by Messrs. Albert B. Chandler, Thos. F. Clark, Wm. J. Dealy, W. A. Van Orden and W. C. Burton. The club was organized last year for the purpose of celebrating the anniversary of the transmission of the first telegraphic message and other important events incident to the institution of the telegraph and the life of Prof. Morse; and to decorate the Morse statue annually.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, May 18, 1895.

THE LIMITING SPEED FOR TROLLEY CARS has been increased to eight miles an hour by the Newtown City Council.

HARTFORD'S LAST HORSE CAR was run into the barn on Monday last and taken out of service. Every line in the city is now fully equipped with the trolley system.

THE CAMBRIDGE MANUAL TRAINING SCHOOL has appointed City Electrician Charles H. Morse to the superintendent's position made vacant by the death of Henry Ellis.

PORTLAND, ME.—The long uncertainty about the building of the Portland & Cape Elizabeth Electric Railway is developing in a general belief that the road will be built this summer.

A TEMPORARY INJUNCTION has been granted by Judge Chipman, of the United States Circuit Court, against the Bryant Electric Company, of Bridgeport, Conn., enjoining it from manufacturing the Bergman keyless lamp socket.

MIDDLETOWN, CONN.—The refusal of the railway committee of the legislature to grant the Middletown Horse Railway a charter to extend the road to Meriden, by way of Westfield, will not, it is believed, have the effect of stopping the road.

THE WEST END STREET RAILWAY COMPANY will electrically equip all its remaining Somerville horse lines this summer—some seven or eight miles. A new car house will be built somewhere near the terminus at West Somerville.

ANSONIA ELECTRIC DIVIDEND.—C. S. Mersick, receiver of the Ansonia Electric Company, has been authorized by Judge Prentice to pay a dividend of 10 per cent. to the creditors of the concern. This is the second dividend of 10 per cent. that the receiver has paid.

WALTHAM'S MOODY STREET LINE of railway has been at a dead standstill recently owing to lively differences of opinion between the city authorities and the street railway officials. Matters were adjusted this week, however, and the construction work is progressing rapidly.

UNDERGROUND WIRES.—Commissioner Murphy has requested the superintendent of streets to grant permission to the New England Telephone & Telegraph Company to put underground conduits in several streets. The Boston Electric Light Company will begin putting its wires underground in Atlantic avenue and Winter street immediately.

AN OPPORTUNITY for profitable investment seems to be presented by the topography of Shelburne Falls, Mass., and vicinity. Just above the village water power aggregating 2,500 to 3,000 horse-power, it is said, may be utilized by the construction of a 20 foot dam at Scott's bridge and a tunnel thence to a point below the stone quarry. There is a natural fall of 50 feet in the river and the dam would raise it 70 feet. Shops near the Fitchburg railway could use 45 feet of the total head, leaving 25 available on the river bank below. The water supply is said to be reliable.

FOUR ELECTRIC LAUNCHES are to be placed in waters within the limits of the Metropolitan Park system for public accommodation this season. Two of these will be moored off City Point, the Marine Park reservation, and the other two will float on the bosom of Jamaica Pond. This will be the first time that any public boats, with electricity for the motive power, have been floated in this vicinity, and now that the first step is made here it is not improbable that there will be a general awakening to the important uses to which electricity can be put on the water as well as on the land.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON May 8, 1895.

AN INTERESTING EXPERIMENT.—At the conclusion of a lecture at the Royal Institution on Tuesday, Prof. George Forbes showed a very interesting experiment which originally was due to Lord Armstrong. As this experiment seems to throw some light on the changes in insulation resistances of bare copper conductors laid in conduits, it is of interest to electrical engineers. The apparatus used consisted of an inner and an outer glass vessel communicating by a small orifice in the bottom of the inner vessel. Both these vessels were filled with distilled water, and some cotton thread was placed in the inner one, the end of the thread being passed through the orifice. On sending a high pressure continuous current from the outer to the inner vessel the thread was seen to move bodily through the orifice in the opposite direction to the current while water streamed from the outer to the inner vessel. On reversing the current the thread receded into the inner vessel and the water streamed outward. It has been thought that this effect may explain the increase of the insulation resistance of the positive conductor and the decrease of the insulation resistance of the negative conductor in an underground system of bare mains.

SERIES GLOW LAMP LIGHTING.—A system known as the "Parfitt" system of lighting is just now being made much of in this country. So far the only actual lighting by this method is that of two parishes near Bristol. It is, however, now proposed to form a company on the strength of a patent belonging to Mr. Parfitt, and the experience gained in this out-of-the-way district, and for the purpose of making the thing go through several extravagant claims have been put forward. For instance, it is pointed out that the total cost of generating a board of trade unit under this system has been found to be only 2½d as against 4d and 5d elsewhere. This is a somewhat disingenuous statement, since on inquiry it is found that a continuous supply is not offered by Mr. Parfitt, whilst those concerns where the total cost of generating amounts to double his figure, have to maintain a supply night and day. Mr. Parfitt's system is nothing more than our old friend series glow-lamp lighting. The main feature which differentiates it from others hitherto tried with such small success, consists in the means employed to prevent the extinction of one lamp interfering with the rest. At the most, the failure of the automatic switch cannot lead to the extinction of more than one additional lamp.

AN ELECTRIC CITY OF NOTE.—In a paper read by Mr. Arthur Wright, the municipal electrical engineer of Brighton, before a recent gathering of the Incorporated Association of Municipal and County Engineers, it was pointed out that Brighton is a city of some note in the annals of electricity It was the first town in England to possess a central station for the express purpose of general public supply, it was the first town to use meters, to adopt the differential system of charging for electricity based on the actual cost of supplying it to each individual customer. It has, moreover, during the past 10 years, enjoyed the advantages of the multiple-series system, the house-transformer system, and the two and three wire system, and now the northern portion of the town is being supplied during the hours of heavy load, on the alternating system, and during the hours of light load, on the continuous current system. The municipal Engineer also points out, that, notwithstanding the fact that coal at Brighton is 20s. per ton, the actual cost of supplying electricity from the Brighton municipal central station is less than from any other central station in Great Britain, the figure being 2.3d per unit as against 2.46d at Liverpool, 2.69d in Westminster (London), and so on; this figure being exclusive of redemption and interest.

General News.

NEW INCORPORATIONS.

THE TEXAS ELECTRIC COMPANY, Austin, Tex., has been incorporated with a capital stock of $5,000.

THE TAYLOR ELECTRIC LIGHT COMPANY, Taylor, Tex., has been formed; the capital stock is $20 000.

THE OSHKOSH NORTHWESTERN TELEPHONE COMPANY, Oskhosh, Wis., capital stock $20,000, has been formed.

THE ALVARADO WATER SUPPLY & ELECTRIC COMPANY, Alvarado, Tex., capital stock $10,000, has been organized by M. Sansom, H. R. Jones, T. B. Pope, E. P. Reynolds and others

THE SAVANNAH TELEPHONE COMPANY Savannah, Mo., capital stock $10,000, has been incorporated by B. E. Egan, John Donald, Jr., L. N. Hooper, Jr., J. T. Hughes and J. A. McLean.

THE EGG HARBOR CITY WATER, ELECTRIC LIGHT & POWER COMPANY, Egg Harbor, N. J., has been organized. The promoters are Dr. Theo. H. Boysen, Robt. Ohnmeiss and Harry May.

THE TOLEDO TRACTION COMPANY, Toledo, O., capital stock $4,000,000, has been formed to construct, maintain and operate street railroads. Albion E. Lang, Chas. L. Wight, Winfield S. Jowell and Edgar H. Eckert.

THE PHILADELPHIA & WEST CHESTER TRACTION COMPANY, Philadelphia, Pa., capital stock $181 000, has been incorporated by W. F. B. Stewart, York, Pa.; W. C. Alderson, Overbrook; W. M. Rotch and others.

THE GRAYVILLE WATER WORKS, Chicago, Ill., capital stock $5,000, has been formed to construct water works, electric light, heat and power plants, etc. Henry A. Gardner, Livingston Griffin and Arthur M. Morgan are interested.

THE INTERSTATE LONG DISTANCE TELEPHONE COMPANY, Leavenworth, Kan., capital stock $100,000, has been incorporated by W. T. Hewitt, W. N. Todd, J. W. Folger and others to build telephone lines between Kansas towns and elsewhere.

THE CABLE INSULATOR COMPANY, Saco, Me., capital stock $10,000, has been incorporated to manufacture and deal in insulators and electrical appliances of all kinds. Sam Oakman, Wingate P. Sargent, Melrose, and James R. Powers, Boston, Mass., are interested.

THE EDDY MILLING COMPANY, Edgecomb, Me., capital stock $5,000, has been formed to establish an electric light plant, and do a milling, lumber and other business. The promoters are Willis H. Clifford, Irving E. Chase, and Fred. W. Clifford, all of N. Edgecomb, Me.

THE TOPEKA ELECTRIC RAILWAY COMPANY, Topeka, Kan., capital stock $75,000, has been formed to construct and maintain a railway from Topeka to Roseville; also street railways, etc. A. J. Arnold, T. M. James, Lewis Stair and Francis C. Downey, Topeka, are interested.

THE LA CROSSE, BLACK RIVER FALLS & MILLSVILLE ELECTRIC RAILWAY COMPANY, La Crosse, Wis., capital stock $300,000, has been formed to build an electric road from La Crosse to Millsville. The promoters are N. Clark, P. McHugh and Wm. Burns, La Crosse, Wis.

THE CLEVELAND, PAINESVILLE AND EASTERN RAILWAY COMPANY, Cleveland, O., capital stock $250,000, has been formed to construct and operate an electric railroad, furnish light, heat, power etc. H. A. Everett Julius E. French, J. A. Beidler and E. W. Moore are interested.

THE WATKINS & HAVANA RAILWAY COMPANY, Watkins, N. Y., capital stock $50,000, has been formed to build and operate a street surface electric railway five miles long. C. L. Hathaway, Horseheads; C. H. Baldwin, E. L. Adams, and C. W. Ingalls, Elmira, N. Y., are interested.

THE McKEESPORT & WEST NEWTON PASSENGER RAILWAY COMPANY, McKeesport, Pa., capital stock $60,000, has been formed to build a passenger railway operated by electricity in Westmoreland County. The promoters are Homer H. Swaney, Jos. R. Henderson and F. W. Patterson.

THE MONTCLAIR LIGHT & POWER COMPANY, Montclair, N. J., capital stock $50,000, has been formed to construct, maintain and operate an electric light and power plant in Montclair. The promoters are Geo. F. Baker, Chas. C. Coe, New York; W. C. Snow and Chas. D. Backus, Montclair, N. J.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Chicago, Ill., capital stock $50 000, has been formed to manufacture and sell electrical and mechanical apparatus and to construct telephone exchanges. Alfred Bromberg, Androv Carlson and Arthur B. Cotton are interested.

THE AMERICAN UNION TELEPHONE COMPANY, New York, maximum capital stock $5,000,000, has been formed to lease and dispose of telephones, telephone switches, electrical appliances, etc. The promoters are M. P. O'Connor and Jno. A. Wallace, of New York, and Franklin Noble, of Brooklyn.

THE INTERNATIONAL ELECTRIC FORGING COMPANY, New York, capital stock $6,000, has been formed to work metals, smelt ores and engage in business in which electricity may be used as an agent. The promoters are James Seager, J. C. Seager, New York, Lorenzo Ullo, and J. L. Ullo, Brooklyn, N. Y.

THE INTERURBAN RAPID TRANSIT COMPANY, Tiffin, O., capital stock $250 000, has been formed to construct, acquire and operate a railway or railways, to be operated by electric, steam, cable, horse, or other motive power. The promoters are M. Frost, A. Betts, Norman McCarty, Lewis Selle and W. F. Noble.

THE ELECTRIC RAILWAY.

HOUSTON, TEX.—The Rapid Transit Company will extend its trolley system to the suburbs.

DUNKIRK, N. Y.—The Dunkirk & Fredonia Street Railway Company will build a power house.

GREENVILLE, S. C.—W. A. Hudson and J. C. Smith are asking for a franchise to build an electric road in this city.

SAYVILLE, L. I., N. Y.—Surveys are being made for the construction of a trolley line from this place to Stony Brook.

DANVILLE, IND.—Danville and Hoopestown have been granted a franchise to connect the two cities by an electric road.

COHOES, N. Y.—The Troy City Railway Company has been granted permission to equip its horse railway with electricity.

WOONSOCKET, R.I.—It is reported that the Woonsocket Street Railway Company contemplates extending its tracks to Manville.

SLATERVILLE SPRINGS, N. Y.—There is a project in progress looking toward the building of an electric railway to this place.

HERKIMER, N. Y.—The roadbed is being prepared and rails laid for the new electric street railway between Herkimer, Ilion and Frankfort.

BRISTOL, PA.—The Council has passed an ordinance granting the right of way to the Newton Trolley Company through the streets of the town.

NORTH ADAMS, MASS.—The Selectmen have granted the Hoosac Valley Street Railway Company permission to extend its tracks to Williamstown.

SPRINGFIELD, MASS.—It has been stated that the street railway people will ask the city authorities for permission to extend their track toward Dalcon.

LAKE CHARLES, LA.—The Lake Charles Electric Railway Company, recently organized with a capital stock of $100,000, will build an electric railway.

KOKOMO, IND.—Capitalists of this place have secured a franchise and right of way for an electric line from Kokomo to Greentown, to be constructed this summer.

BALTIMORE, MD.—The City & Suburban Electric Railway Company will soon double track its line on North avenue from Pason to 10th streets, a distance of 1¼ miles.

CINCINNATI, O.—The Consolidated will build a line from Hyde Park to the C. H. & D. depot The road is about six miles long. John Kilgour, Fifth and Walnut streets, is president.

ALGIERS, LA.—Algiers and Gretna will be connected by an electric road. Messrs. Maas and Gerdes have secured a franchise to erect poles and string wires for electrical purposes.

MUSCATINE, IA.—The Muscatine Electric Railway Company is contemplating the enlargement of its lighting plant. General Superintendent Paul F. Seevers can furnish particulars.

SYRACUSE, N.Y.—At a meeting of the Common Council the Syracuse & East Side Railway Company petitioned for permission to construct a street railway through the various streets of the city.

YOUNGSTOWN, O.—Proposals will be received at the office of the board of city commissioners until 12 m., May 26, for the construction of street railway route No. 4. J. Howard Edwards is city clerk.

PORTLAND, CONN.—It is reported that the Portland Electric Railway Company will soon begin the construction of a road from Portland Dock to Glastonbury, to connect there with the Hartford electric road.

WACO, TEX.—The sale of the Waco Electric Railway & Light Company, popularly known as the Hudson Company, has taken place. There will be extensive improvements made in the electric lighting and street car facilities.

SAYVILLE, L. I., N.Y.—It is proposed to hold a public meeting to discuss the feasibility of securing the right of way through the village for an electric road. Civil Engineer Hawkins, of Stony Brook, will probably give information.

PIERMONT, N. Y.—The Nyack Traction Company has made application to the board of trustees of Piermont, for permission to construct, maintain and operate along and through Piermont avenue a street surface railway to be operated by electric power.

VALPARAISO, IND.—The proposed electric railway to connect this city with Chicago is assured. The following are the officers of the company: President, A. Morrison, of Chicago; vice-president, Seward Lightner; secretary, A. J. Smith; treasurer, J. H. Roper. A franchise will be secured at the commissioners' court, June 1.

ELECTRIC LIGHT AND POWER.

ALEXANDER CITY, ALA.—Steps are being taken to establish an electric plant.

CLARE, MICH.—The new electric light system is now in active and successful operation.

BIRMINGHAM, ALA.—The Consolidated Electric Light Company will erect an electric plant.

ENTERPRISE, MISS.—L. B. Bradley has been granted a franchise for an electric light plant.

PASS CHRISTIAN, MISS.—Maurice Kaufman has been granted a franchise for an electric light plant.

ALGIERS, LA.—The Algiers ice and electric plant has been purchased by Charles Carroll for $38,500.

KAUKAUNA, WIS.—The Kaukauna Electric Light Company's stockholders have applied for a receiver.

ELKINS, N. C.—Steps are being taken toward the establishment of an electric light plant. H. G. Chatham is interested.

DODGEVILLE, WIS.—The Dodgeville City Council has decided to advertise for bids for lighting the streets by electricity.

ARLINGTON, MASS.—The election held to vote on the question of establishing an electric light plant resulted unfavorably.

GLENWOOD, MINN.—The contract for an electric light plant has been let to J. R. Sarren, proprietor of the Glenwood Roller Mills.

MURFREESBORO, TENN.—A bill has been passed in the legislature authorizing the city to issue bonds for an electric light plant.

PALM BEACH, FLA.—Henry M. Flagler will erect an electric light plant to light the Hotel Poinciana and another hotel yet to be built.

MOOREHEAD, MINN.—P. H. Lamb has been awarded the contract for the building of the new electric light and waterworks station at a cost of $3,804.

BALTIMORE, MD.—A ½-hp electric motor, for either arc or 220-volt constant potential circuit, is wanted by W. E. Eberhard, Oehm's Acme Hall, Baltimore.

FLAGSTAFF, ARIZ.—J. D. Moore, of the Prescott Light & Power Company, has been canvassing the town with the view of putting in an electric light plant.

PAWTUCKET, R. I.—It is believed that the board of aldermen will oppose the plan of the Bridgemill Power Company to distribute electricity throughout the city.

PHILADELPHIA, PA.—The application of the Edison Electric Light Company for permission to lay conduits on Market, Chestnut and Walnut streets, has been granted.

HAGERSTOWN, MD.—Powell Evans, of Philadelphia, Pa., has made application to the City Council for authority to erect poles in Hagerstown for an electric power system.

PAWTUCKET, R. I.—At a meeting of the board of aldermen an application was received from Darius L. Goff and Lyman B. Goff, of the Bridge Mill Power Company, for permission to distribute electricity for general purposes throughout the city.

EVANSVILLE, IND.—Sealed proposals will be received by the board of public works on June 15, for lighting the streets and public places of the city with electricity for a period of five years. There will be 400 lamps of 2,000 candlepower each.

ASBURY PARK, N. J.—Proposals for lighting this town by electricity will be received until 12 m., June 3, by Wm. C Burrows, clerk. The bids to be for 25 arc lamps of 2,000 candle-power, with the privilege to the borough of additional lamps, if desired.

NEWTOWN, L. I., N. Y—The contract for lighting the town has been let to the Long Island City Electric Illuminating Company, whose bid was $127 75 per lamp per year. The contract for lighting the town with gas was let to the Newtown Gas Company.

ELK POINT, S. DAK.—C. L. Potter, of the firm of B. N. Potter & Co., of New York, has proposed to the city that if it will grant a 50-year franchise and will agree to pay for all water used, he will put in an electric and water works plant to cost $30 000.

MACKINAC ISLAND, MICH.—The City Council of Mackinac Island has granted to J. F. Knightsley, of Jackson, a 30 year franchise for furnishing an electric lighting plant, from June 1, 1896. The plant will include both arc and incandescent lights.

HAGERSTOWN, MD.—The William Wharton, Jr., Company, of Philadelphia, Pa., has been granted the privilege to erect an electric plant on the canal of the Chesapeake & Ohio Canal Company. It proposes to furnish the factories at Hagerstown with electric power.

PAWNEE CITY, NEB.—Sealed bids will be received by the City Council until May 27, for one high, low, or medium speed high pressure engine of 80 to 100 horse-power with one feed water heater of suitable capacity, and one 500 or 600-light incandescent dynamo, with necessary switches, voltmeters, amperemeters and other requisite equipment. G. Humphrey can give further details.

TELEGRAPH AND TELEPHONE.

MANCHESTER, IA.—The Manchester telephone system is expected to be in operation shortly.

GARRETSVILLE, O.—F. B. Hopkins has been granted a franchise for telephone exchanges at this place for 10 years.

COLUMBUS, O.—The Ohio Telephone Exchange Company has announced its intention to cut the prices of the old companies about 50 per cent.

LOS ANGELES, CAL.—C. W. Hinchliffe, assistant superintendendent of the Sunset Telephone Company, has filed plans for the city clerk, showing the proposed location of an extension of the company's underground system.

MADISON, WIS.—The United States patents covering the Milne telephone system have passed into the control of a company headed by Madison capitalists, the principal of whom are H. L. Spooner, president; B. B. Clarke, vice-president; E. W. Batchelder, secretary; and B. M. Lamp, treasurer.

CAPE MAY, N. J.—The City Council has passed an ordinance granting the right of operating in the city to the Telephone Company of South Jersey, and has also passed through second reading ordinances granting franchises to the Postal Telegraph & Cable Company and the Cape May City Electric Light & Power Company.

PERSONAL NOTE.

PROF. J. J. FLATHER, of Purdue University, was in Lexington, Ky., last week, where he delivered a lecture on "Rope Driving" before the engineering students of the State College. The lecture was illustrated with numerous lantern slides and proved a most interesting subject.

MISCELLANEOUS NOTES.

WASHINGTON AND LEE UNIVERSITY has decided to abolish the degree of civil engineering and substitute therefor the degree of bachelor of science, which will be conferred in three courses, those of civil engineering, electrical engineering and mining engineering.

THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY announces a supplementary summer course to be given during June and July. The courses are to be seven in number, viz. I. Mechanical Drawing and Descriptive Geometry; II. Mathematics; III. Architecture; IV. Chemistry; V. Biology; VI. Physics; VII. Modern Languages. Entrance examinations for the regular winter course will be held at the Roges Building, 491 Boylston street, Boston, on June 27 and 28, and Sept. 24 and 25. For the convenience of applicants outside of New England the June examinations will also be held in 18 cities widely separated. Full information is given in pamphlets which the Institute is distributing.

THE BROOKLYN ELECTRICAL SOCIETY on May 24 listened to an interesting lecture on the subject of "Induction," delivered by Mr. Nelson W. Perry. Mr.

Perry made use of some very effective similes in explaining to his audience inductive effects. He called attention to the analogy between the phenomena of induction by ethereal waves and the transmission of energy by the liquid waves when a stone is cast in the water, and illustrated the action of lines of force about a conductor carrying alternating currents by the spring on the balance wheel of a watch which continually contracts and expands. The lecture closed with an exhibition of the operation of Dr. Lodge's coherer, by which ethereal waves were caused to close a circuit and ring an electric bell. After Mr. Perry's lecture Mr. Durant exhibited a number of Geissler tubes in which light effects produced by induction were very prettily shown.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS will hold its annual meeting for the election of officers and the reception of the Council's and Treasurer's reports at 12 West 31st street, on Tuesday evening, May 21, at 8 p.m., being the third Tuesday in the month as fixed by the rules. In accordance with a vote at the meeting of April 17, the discussion of Prof. Anthony's paper on "Underwriters' Rules" will be resumed. It will be opened by Prof. Wm. L. Puffer, of the Massachusetts Institute of Technology, Consulting Electrical Engineer of the Associated Factory Mutual Insurance Companies. This meeting should not be confounded with the general meeting to be held at Niagara Falls in June. The Council will meet in the office of the Institute, 26 Cortlandt street, Tuesday May 21, at 4 p. m. Non-members receiving a notice are cordially invited to attend the meeting. On account of some uncertainty as to the arrangement at Niagara Falls, a committee has been appointed by Council with power to postpone the general meeting if necessary to a date no later than July 1. Due notice will be given of any action taken.

Trade and Industrial Notes.

J. H. BUNNELL & CO. 76 Cortlandt street, New York, have been granted a patent upon their aluminum-lever telegraph sounder recently illustrated in our columns.

THE LAW BATTERY COMPANY has removed its offices to 39 Cortlandt Street, New York. The company has equipped a large new factory at Cranford, N. J., and is making preparations to greatly extend its business.

THE KNAPP & ELECTRIC NOVELTY COMPANY, 47 Warren Street, New York, reports a surprisingly good business in its battery fan outfits, an indication that people appreciate a good article and are willing to pay a fair price for it.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, is receiving a large number of inquiries regarding the new Meston alternating current ceiling fan, which promises to find fully as useful, if not as large a field, as the regular Meston desk fan

THE METROPOLITAN ELECTRIC COMPANY, 186-188 Fifth avenue, Chicago, furnished the lamps for the large spiral tower of A. M. Rothschild & Co.'s new store. This tower has created a sensation in Chicago and the Metropolitan Company feels that it has "scored a bit" by having its lamps selected after other lamps had failed.

THE ALLEGEMEINE ELEKTRICITATS GESELLSCHAFT, of Berlin, Germany, has issued a large, handsomely illustrated catalogue of its trolley system, embracing everything from the generator to the track, inclusive. The system does not materially differ from the best American practice. The catalogue is printed in English.

CHAS. A. SCHIEREN & CO., 47 Ferry street, New York, report that their factory is running full time and is considerably behind orders. The firm attributes the increasing demand for its belting to the fact that all the tanning is done by slow process and with pure oak bark, which results in giving the leather the greatest durability.

BALSLEY & BRYNER, of Connellsville, Pa., are putting on the market a very meritorious insulated socket. A notable feature of the device is the location of the key and switch in the barrel of the socket, so that when the two parts are separated the cap or base contains only the two terminal pieces, greatly facilitating the work of "wiring up" the socket.

SMETHURST & ALLEN is the style of a new electrical engineering firm whose headquarters are in the Betz Building, Philadelphia. Mr. Smethurst was formerly with Pepper & Register, and has had an extensive experience in practical engineering. Mr. Allen was previously connected with the Philadelphia Traction Company. The firm has recently been awarded an important contract by the New York & Philadelphia Traction Company.

THE COMMERCIAL ELECTRIC COMPANY, of Indianapolis, Ind., in an exceedingly tasteful new catalogue describes at length, and with the aid of numerous illustrations, its line of dynamos and motors. The small sizes are made in bipolar form, the larger ones being furnished in both bipolar and multipolar designs according to the service required. The company is making a specialty of multipolar slow-speed dynamos either belt-driven or direct-connected.

THE C. W. HUNT COMPANY, 45 Broadway, New York City, has recently furnished the Schoen Manufacturing Company, of Pittsburgh, Pa., with a complete industrial narrow gauge railway system, comprising track and cars. The Hunt Company has issued a 40-page catalogue descriptive of its industrial railway system, which embraces special cars of every conceivable description, standard dumping cars, flat cars, tip cars, sectional track, switches, turntables, etc.

J. E. PUTNAM & CO., of Rochester, N. Y., have just completed the electrical work in the new Chamber of Commerce Building in that city. The equipment includes two Western Electric 50-kw multipolar generators connected direct to Ames automatic engines. Three thousand incandescent lamps are wired up, brass armored conduit being used throughout. The switchboards are five panel, marble, and the feeders are so arranged that they may be supplied from the local Edison mains if desired. There are also two Blackman ventilating fans, 86-inch and 60-inch, driven by Lundell motors, and about 25 arc lights.

THE INTERIOR CONDUIT & INSULATION COMPANY, 527 West 34th street, New York, found that the hot spell made business lively in one department of the electrical supply trade. Mr. E. W. Little, the general manager, reports that the sudden advent of midsummer created a boom of no small proportions in the sale of Lundell fan motors. The Pettingell-Andrews Company, New England agent for the Interior Conduit Company, reports sales aggregating $4,000 in one day recently, and the orders from the Central Electric Company, of Chicago, have alone been enough to keep a good-sized factory busy. Sales of the Lundell fan motors in other parts of the country are reported to be quite large and much in excess of the figures reached this time last year.

H. E. COLLINS & CO., Bank of Commerce Building, Pittsburgh, sole sales agents for the United States and Cuba for the Cahall Vertical Water Tube Boiler, manufactured by the Aultman & Taylor Machinery Company, of Mansfield, Ohio, have within the past month closed contracts with the Salem Iron Company at Leetonia for 250 horse-power for their blast furnaces; Ætna Standard Iron & Steel Company, Bridgeport, Ohio, 100 horse-power; Brown-Bonnell & Co., Youngstown, Ohio, 324 horse-power; Carrie Furnaces, Pittsburgh, Pa., 2,000 horse-power; Canonsburg Iron & Steel Company, Canonsburg, Pa., 250 horse-power boilers. The orders from the Salem Iron Company, Ætna Standard Iron & Steel Company and Brown-Bonnell & Co., are repeated orders from these concerns. The boilers for the Salem Iron Company and Carrie Furnace Company are both for burning blast furnace gases and the boilers for the Canonsburg Iron & Steel Company are for utilizing waste heats from heating furnaces.

THE BALL ENGINE COMPANY'S WORKS, at Erie, Pa., are unusually busy just now, the erecting floors being crowded with engines in process of construction. Especially noticeable, by their appearance, among the many engines are three of 175 horse-power each, adapted for direct connection to Mather dynamos, which are to go to the new library of Congress, Washington, D. C., in a few days. These engines are painted pure white, according to the instructions of the government, and with their polished brass fittings certainly present a handsome appearance. Among other engines in process of erection are two 125-hp tandem compounds for the Norfolk & Ocean View Railway Company, Norfolk, Va.; one 300-hp tandem compound railway engine for the Rock Creek Railway Company, Washington, D. C.; one 400-hp vertical cross compound engine for the Camden Horse Railway, Camden, N. J.; two 160-hp tandem compounds for the Salamanca Water Works, Salamanca, N. Y.; one 175-hp for the Suburban Traction Company, Orange N. J., and one 100-hp vertical engine for the Detroit *Free Press*, Detroit, Mich.

Business Notices.

ELECTRIC LEAGUE.—Meets every Thursday evening, 100 West 24th street. Electrical engineers and electricians cordially invited.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 14, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

539,024. ELECTRICAL CONNECTOR; F. N. Bell, Milford, Mass. App. filed July 28, 1894. The combination of an outer thimble having one end closed near a centrally located bolt hole, the walls of the thimble being split in the direction of the length and an inner sleeve, having a tapering surface adapted to expand the outer thimble upon being subjected to pressure from a screw bolt, connecting with a rod passing through the thimble and sleeve.

539 032. CARBON BRUSH HOLDER FOR DYNAMOS; W. S. Bosley, Chicago, Ill. App. filed Sept. 8, 1894. The combination of a bar with its end upturned, a clamping plate secured by one end to the bar, a carbon block adapted to rest between the upturned end and the elevated end of the clamping plate, the clamping plate having a screw to move the plate either toward or from the bar to hold or release the carbon block.

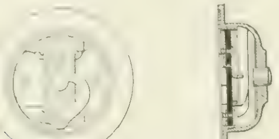
39,040. INSULATOR; L. H. Desisles, Boston, Mass. App. filed Sept. 10, 1894. The combination of a main block having end brackets, a metallic clip, and a holding screw; the screw and clip having screw thread connections with each other and co-operating in a bracket to hold a wire.

539,068 TELEPHONE; M. Martin, Malden, Mass. App. filed Nov. 10, 1886. The combination of a diaphragm or vibrating piece of magnetic material having a central opening, with a magnet having a pole piece terminating opposite the said opening, whereby the attractive force of the magnet acts mainly in the direction of the plane of the diaphragm.

539,079. ELECTRIC PUSH BUTTON; A. J. Gehring, Chicago, Ill. App. filed Nov. 2, 1893. The combination of a base of yielding material having projecting pins or studs formed integral therewith, and a switch plate thoroughly insulated, secured to the base by bending the said studs down upon it.

539,086. TELEPHONE TRANSMITTER; R. F. Rice, Hartford, Conn. App. filed May 18, 1893. The combination of a diaphragm of an undulator consisting of a multiplicity of surface contacting members under successively increased loads, and comprising single part and multi part members in alternating succession.

[illegible] ANNUNCIATOR CONNECTION FOR MULTIPLE SWITCHBOARDS. [illegible] Turner, Keene, N. H. App. filed April 11, 1892. An annunciator included in a telephone series, a normally open circuit about said annunciator, and means for closing the said circuit by the act of making connection with the line.



No. 539,079.—ELECTRIC PUSH BUTTON.

539,105. VARIABLE RHEOSTAT; F. P. Warner, Chicago, Ill. App. filed Sept. 18, 1894. The combination of bare resistance wires constituting the winding, with a contact device adapted to travel over said wires, the contact device being provided with contact rollers which are adapted to bear upon a number of the convolutions of the winding at the same time.

539,142. TELEPHONE CIRCUIT AND APPARATUS; C. W. McDaniel, Kansas City, Mo. App. filed March 16, 1895. A telephone circuit extending through a plurality of way stations, in series, in each of which the circuit passes through two double spring jacks beween which branches extend from each circuit conductor to a high resistance call bell in a permanent bridge, and other branches extending from the said conductors to the open terminals of a conducting plug, whereby when the said plug is inserted into one of said jacks the circuit conductors are opened at the said jack and transferred through the said plug terminals to the other jack, a new circuit through the way stations being established through the telephone switch.

539,150. ELECTRIC LAMP; W. H. Sheppard, New York, N. Y. App. filed Nov. 20, 1894. An incandescent lamp socket having bracket arms secured thereto, the arms swinging or not as desired, and secured at their lower end a shade and support for an electric lamp, the wires being led through one of the brackets.

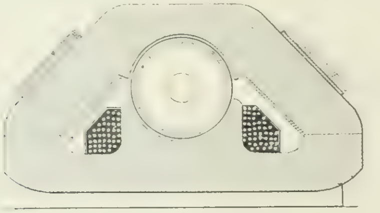
539,154. RAILWAY SIGNAL SYSTEM; G. L. Thomas, Brooklyn, N. Y. App. filed Jan. 28, 1895. A system having a series of signals arranged along a track, a train moving along the track to control the signals, the electric circuits being arranged to hold the signals at danger and a device to prevent a plurality of signals both before and after a train being turned to safety by an approaching train when the track is not clear.

539,163. TELEPHONE TRANSMITTER; A. C. Brown, London, Eng. App. filed Sept. 27, 1894. The combination of a diaphragm, a back electrode, a mass of granulated material being between the two, a rigid ring seating on one side of the diaphragm, and an elastic support on the other side acting to press the diaphragm toward the granulated material and compressed to a predetermined weighed pressure and permanently fixed independent of the weighed pressure.

539,170. MAGNETIC CALL APPARATUS; F. B. Cook, Chicago, Ill. App. filed Dec. 26, 1894. The combination of a telephone circuit having magneto call generator normally connected therein, but shunted from the main circuit; generator actuating mechanism, an automatic switch, and means for withdrawing the generator from the shunts.

539,184. CLOSED CONDUIT ELECTRIC RAILWAY; P. Lucas, Berlin, Germany. App. filed June 23, 1894. The combination of a casing containing a series of stationary contacts, a conductor, levers arranged to be rocked by the car, and supplemental levers pivoted to the said levers carrying contact plates; electrical connections from the plates to the stationary contacts, and switches within the casing having arms extending outside the casing.

539,192. ELECTRIC LIGHT HEAD GEAR FOR PERSONAL WEAR; A. M. Rodriguez and E. D. Rockwell, Brooklyn, N. Y. App. filed Feb. 25, 1895. The combination of wires located in a cap with contacts attached thereto, and a lamp; the lamp to be worn on a cap or hat.



No. 539,277.—ELECTRIC MOTOR.

539,216. RHEOSTAT; A. C. Carey, Lake Pleasant, Mass. App. filed Feb. 26, 1895. A rheostat having a central tube with heads mounted on each end, having conductors leading through the centre, refractory and insulating linings for the adjacent faces of said heads, contacts applied to such linings, a rotary spool arranged upon the heads, a series of layers of wire insulated from each other, and contacts for including such layers of wire in the main circuit.

539,222. ELECTRIC CONDUCTOR; J. R. Hare, Baltimore, Md. App. filed Nov. 23, 1894. An electric conductor formed in separated sections, which are electrically connected by rods which project from side to side.

539,234. ELECTRIC FIRE AND WATER ALARM; G. S. Neu, New York, N. Y. App. filed Jan. 25, 1895. An alarm having a device to be released by heat and water, and provided with a spring actuated plunger, a soluble button, a fuse and electrical contacts kept normally apart by the fuse and button.

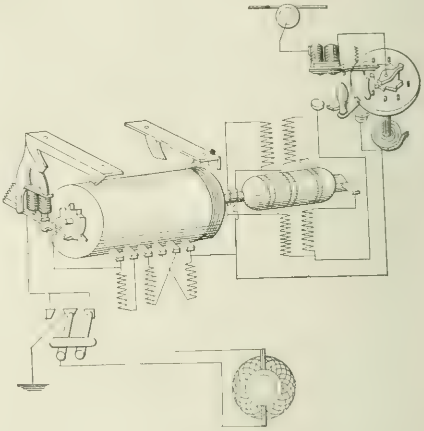
539,274. MOUNTING FOR TELEPHONES; T. Kelly, Philadelphia, Pa. App. filed Sept. 8, 1894. The combination of a telephone receiver and transmitter with a plate carrying the same, fastenings whereby said plate is secured to the wall of the room, and distance pieces serving to prevent contact of the plate with the wall.

539,277. ELECTRIC MOTOR; J. C. Lincoln, Rochester, N. Y. App. filed Jan. 16, 1892. The combination of shunt field magnet windings connected in series across the main line, an armature and a series coil partially surrounding the armature and directly magnetizing it; the series coil and armature being connected in series with each other across the main line.

539,293. CONTROLLER FOR ELECTRIC MOTORS; H. F. Parshall and J. W. Darley, Jr., Lynn, Mass. App. filed Feb 11, 1893. The combination, with a controller cylinder for an electric motor, of an electric motor for actuating said cylinder, and means for returning it to its normal position when the current is broken.

539,298. COMMUNICATING, SIGNALING, ETC., TO OR FROM MOVABLE OBJECTS; J. Y. Porter, Cleveland, O. App. filed Feb. 14, 1894. A trolley wire having a pivoted conductor and a depending portion thereof extending below such wire, the same being free to swing across the vertical plane of the trolley wire without engagement therewith.

539,324. SIGNALING SYSTEM; John P. Coleman, Swissvale, Pa. App. filed Aug 26, 1893. In a signaling system, the combination of signal operating mechanism, an electrically controlled lock for such mechanism, a circuit for the lock, a make and break mechanism arranged in the circuit, an electrically controlled indicating device for operating the make and break mechanism, a circuit for said indicating device extending to the next succeeding station, and a make and break mechanism in the circuit at such station.



No. 539,293.—CONTROLLER FOR ELECTRIC MOTORS.

539,365. ELECTRIC ARC LAMP CLUTCH; W. B. Luce, Brookline, Mass. App. filed March 15, 1894. A clutch consisting of a clutch ring or plate, composed of an inner ring or plate, a ring or plate of insulating material and an outer plate or ring.

539,369. MEANS FOR EFFECTING SYNCHRONISM; J. H. Rodgers, Washington, D. C. App. filed Dec. 29, 1888. The combination of two mechanically disconnected motors—contact makers operated thereby, one member of each contact maker being stationary and the other revolved by its motor—an electric circuit periodically closed by one contact maker, and means for shifting the stationary member of the other contact maker when synchronism fails.

539,376. STARTING BOX FOR ELECTRIC MOTORS; D. M. Bliss, Boston, Mass. App. filed Feb. 20, 1895. A rheostat comprising contacts successively connected with a series resistance, a movable switch member adapted to co-operate with said contacts, an armature co-operating with the switch, and a stationary electro-magnet having its entire polar face adjacent to the path of movement of said armature, whereby the said armature and switch may be locked by the attraction of said magnet in any position.

539,392. ARC LAMP; C. A. Pfluger, Chicago, Ill. App. filed April 6, 1894. The combination of two electrodes each having two carbons adapted to be fed toward each other at an acute angle, means for moving the upper carbons simultaneously to establish the arc, and a device for feeding the lower carbons comprising a weight, a rod upon which said weight is adapted to slide, and cords connecting said weight and said carbons passing in opposite directions over two pulleys.

539,393. ELECTRIC ARC LAMP; C. A. Pfluger, Chicago, Ill. App. filed July 2, 1894. Substantially the same as above.

539,396. RAILWAY SIGNAL; J. Stringham, Jersey City, N. J. App. filed Feb. 6, 1895. An apparatus having a signal set at danger by the passage of a train into a guarded section, a releasing circuit for setting the signal at safety, a circuit controller for the releasing circuit, and electrical connections with the track preventing actuating of said circuit controller until the rails are bridged at a plurality of points before the signal is reached by the train.

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ELECTRICAL INSTALLATION RULES.

The English Institution of Electrical Engineers having announced that it proposes to issue a set of rules for interior electrical installations, Mr. Musgrave Heaphy, the underwriters' expert, informs the public through the London *Electrician* that his company will not for one moment recognize such a foreign code. In view of the desire of some members of our Institute to commit that body to a similar measure, the reasons advanced by Mr. Heaphy on the subject are of interest at the present moment, and also worthy of serious consideration. These reasons are very brief, namely, that his company "has the responsibility of paying for fire losses, and, therefore, it is "absurd to think that it would agree to anything that might practi-"cally place the disposal of its funds at the mercy of the views of "an outside body," and it will therefore "not depart from the "course that long experience has proved to be so safe, and will "require as before that in any building insured with it the electrical "work shall comply with its rules." That this position is a reasonable one cannot, we believe, be contested, and the only result of the Institution rules will probably be to further strain the relations of underwriters' experts and electrical contractors. Instead of formulating an entire code of rules, the influence of such a professional body should, we believe, be directed toward inducing the underwriters to change such of their rules as are really objectionable. In this it would probably be finally successful, for we doubt if the insurance interests would care to defy such authority. There is, however, no prospect whatever that they would ever discard their own rules for those of an outside body, which latter code would therefore have no other effect than to accentuate the differences between two interests naturally antagonistic.

THE BERLINER TELEPHONE PATENTS.

In another column we print an account of all of the Berliner telephone patents issued prior to 1882, from which it appears that of eight granted within that period, four are now in force in this country and four have expired with the French and Belgium patents on the same inventions, the latter patents being identical with the English one to the same inventor, dated Jan. 8, 1880. It will be noted that none of these Berliner patents is of any apparent practical value, and the same may be said of that issued in 1891, which assumes a great importance merely from its claim of the variable-pressure, constant-contact principle. In the same article will be found the dates determining the priority of Berliner over Edison in the invention of the microphone, from which it will be seen that the interval was one of but a few months, and that Edison had grounds in his application of April 27 on which to claim the microphonic principle for which Berliner filed an application on June 20 of the same year. In this connection it is well to remember that the Bell Company in 1878 and 1879 bought both the Berliner and Edison claims for patents, and, therefore, the incentive was lacking which otherwise would have brought about a hard-fought contest for priority. The relation of the Berliner patent to the Edison, Blake and Hunnings patents does not seem to be very well understood, if we are to judge from our correspondence. If the Berliner 1891 patent is valid, it covers the fundamental principle upon which the latter rest for their action—that of producing the undulatory telephonic current by a constant contact subjected to variable pressure by the vibrations of a telephone diaphragm. While the Bell patents were in force, the Berliner principle was tributary to it as far as related to the transmission of speech by the undulatory current, and the other patents named were tributary to both the Bell and Berliner. The principal Edison patent—issued in 1892 and expired on account of the expiration of a corresponding foreign patent—covers the use of carbon in the application of the Berliner principle, and thus ranks after both the Bell and Berliner patents. The Hunnings patent covers the use of granulated carbon, and therefore is secondary to the Edison patent, which is also true of the Blake patent, the latter covering certain mechanical telephonic devices, and not the employment of carbon. For the first of the two earliest Berliner patents now in force—that of Dec. 14, 1880—the claim is made that it covers the use of the induction coil, but the patent refers to an entirely different method of using that device than has ever been employed, the claims being for a battery in two independent primaries, one including the receiver and the other the transmitter circuit, the secondary of the induction coil being stated to act on the *current* in the transmitter circuit. In our last issue we inadvertently stated that the Nov. 2, 1880, patent had expired, which is an error. However, even should the 1891 patent be declared void on account of the fourth claim of the earlier patent involving also the transmitter, the Nov. 2, 1880, patent will have no effect, as its direct claims are confined to a form of receiver that has no practical value whatever.

STEAM JACKETS AND SUPERHEATING.

Prof. Unwin, in a recent lecture before the English Institution of Civil Engineers, expresses the opinion that little or no economy is to be derived from the use of steam jackets on well-designed engines, though they may increase the efficiency of poorly designed or small engines. The subject of steam jackets has been one upon which the widest differences of opinion have existed, but the verdict of Prof. Unwin is in accordance with the results of the latest and most carefully conducted trials. In the same lecture the advantages of superheating are strongly brought forward, the statement being made that no possible improvement of the steam engine of which we have any knowledge at this moment, offers anything like so great a chance of important economy. This claim does not relate to a rise of but a few degrees in temperature, as was the practice 25 years or more ago when superheating met with considerable favor, but refers to an elevation of 100 degrees or more above the temperature of saturation. Some experiments are quoted in which the temperature was carried to 670 degrees, or over 300 degrees above the saturation point; with a pressure of 165 pounds of steam and a piston speed of but 380 feet, the consumption of steam in this case was but 10.2 lbs. of water per indicated horse-power. The reason why superheating was abandoned in the early days notwithstanding the economy it had demonstrated, was largely on account of the practical difficulties met with in the superheating apparatus and in the lubrication of the engine cylinders. As these difficulties have now been largely overcome, the fact that superheating had once been tried and practically found wanting has no longer any bearing, and any objections to its utilization at the present day can rest on no other grounds than prejudice—which, however, is an extremely potent factor among steam engineers.

ORGANIZATION OF TELEPHONE MANUFACTURERS.

As noted in another column, a movement is under way to organize an association of the telephone manufacturers of the United States with a view to the protection of their mutual interests. Such an association can be productive of much good in many directions, and particularly with respect to the determination of the value and status of the numerous telephone patents now owned or controlled by the Bell Company. In the brief of that company in the Berliner case these are stated to number 934, or almost one third of the entire number granted on improvements in telephones and in apparatus to be used in connection with telephones. Owing to the complete monopoly of the Bell Company during a long period of years, there was little or no interest for any one outside of that company to keep track of the course of telephone invention, and the consequence is that knowledge at present in regard to the scope and status of telephone patents is extremely limited. This is particularly true with respect to switchboard patents and those dealing with details of exchange equipment, and with telephonic accessory apparatus. When the several suits now pending involving the above features are tried, some points may be cleared up, but this process will take a long time, and what is needed is immediate information. Owing to the extremely large number of patents, the necessity of also examining all foreign patents and the complexity of the legal and other points involved, a proper consideration of the subject will require the best expert and legal services, and an expenditure of money that would be probably greater than any individual firm would feel justified in assuming. We would, therefore, suggest that one of the objects of the proposed association be the undertaking of the work referred to, thereby placing its members in a situation to intelligently direct their efforts instead of, as at present, having frequently to grope in the dark.

The American Institute of Electrical Engineers.

The annual meeting of the Institute for the reception of the yearly reports and election of officers was held at 12 West 31st Street May 21. The Council reported a membership of 944, showing a net gain of 144 members for the year ending April 30, 1895.

The chair then announced that the discussion of Prof. Anthony's paper on "Underwriters' Rules" would be taken up, and called upon Prof. W. L. Puffer, of the Massachusetts Institute of Technology, to open the discussion, which he did by the presentation of some interesting data that had been obtained from tests made for the Mutual Insurance interests of Boston, showing the amount of current required in a given wire to cause the insulation to deteriorate, and that which would make it smoke.

At the conclusion of Prof. Puffer's remarks Prof. Anthony said that he was very glad he had presented his paper if it had been the means of having such valuable information brought before the Institute. It was the general sense of the majority present that the Institute should not attempt the formulation of any rules, but that a conference between committees from this body and the underwriters would no doubt be productive of benefit all around.

The count of letter ballots, which was not completed until midnight, gave the following result:

FOR PRESIDENT.

Dr. Louis Duncan, of Baltimore, Md.

FOR VICE PRESIDENTS.

Dr. Michael I. Pupin, of New York City.
W. F. C. Hasson, of San Francisco, Cal.
Angus S. Hibbard, of Chicago, Ill.

FOR MANAGERS.

Carl Hering, of Philadelphia, Pa.
Bion J. Arnold, of Chicago, Ill.
Charles F. Scott, of Pittsburgh, Pa.
Dr. Cary T. Hutchinson, of New York City.

FOR TREASURER.

George A. Hamilton, of New York City.

Organization of Telephone Manufacturers.

A movement has been started contemplating the organization of an association including all of the telephone manufacturers of the United States except the Bell Company. To this end Mr. J. E. Keelyn, of Chicago, has addressed a letter to the various companies calling a meeting in Chicago on June 1. It is urged that the probable effect as to the form of order to be entered by the United States Court of Appeals in the Berliner case at Boston, requires the earnest and urgent attention of all those expecting to be engaged in the manufacture or production of telephone apparatus. The further necessity for preparing for the promised onslaught of the Bell people, it is stated, also calls for immediate organization toward a peaceful conduct of legitimate telephone business, and the maintenance of the legal and business rights of those engaged in it.

Salaries of Electrical Engineers.

Without entering upon the debatable region of ethics, says the London *Electrician*, it is quite possible to argue, on the ground of bare expediency, that the low salaries of electrical engineers, which until lately were universal, and still remain the rule, are a mistake. Men tantalized by such doles naturally become mere birds of passage, ready to take flight to fresh fields and pastures new for the smallest increment of pay.

Berliner Telephone Patents.

As but little appears to be known of the earlier Berliner telephone patents, we give below an account of these issued prior to 1882. In order, however, that the bearing of these patents may be clearly understood, it is necessary first to take a glance at the history of the 1891 patent, which contains the fundamental claim, the others issued claiming only invention of details.

On April 14, 1877, Berliner filed a caveat describing the variable-pressure constant-contact transmitter. On April 27 Edison made application for a patent on a transmitter in which an electrode presenting a considerable surface and coated with plumbago is in contact with the diagram, but did not make any claim for the principle of variable pressure and constant contact which was partly involved in its operation; patent No. 474,230, issued in 1892, is based on this application. On June 4, 1877, Berliner filed his application for a patent on the invention described in the caveat of April, which patent was finally granted in 1891 On July 20, Edison filed an application covering broadly the use of carbon as a material for the electrode contact in a transmitter operating by variable pressure and constant contact, which resulted in patent No. 474,231 of 1892. In March, 1878, interference proceedings relating to the Berliner patent were begun in the Patent Office and ended in 1882; from 1882 to 1888, the patent was withheld on account of Drawbaugh's claims and suits; in 1888 the Patent Office rejected the application of Berliner on the ground that his original application was bad, and because of intermediate patents, but in 1889 reversed this decision; the next two years were spent in public use proceedings in connection with Drawbaugh's claims, and awaiting the final decision of the Supreme Court in the Drawbaugh case, the patent being finally issued Nov. 17, 1891.

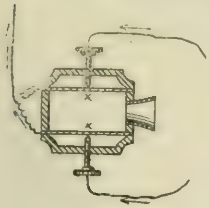


FIG. 1.

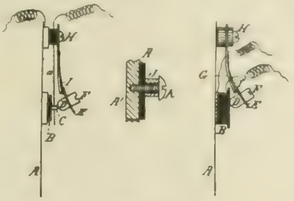


FIG. 4.

While the application of Berliner involving the fundamental principle of the microphone was thus tied up, the inventor applied for and obtained a number of patents on telephones, the first of which was issued Jan. 15, 1878 (No. 199,141, reissued as No. 9,499 Dec. 14, 1880), on an application dated Oct. 16, 1877, the preamble of the patent referring to the application of June 4, 1877, as containing the principle of transmitting speech by the microphonic principle. The patent is for a receiving instrument consisting of several metal or carbon electrodes in contact with a metal or carbon diaphragm, or of two diaphragms (Fig. 1), each having a single electrode in contact. Also, for a telephonic relay consisting of two cores of iron, one coil of each forming a common closed circuit, and the other coil of each being in the transmitting and receiving circuit, respectively, each circuit containing a primary battery. In the specifications it is claimed that by this means the transmitting current in the coil will, by means of the action of the common coil, affect the *current* in the receiving circuit so as to increase its action on the receiving instrument. Claim 1 is on several electrode pins and a single diaphragm, and Claim 2 for two plates with a single electrode for each; Claim 3 is for the induction apparatus with two separate battery circuits and a common closed secondary; Claim 4 is on a method of transforming telephonic currents by permitting them to act by induction on a continued galvanic current acting on the receiver; Claim 5 is on a receiver situated in the second galvanic circuit, in which undulations are produced by the inductive undulatory currents of another circuit. This patent was reissued Dec. 14, 1880, on an application filed Oct. 23, of the same year, a disclaimer being added for an induction coil that interrupts the current, and two additional claims added; one of these is for the combination of a transmitter, local battery, a short primary circuit of induction coil, and a secondary circuit proceeding toward the distant station; the other claim is for a grounded tertiary circuit of the coil.

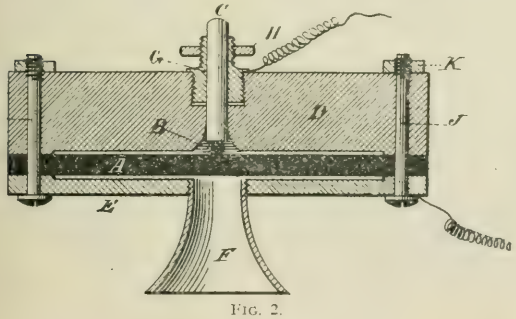


FIG. 2.

The second Berliner patent (No. 222,652) was granted Dec. 16, 1879, on an application filed Aug. 11, 1879, and relates to a carbon telephone and a method of preparing and hardening the carbon electrode. The claims referring to the instrument (Fig. 2) are four in number and relate to the electrode, which may rest by its weight on the diaphragm, or be clamped in position. The fifth claim is on the process of manufacture of the carbon electrode.

Patent No. 224,573, dated Feb. 17, 1880 (application filed Sep. 5, 1879), is on methods of dispensing with the clamping device for the carbon electrode referred to above, and maintaining the electrode constantly in contact with the diaphragm by the action of gravity, and in connecting the electrode to the battery by a device that will not interfere with its action. Fig. 3 reproduces the illustrations accompanying the specifications. The first claim is for a gravity electrode and connection to battery so as not to interfere with its action, and the four other claims on the details of the device shown.

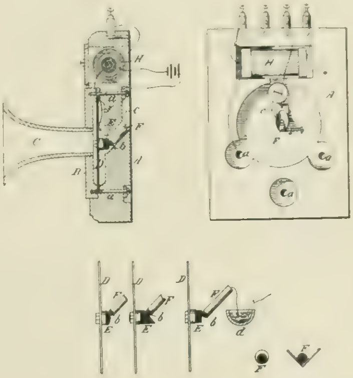


FIG. 3.

Patent No. 225,790, dated March 23, 1880 (application filed Nov. 12, 1879), is on methods of keeping the carbon electrode in contact with the diaphragm by means of a pendulous weight suspended by a band or ribbon of some flexible material, as shown in Fig. 4. The seven claims relate merely to details of the devices shown.

The next patent in order of date is the celebrated one of Nov. 2, 1880, which will be taken up for consideration later.

Patent No. 234,744, dated Nov. 23, 1880 (application filed March 31, 1880), covers various details relating to the device described in No. 225,790, consisting of an adjusting device whereby the angle of the pendulous weight may be varied, of a damper attached to the diaphragm and acting on the carbon electrode and a method of suspending the pendulous weight from a magnet which holds the weight by attraction. Four claims cover the above points and a fifth covers electroplating the magnet on its face of contact.

Patents Nos. 222,652, 224,575, 225,790 and 234,744 were combined in one patent granted in England, France and Belgium, while an endorsement on the last-named United States patent shows that it was also taken out in Italy on Feb. 15, 1880. The English patent was applied for Jan. 8, 1880, and sealed April 16, 1880, but the specifications, drawings and claims were not filed until July 7, 1880. The French patent was granted Jan. 8, 1880, and the

Belgium patent Jan. 9, 1880, and have therefore expired, thus voiding the four United States patents. The above British patent (No. 91) is the only one issued to Berliner in that country previous to 1882.

Patent No. 241,912, dated May 24, 1881 (application filed Dec. 22, 1879), is an improvement relating to that class of telephones in which one electrode is held in position by being attached to a spring, and consists in an improved manner of adjusting the tension of the spring by a second spring, and the five claims refer to various combinations of the two springs.

Patent No. 248,839, dated Nov. 1, 1881 (application filed July 30, 1881), contains two claims, one on electrodes in an air-tight box in which there is a vacuum, and the other on the particular arrangement of the carbon electrode.

The above are all of the patents granted to Berliner previous to 1882, and of these none is of any practical importance and only one—that of Nov. 2, 1880—has any bearing on the Berliner case. The latter is on a form of receiver that has never been used and the others relate merely to details that have had no practical application.

The importance of the patent of Nov. 2, 1880 (No. 233,969, and for which application was made Sept. 3, 1880), comes from the construction placed by the government counsel in the Berliner suit on the fourth and final claim, the other three claims being conceded as relating to the particular receiver shown in the patent. This claim reads as follows: "A system of two or more telephone instruments in electrical connection with each other, each consisting of two or more poles of an electrical circuit in contact one with another, either or both poles of each instrument being connected with a vibratory plate, so that any vibration which is made at one contact is reproduced at the other, substantially as set forth."

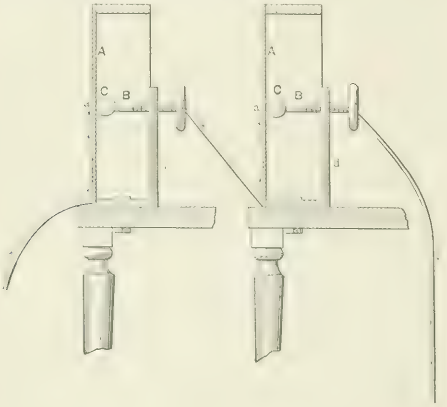


Fig. 5.

Fig. 5 is a reproduction of the drawing of the patent of Nov. 2, 1880, which is the same as one in the patent of 1891. The following are the claims of the latter patent upon which its great value depends:

"1. The method of producing in a circuit electrical undulations similar in form to sound waves by causing the sound waves to vary the pressure between electrodes in constant contact, so as to strengthen and weaken the contact, and thereby increase and diminish the resistance of the circuit, substantially as described.

"2. An electric speaking telephone transmitter operated by sound waves and consisting of a plate sensitive to said sound waves, electrodes in constant contact with each other, and forming part of a circuit which includes a battery or other source of electric energy, and adapted to increase and decrease the resistance of the electric circuit by the variation in pressure between them caused by the vibrational movement of said sensitive plate.

"3. The combination, with the diaphragm and vibratory electrode, of a rigidly held opposing electrode in constant contact with the vibratory electrode, substantially as described.

"6. A speaking telephone transmitter comprising a diaphragm or disc sensitive to sound waves, combined with a rigidly held but adjustable electrode in contact with the same, whereby the electric current is transformed into a series of undulations corresponding with the vibrations of said diaphragm."

The government in the recent suit held that the divisional patent of Nov. 2, 1880, describes the whole invention of the microphone exactly as it is described in the patent of 1891, and claims it as so described, but only when used in association as a receiver; that the patent of 1891 adds nothing to the description of the invention, and nothing to the claim of it except to broaden the scope of the claim by omitting the limitation of association with the microphone receiver; and that the case therefore falls under the principle that two patents cannot be granted for one and the same invention. It covers the described microphone receiver and the described microphone transmitter, each constructed just like the other, set up at opposite ends of the line, and provided with suitable speaking and hearing tubes, so that either may act as a receiver or a transmitter, according as the talking is done at one end of the line or the other. The Berliner Claim 4, of 1880, it was maintained, is not for the combination of microphone transmitter and microphone receiver, as there is no transmitter which is not a receiver, and no receiver which is not also a transmitter; therefore, there is no distinctive transmitter and no distinctive receiver, and the case does not come under the law of combination. "The patent describes, and Claim 4 covers, a duplex telephone having a microphone transmitter and a microphone receiver at each end of the line. Such a patent might exist as junior to a patent for the microphone transmitter; but a patent for a microphone transmitter cannot validly exist as junior to it." It was argued by the government counsel that in his first patent Berliner had claimed his microphone when it was also a microphone receiver, and that in the second patent he claimed his microphone transmitter whether it was also a microphone receiver or not.

Judge Carpenter held that the 1880 patent was for a system or combination of a transmitter and a receiver for a speaking telephone. "The whole apparatus is shown in the drawings of both patents and is identically the same in both. The transmitter and the receiver are identical in form and differ in function according as they are placed at the transmitting or at the receiving end of the telephone wire. It, therefore, appears that one of the functions of the device shown in the patent of 1880, namely, the function of transmitting articulate speech, is identical with the sole object or function of the device covered by the patent of 1891, and that the device for effecting the transmission is identical in both patents. The patent, therefore, seems to me to be void and beyond the power of the commissioner to issue."

The counsel for the Bell Company argued, on the other hand, that in January, 1877, Berliner "invented a new transmitter, and when this is put in place of Bell's transmitter the complete apparatus, still using Bell's receiver, will transmit speech. He was *then* entitled to a patent for that transmitter. His 1891 patent is patent for exactly what he then did and for nothing else. In April, 1877, he invented a new receiver. When this is put in place of Bell's receiver, either in the complete apparatus Bell made, or in the complete apparatus Berliner himself used in January, speech will be transmitted. He *now* became entitled to a patent for exactly the difference between what he had done in January and what he had done in April. His 1880 patent is for that and for nothing else. All that Berliner did or knew how to do in January may be done without infringing the 1880 patent, unless there be *also* used the receiver, which Berliner did not conceive of until April."

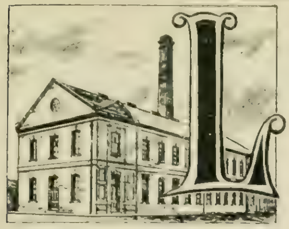
It was contended that the transmitter and receiver were totally distinct inventions; that neither invention lies in the structure, each consisting in the new mode of operation by which the respective functions of each is performed. "The functions of the two are different in kind; the results are different in kind; and the respective modes of operation are utterly different in kind and have nothing in common."

It may be added that had the 1891 patent remained void, the Bell Company could not have claimed any protection under the 1880 patent (which expires in 1897) except against the unauthorized use of the instrument there described as a receiver.

A Good Example for Brooklynites.

A Jersey City newsboy recently found himself in front of a rapidly moving trolley car without an opportunity to get off the track. Instead of waiting to be knocked down he jumped into the fender, and when the car stopped, hopped out unhurt and proceeded to sell his papers. Citizens of Brooklyn might practice the time-honored art of "jumping the rope" in their back yards on Sundays so as to profit by this youngster's example when the emergency arises.

A Modern English Central Station.



LEICESTER, England, is one of the latest of the English municipalities to establish an electric lighting plant, and the success of its plans is largely due to the sensible policy pursued in leaving the whole of the technical and engineering work in the hands of one capable engineer. Mr. Alfred Colson, the company's engineer, having had a large general engineering experience, was thoroughly posted as to the best practice in steam production, etc., and in order to be fully informed as to the latest methods and results in the electrical branch of the work, visited all the largest and most modern plants in Europe. As a result of the studies made, he determined to adopt a type of direct-connected alternating current unit somewhat similar to those which were seen at the Columbian Exposition in Chicago, namely, a horizontal engine with Corliss valve gear, having the rotating element of the alternator coupled to the shaft so as to act as a flywheel.

The points had in view when the plant was built were: (1) As nearly perfect safety as science could possibly provide; (2) the generating station to be so located as to avoid being a source of great annoyance to residents; (3) the system to be flexible and easy of extension without unreasonable or unprofitable expenditure; (4) the distributing system to be designed and installed in such wise as to avoid as far as possible all interference with the streets, both during original construction and in the event of making repairs; (5) all machinery, apparatus and appliances to be of known reliability, beyond the experimental stage, and of the character best suited for the work to be performed. The plan adopted, after due deliberation, was to generate high-tension alternating currents at a station a mile and a half from town and use underground transformer substations to supply a network of distributing mains at low voltage.

The boiler house is behind the main building, containing the dynamo room and offices, and contains four Babcock & Wilcox boilers, divided into two sets. Each boiler is of 125 hp. Coke is used for fuel, and is obtained from the gas works near by. There is also the regulation equipment of pumps and feed-water heaters.

The dynamo room, a partial view of which is shown in Fig. 1, (which, with the other illustrations, is reproduced from English contemporaries, to whom we are also indebted for the data herein contained), is 40 feet wide, 114 feet long and 31 feet high. It is lighted with a double tier of windows on one end and both sides, except where the boiler rooms abut it. Contrary to the latest American practice the roof has pine rafters and purlins, filled in with diagonal tongue-and-groove panels. The floor is formed of cement concrete poured in between steel joists and paved with tessellated tiling.

A 15-ton electric crane travels the full length of the dynamo room. Three Brush motors, of 4 hp each, series-wound, are used on the crane, and transmit motion to the drums, etc., by means of worm gears. The worm shafts have roller thrust bearings, and the gears run in oil. The motors are direct-current machines and are supplied from the exciter dynamos.

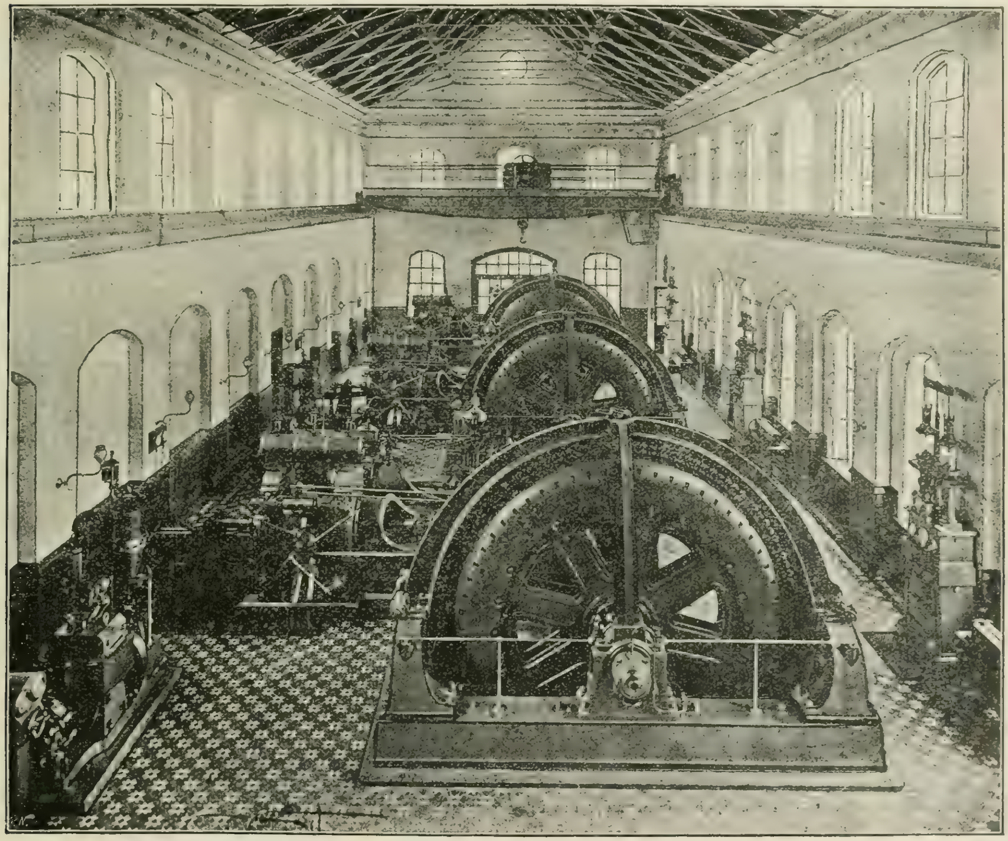


FIG. 1.—VIEW OF DYNAMO AND ENGINE ROOM.

The generating plant comprises three horizontal cross-compound condensing engines of 300 hp each, driving Mordey-Victoria alternators of 200 kw capacity, each unit being direct-connected. Corliss valve gear is used, and the governor controls the valve gear of both cylinders. Each engine has an individual jet condenser and drives its air pump from a rocker arm attached to the back end of the low-pressure piston rod. In addition to these three large units there is a 75-kw alternator direct-driven by a 112-hp engine, which latter is in every respect similar to the large ones, except that the governor handles only the valve gear of the high-pressure cylinder.

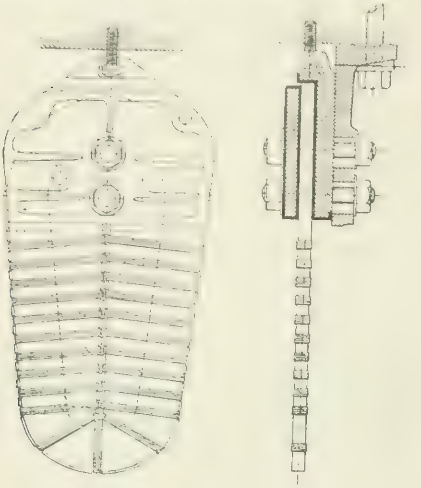


Fig. 2.—Detail of Armature Coil.

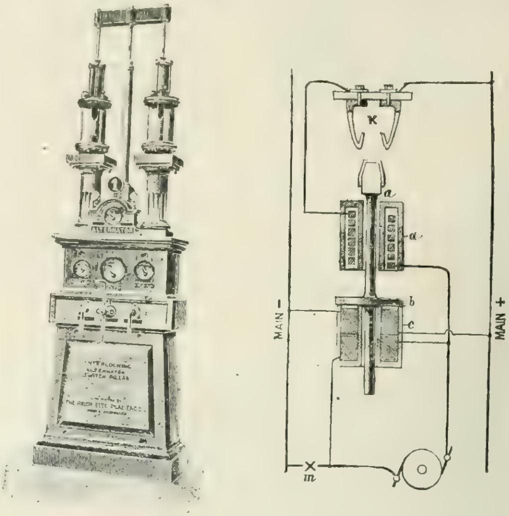


Fig. 3.—Switch Pillar.

All the cylinders are built up of four castings, an outer shell, a lining shell, and two valve chambers at the ends. Cylinder jackets are provided through which the live steam passes on its way to the valve chambers, and the receiver between the high and low pressure cylinders is similarly jacketed, the steam in its jacket having the full boiler pressure. The valve gear gives unusually rapid opening and a great range of cut-off — from nothing to three-quarter stroke.

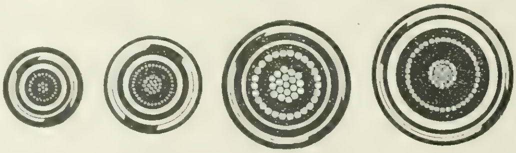


Fig. 4.—Cross Section of Cables.

The alternators, as previously stated, are of the Mordey type, direct-driven, the field magnets being connected up by means of Raworth flexible couplings. The magnets are massive steel castings, with 60 polar projections on each side of the armature, and are most accurately balanced. There is only a single field coil, as usual in this form of machine. The energy required for excitation is stated as being 2.16 per cent of the output of the machine, which is low for such a slow speed generator.

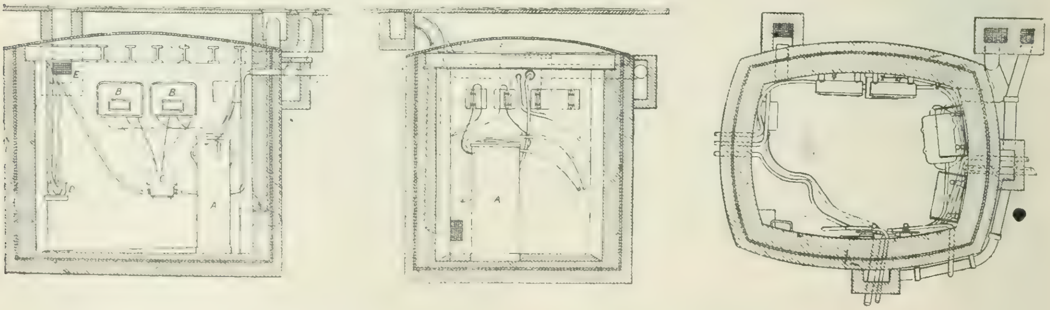


Fig. 5.—Cross-Sectional Views of Transformer Vaults.

The armature is of the familiar Mordey type, generally speaking, but there are some interesting details worthy of special attention. In the 200-kw machine there are 120 armature coils mounted on a non-magnetic metal ring, which is bolted to a cast-iron frame made in four sections. Two of the iron quadrants are above the floor, and are hinged at their lower extremities so that either or both can be thrown back for the inspection, *in situ*, of the armature or the removal and replacement of coils. Fig. 2 shows one of the armature coils. A radial adjustment is provided by which the coils may be tightened until they touch one another, but it is found that mutual support is not necessary with these new coils. The supports of the coil are of German silver, ebonized over all the necessary surfaces for purposes of insulation. The coil and its clamps are self-contained, and may be removed from the armature ring simply by slackening the two nuts at the back of the ring. The core is of slate, and has a series of holes down the centre line. After the copper conductor has been wound on and a sheet of anti-sparking material placed over it, pressure is applied, and then the whole is bound tightly together by whipcord threaded through these holes in the core. In this way the slack usually taken up after running is removed before the coils leave the shops. The alternators at Leicester were not erected or tested at the factory and since erecting in the station the armature coils have not given the slightest trouble, neither have they needed any subsequent adjustment.

The exciters are 12-kw dynamos, compound-wound and direct-driven. There are two machines, but one is capable of exciting the fields of all the alternators. The engines for these exciters are tandem compounds, fitted with Raworth's system of electric governors. By means of a resistance in the governor circuit the voltage of the whole station may be varied at will. There is no switchboard, a number of "switch pillars" serving in the place of one. The exciters feed into a pair of bus bars to which the alternator fields are all connected in parallel. Near each exciter is a cast iron switch pillar, which automatically closes the circuit when the E. M. F. of the exciter rises to that of the bus bars, and opens the circuit when the exciter E. M. F. drops below that of the bars. One of these pillars is shown in Fig. 3. Each alternator has a switch pillar containing a system of interlocked switches, which prevent the closing of the main circuit before the field circuit and synchronizing circuit are closed, and also the opening of the field circuit while the main circuit is closed. A synchronizer is provided for each of these pillars, and is in mechanical connection with the main switch. Conductors are taken from the four "alternator pillars" to a "dividing table," and from thence through separate switches to two "circuit pillars" containing double-pole switches, fuses and ammeters for each of the two concentric feeders which carry current to the transformer sub-stations. The switch pillars are kept locked to prevent tampering.

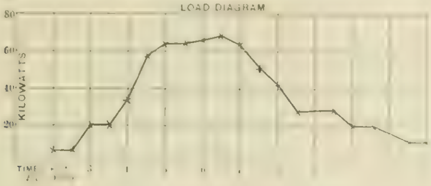


FIG. 6.—A JANUARY LOAD CURVE.

The control of the E. M. F. of the whole station, as above stated, is effected by means of electrically controlling the governors of the exciter engines. Each exciter engine has a solenoid arranged to act upon the adjusting lever of the governor; the speed of the engine can, therefore, be varied by varying the current in the solenoid. The two solenoids are in parallel on a circuit which includes a rheostat. It is part of the system that the controlling solenoids shall be always in circuit, so that no exciter can be started without being at the same time under the control of the switch room. The action of the regulating circuit is to increase the speed of the exciter engines, so that in the event that the regulating circuit breaks down, the only effect would be that the E. M. F. would fall and would have to be raised by hand adjustment of the governors. The exciter circuits are not provided with any fuses whatever.

The underground cables, cross-sectional views of some of which are given in Fig. 4, are all of the Fowler-Waring concentric make, being lead-sheathed and armored with steel tape, excepting in the case of the high-pressure mains in the limited area where, as the cables have been laid in 3-inch iron pipes, no armoring is used. The outers of the system are grounded at the station through a switch at each of the "circuit pillars," so that each feeder may be disconnected from earth for testing. The two feeders running to No. 1 sub-station in Market Street are each about 1.5 miles in length, and are 0.146 square inch in section. From No. 1 station the high-pressure mains are run round the limited area in a ring main 0.097 square inch in section, the cable, which is braided over the lead sheathing, being run in 3-inch cast-iron pipes.

The transformer sub-stations are eight in number, and consist of vaults located under the sidewalks; each vault contains two or more transformers. Fig. 5 gives cross-sectional views of one of these vaults, which are all of the same size, namely, 5 feet 6 inches wide, 7 feet 6 inches long and 7 feet high. The sides and ends are curved outwardly about 6 inches. The walls of the vaults are formed of good hard bricks in cement in two thicknesses, with an inch space between. This space is filled in with specially prepared asphalt, which is also continued under the paving of the floor as well as over the roof, thus making the chamber perfectly water and gas tight. The roof is formed of rolled steel joists filled in between with cement concrete. A suitable manhole with double cover is provided for access to the chambers, which are descended by means of step irons built into the inner thickness of wall. All the chambers have an air inlet and outlet for securing proper ventilation. The bell mouths of the pipes carrying the high tension main are caulked with Vulcan cement, with the object of preventing any gas finding its way into the chambers. As an additional precaution against accidents, the pipes are provided with a ½-inch hole about a foot from the back of the wall of the vault, which communicates with a ventilating flue. This arrangement allows any gas which finds its way into the pipes escaping before reaching the vault. A similar arrangement with the same object is provided in connection with the low-tension cables.

The transformers are of the well-known Mordey-Victoria type, and each one is provided with a double-pole trigger switch enclosed in a cast iron box. The secondary terminals are connected to the distributing network through double-pole switches and fuses. The transformer cases, switch boxes and frames are all grounded to insure safety in handling.

The curve shown in Fig. 6 was taken on Jan. 8 last, and, judging from the population and the excellent service rendered it will probably not be long before the consumption reaches the maximum capacity of the station.

On a Possible Law of Residual Magnetism in Iron and Steel.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

So far as the authors are aware, no relation has been published between the magnetic intensity attained in a bar of iron or steel and the residual intensity upon the removal of the magnetizing force. We have discovered from a comparison of these values in those measurements made by Prof. Ewing which we have been able to examine, that a relation of a linear character seems to exist between these quantities, that is to say, any increase or decrease in the magnetic intensity produced in iron or steel appears to be followed by a corresponding increase or decrease of residual intensity in a fixed ratio; or, symbolically, if $\mathcal{B}$, be the intensity produced in gausses, and $\mathcal{B}_o$, the residual intensity or remanent magnetism, also expressed in gausses, after the magnetizing force is withdrawn, then,

$$\mathcal{B}_r = a(\mathcal{B} - c) \text{ gausses.}$$

This relation appeared from some measurements made by one of the authors, but we prefer, at the present time, to rest the evidence we have obtained entirely upon observations made by Ewing.

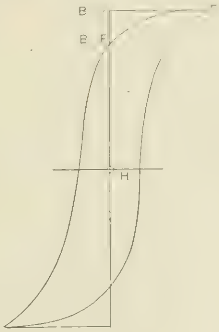


FIG. 1.

As is well known, a given magnetizing intensity $\mathcal{H}$, produces a certain intensity of magnetic flux $\mathcal{B}$, in a given specimen of iron or steel, and when the magnetizing force is removed, the magnetic intensity in the specimen falls to a residual value which we may call $\mathcal{B}_r$. Or, as shown in Fig. 1, in a cycle of magnetic intensity $\mathcal{B}_r$, rises under the application of $\mathcal{H}$ to the value indicated at the point *E*, on the vertical scale. On the removal of $\mathcal{H}$, or its reduction to zero, the intensity now falls along the line *E F* to the value at *F*, or $\mathcal{B}_r$, which is its residual value under these conditions. $\mathcal{B}_r$ appears to be linearly related to $\mathcal{B}$, that is to say, if we take a number of cycles for the same specimen of iron or steel and plot the values of $\mathcal{B}_r$, as ordinates, to values of $\mathcal{B}$ as abscissas, the values of $\mathcal{B}_r$, fall upon what appears to be a straight line within limits of possible errors of observation.

Fig. 2 gives the result of plotting five series of observations given by Ewing. Curve No. 1 is taken from a diagram of cycles for a sample of soft iron published in the London *Electrician* for Jan. 11, 1895, Vol. XXXIV., No. 869, p. 298.

The maximum cyclic values are given numerically as well as graphically, while the residual values have had to be measured as closely as possible from the curves in the figure on page 298. The corresponding values are:

$\mathcal{B}$	$\mathcal{B}_r$
1,200	700
1,930	1,300
2,630	1,960
4,270	3,350
5 200	4,220
6,610	5,500
7,480	6.200

When $\mathfrak{B}_0$ is plotted in terms of $\mathfrak{B}$, in Fig. 2, we obtain curve No. 1.

It will be observed that all the seven values fall very closely upon a straight line expressed by

$$\mathfrak{B}_0 = 0.88 (\mathfrak{B} - 400) \text{ gausses.}$$

In other words, if we substract 400 gausses from the maximum cyclic intensity, the residual intensity will be 88 per cent. of the difference.

On page 106 of "Ewing's Magnetic Induction in Iron and Other Metals" (1892), is a Fig. No. 50, in which the graded cyclic magnetizations in an annealed soft iron wire are given.

The following numerical values have been obtained from this figure:

$\mathfrak{B}$	$\mathfrak{B}_0$
12,070	9,800
11,[illegible]	9,550
10,620	8,922
9,048	7,477
7,288	5,906
6,032	4,901
3,[illegible]	3 016
2,262	1,257

Plotting these values we obtain curve No. 2, which gives a line practically parallel to curve No. 1, except that the two highest and lowest observations are somewhat in defect, as shown. The linear relation here being

$$\mathfrak{B}_0 = 0.88 (\mathfrak{B} - 500) \text{ gausses.}$$

The soft iron wire whose measurements are here recorded agrees very closely in its residual magnetism with those of the soft iron ring published by Ewing this year and above referred to.

On page 109 of Ewing's work already referred to, and in Fig. 52 appears a similar series of curves for a sample of annealed piano forte wire. From these curves the following numerical values have been obtained:

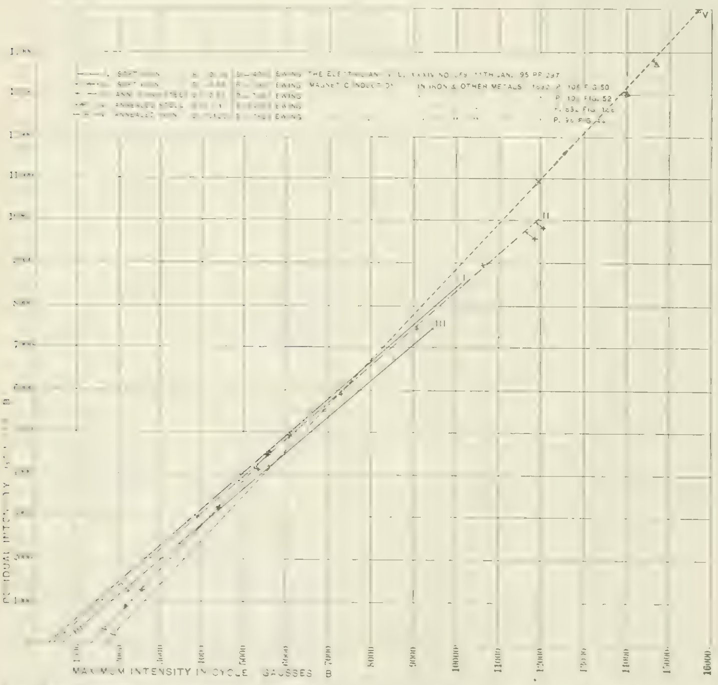


FIG. 2.—DIAGRAM INDICATING LINEAR RELATION BETWEEN RESIDUAL AND MAXIMUM CYCLIC MAGNETIC INTENSITIES IN IRON AND STEEL.

$\mathfrak{B}$	$\mathfrak{B}_0$
[illegible],426	7,540
7,540	5,780
5,655	4,273
[illegible]	2,388
1,508	691

These five observations fall fairly closely upon the line No. 3, represented by

$$\mathfrak{B}_0 = 0.85 (\mathfrak{B} - 700) \text{ gausses.}$$

On page 332 appears the diagram of some cycles in annealed steel. It is interesting to observe that these cycles are distinctly dissymmetrical with reference to the origin, as is, in fact, pointed out in the text. The numerical values obtained from this diagram are:

$\mathfrak{B}$	$\mathfrak{B}_0$
5,350	4,120
5,500	4,400
4,400	3,200
2,600	1,250
2,200	850

On plotting these values we obtain the line No. 4, on which all the five stars lie,

$$\mathfrak{B}_0 = 1.1 (\quad - 1450) \text{ gausses.}$$

This agreement with the linear relation is the more noteworthy owing to the dissymmetry in the cycles already referred to.

On page 96 appears Fig. 44, in which a number of observations made on an annealed iron wire are graphically recorded. In this case the wire was not subject to alternating magnetic force, but was advanced steadily through a unidirectional range of intensity. From the figure we obtain the following numerical values:

$\mathfrak{B}$	$\mathfrak{B}_0$
15,700	15,000
14,700	13,700
14,000	13,000
11,900	10,900
6,900	5,550

These values give the last line, No. 5, of triangles. All five fall very nearly upon the straight line.

$$\mathfrak{B}_0 = 1.125 (\mathfrak{B} - 1750) \text{ gausses.}$$

Laboratory of Houston and Kennelly, Philadelphia.

The Practical Aspect of Experimental Investigations.

In considering experimental work relating to the reduction of metals a certain sobriety of thought and statement is indispensable, says a writer in the London *Electrician*. There is but little lately accomplished in the production of any of the refractory metals which has not been performed years ago by the chemist engaged in purely scientific research. The only justification for satisfaction concerning larger scale experiments, and their easy and brilliant execution, is the consequent device of industrial methods and the discovery of some means of utilizing the products. Much nonsense is talked about possible new structural metals, the orators forgetting that the abundance of an element on the earth's surface is a weighty factor in its utilization. Glucinum is no doubt a nice material for many purposes, and its reduction is not beyond our means; but unhappily there is, so to speak, none of it. Even given abundance and fair ease of production, a "new" metal must be shown to be in some respect better than the older group before it can be more than a curiosity. Much more is to be hoped from persistent and enlightened experiment on the influence of small quantities of the more refractory metals on those longer and better known in the metallic state, with the view of obtaining alloys superior to those in common use.

Electric Lighting and Friendships.

Politics and sectarianism, says the London *Electrician*, especially of the village order, have done not a little in their time to embroil peace-loving folk. But if a Fareham rate-payer is to be believed, electric lighting promises to become an equally potent cause of disturbance. Speaking at a recent meeting of rate-payers, held to discuss what steps should be taken to bring the pending litigation between the Fareham District Council and the Fareham Electric Light Company to an amicable termination, Mr. Dodds is reported to have said that "the electric light question had torn asunder friendships that had lasted for years, and men now passed each other in the street like dogs." What an excellent advertisement this sad state of things would make for, say, incandescent gas: Warranted to give n candles for $n-x$ cubic feet of gas and to destroy no friendships.

Rope Driving.—XVIII.

BY J. J. FLATHER.

It is evident that in order to prevent slip and the loss of power incident thereto, it will be necessary to obtain a uniform velocity in the several ropes running over a pair of pulleys; to approach this desideratum each set of ropes should be of the same make and degree of hardness, of uniform diameter, evenly spliced, having the same amount of sag in both members, and run over grooves of uniform diameter, shape and smoothness.

Obviously it would be impossible in practice to maintain all these conditions, even if it were practicable to overcome the mechanical difficulties and install a plant under the given requirements; yet much may be done to affect the desired end.

Uniformity of length is an important requirement, as, if one rope of a set be allowed a less amount of sag than the others, the sum of the tensions will be greater in this rope, and in consequence it will be drawn more deeply into the groove; its pitch diameter will therefore be reduced, and its velocity will be different from the others in the set; in which case if the driving and driven pulley are of unequal diameters the tendency will be to give the driven pulley a different velocity, and slip must necessarily occur.

The following from the *American Machinist* is pertinent to the subject:

"It will be readily seen that in a set of ten or a dozen ropes, each of a somewhat different length, the loss of power from this cause may easily become a very serious item, and to this there is to be added the correspondingly diminished life of the ropes. A similar action occurs when worn ropes are allowed to work conjointly with new, even though the sags, and, therefore, the tensions, on the several ropes are practically equal. In this case the loss due to abnormal tension and wedging of some of the ropes into the grooves is avoided, but the differential driving effect due to the ropes virtually running on pulleys of different diameters still exists, and is equally objectionable. It may here be noted that the effect of the differential driving upon the ropes depends to a very large extent upon the relative diameter of the two pulleys."

It is evident that, when the driving and driven pulleys are of the same diameter, any variation in the effective pitch diameters of the several grooves will have no appreciable effect upon the transmission, provided that the diameter and shape of the corresponding grooves in the two pulleys are the same. It may be noted, however, that the worn ropes which run deeper in the groove, having a slightly diminished velocity, are subjected to a somewhat greater stress than their newer and larger companions.

With a form of groove similar to that shown in Fig. 45, in which the sides of the grooves are circular arcs of large radius, there will be a tendency to correct the differential driving, especially so when the driving pulley is smaller than the driven. In this case if we assume that all the ropes in a set are put on with the same amount of sag so that the tensions are practically equal for both old and new ropes, any difference in diameter of rope will cause the larger to carry more than its share of the load, since the effective radius of the pulley and therefore the velocity of the rope is greater; moreover since the coefficient of friction varies inversely with the depth of contact in this form of groove, the larger rope is acted upon by a more intense grip, by reason of which more work is imposed upon it, while a smaller rope will be relieved of some of its work. The tendency of the larger rope is to turn the driven pulley at an increased velocity.

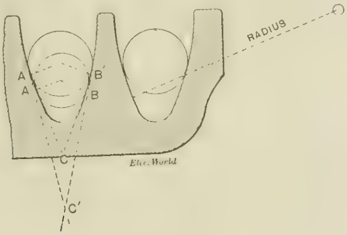


FIG. 45.

Thus, in Fig. 46 if D be the driving pulley and F the follower, with respective diameters such that the velocity ratio $\frac{R}{r}$ is one to three, then the smaller ropes, o, will tend to drive F in the ratio $\frac{1}{3}$ while the larger ropes n working at a distance x farther away from the centre of pulleys, will tend to drive F in the ratio $\frac{1+x}{3+x}$ and therefore at a higher velocity. The resulting velocity of the follower will depend upon the work done by each rope so that some slip must necessarily occur; on account of the greater load taken by the larger ropes they will be rapidly compressed and worn, so that any initial variation in turning effort will be speedily reduced to a minimum by this equalizing process, which, although it incurs loss, ultimately insures a better distribution of the work with the least wear on the ropes.

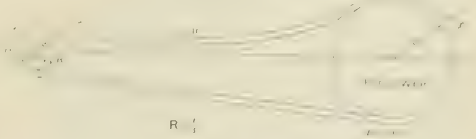


FIG. 46.

On the other hand, when the driving pulley has a greater diameter than the follower, the larger ropes are drawn less deeply into the grooves and tend to impart a lesser velocity to the driven sheave. Thus, in Fig. 47 the large pulley is the driver and the velocity ratio is $\frac{R}{r} = \frac{3}{1}$ with the smaller ropes, o; with the larger ropes, n, working at a distance x nearer the circumference the tendency will be to produce a ratio equal to $\frac{3+x}{1+x}$ hence the effect will be retardation. Since the larger ropes acting higher in the groove have an increased grip and speed they will exert a greater influence upon the smaller pulley, and although the smaller ropes may be drawn more deeply into their grooves in attempting to drive the follower at a greater number of revolutions per minute their effect is lessened on account of the diminished grip, due to the form of groove, in consequence of which the larger rope acts with a greater effect and the smaller with a lesser effect than would obtain with an ordinary V-groove under like conditions.

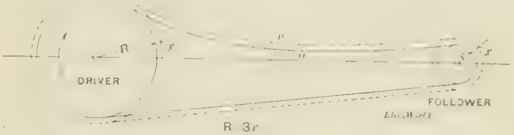


FIG. 47.

To equalize the driving efforts of a number of ropes and to prevent the slip which must inevitably occur with a solid grooved rim, Mr. John Walker has devised and patented* a "differential" driving pulley, since it allows the ropes to travel at different speeds suited to the conditions imposed upon each rope.

Originally intended for cable railway machinery where the wear on the drums due to the wire cable is excessive, the differential principle has been extended to other uses—notably elevator sheaves and rope transmission pulleys.

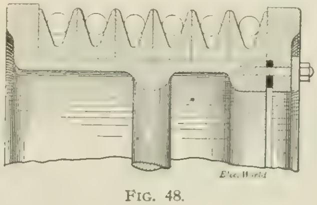


FIG. 48.

In the latter the rope is led over a number of separate rings, Fig. 48, adapted to turn loosely and independently of each other on the smooth circumference of the drum.

While the rope is passing over the pulley the tendency of the rings will be to adjust themselves to the strain in each member by moving around the circumference of the drum; thus the driving tension is equalized and each rope is brought to do its own share of the work without slipping in its groove. These rings have a diametrical friction, due to the pressure of the rope in the groove transferred to the flat surface of the drum; in addition to this, an adjustable rubber washer is inserted between the rim of pulley and loose flange, so that by tightening this adjustable joint the separate rings are caused to exert enough pressure upon each other to produce a certain amount of friction on the side surfaces, the combined friction of the several rings being sufficient to drive the pulley or ropes as the case may be.

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*Feb. 23, 1892.

In this way each rope bears its due share of the work, as the adjustment is such that the friction between pulley and rings, rings and rope, are brought into equilibrium.

In practice, the axial rotation of the ropes will frequently exert a modifying influence on the differential driving, since other conditions being unchanged, a rotating rope tends to maintain its circular form and therefore will work less deeply into its groove than one which does not possess this property. An additional advantage is that such rotation promotes the durability of the rope as the wear is more uniform.

The loss due to the elastic slip, or creep, of the belt has some influence upon the efficiency of transmission, but in any case its effect is small. When an elastic body, such as a rope, is placed under tension it stretches, and the elongation, within the limit of elasticity, is proportional to the strain in the rope. When power is transmitted from one pulley to another by a rope the driving side is subjected to a greater tension than the slack side, in consequence of which the velocity in the driving side will be slightly greater than that in the slack side, and the circumferential velocities of the two pulleys will not be the same. This will be evident from the following considerations:

Let V = circumferential velocity of driver;
" V' = " " " " follower;
" T_1 = tension in driving side of rope;
" T_2 = " " slack " " " ;
" A = cross-section of rope in square inches;
" L = original length of a piece of the rope in either side in its normal condition;
" e = elongation in driving side due to tension T_1;
" e' = " " slack " " " " T_2;
" E = modulus of elasticity of the rope.

When the rope is at work $e = \frac{T_1}{EA}$ and $e' = \frac{T_2}{EA}$ so that the length of each member will now be $L + e$ and $L + e'$ respectively; the length of rope running on to the driving pulley in a unit of time will therefore be greater than that delivered to the driven pulley in the proportion $\frac{L+e}{L+e'}$, and the velocity of the two pulleys will now be $\frac{V}{V'} = \frac{L+e}{L+e'}$; hence, $V' = V \times \frac{L+e'}{L+e}$.

Calling L unity and assuming $\frac{T_1}{T_2} = 2$, $\frac{T_1}{A} = 320$ pounds, since $T_1 = 200\,d^2$ pounds, and $A = 0.8 \times \frac{\pi}{4} d^2$, and $E = 40{,}000$*, we have $e = \frac{320}{40{,}000}$ and $e' = \frac{320}{2 \times 40{,}000}$, therefore,

$$V' = V \times \frac{1 + \frac{320}{80{,}000}}{1 + \frac{320}{40{,}000}} = 0.996\,V,$$

that is, the loss due to creep when all the ropes are working under normal conditions is about one-half of one per cent. With different ratios of driving to tight side tension and different intensities of stress it is evident that this loss will vary in the different ropes; in any case the loss ought not to exceed one and one-half per cent. as will be seen if we assume extreme conditions.

For instance, let the stress on the rope be 600 pounds per square inch of section and assume the ratio of tensions equals one-fifth; with the most elastic long staple cotton rope it is possible that the modulus of elasticity may be reduced to 30,000 pounds; therefore, under these conditions the velocity of the circumference of the driven pulley will be

$$V' = V \times \frac{1 + \frac{600}{5 \times 3{,}000}}{1 + \frac{600}{30{,}000}} = 0.984\,V,$$

thus representing a loss of 1.6 per cent. It is probable that one per cent. is an ample allowance even under unfavorable conditions.

The construction of rope pulleys is a matter of considerable importance, for it is evident from what has preceded that the size, shape, and condition of the pulley all exert a marked influence upon the efficiency of rope transmission. It has been shown that the size of the pulley materially affects the wear of the rope; the larger the sheaves, the less the fibres of the rope are flexed, and the less they slide on each other: consequently there is less internal wear of the rope.

The minimum diameter of the pulley as given by different authorities varies from 30 to 40 times the diameter of rope to be used. Forty times the diameter of rope for manilla is excellent practice, and experience has shown that a larger multiplier would be still better, as the larger a pulley, the better for either belt or rope passing over it; but such a rule, although convenient to use, was evidently founded upon large-sized ropes running at a high velocity, and a little consideration will show that while 40 times the diameter of rope may be all right for a two-inch rope it is also true that a lesser proportion will give suitable diameters of pulley for a one-inch rope. If we take two ropes d_1 and d_2 whose diameters are one and two inches, respectively, and bend them over pulleys of the same diameter, the fibres in d_1 will be stressed an amount equal to x, due to the stretch and sliding of the fibres one upon another; on the other hand, since the outer fibres in d_2 are twice as far from the neutral axis these fibres will stretch and slide upon each other to an extent equal to twice that produced in the smaller rope; but the relation of the areas of the two ropes is $\frac{\frac{\pi}{4} d_2^2}{\frac{\pi}{4} d_1^2} = \frac{d_2^2}{d_1^2} = 4$ in this case, hence the total slip in the larger rope due to the sliding of the fibres upon each other will be eight times greater than in the smaller one or as $\frac{d_2^3}{d_1^3}$; therefore, for equal extension and slip of the fibres in bending a rope over a stationary pulley, it would appear that the pulleys should have diameters proportional to the cube of the diameters of the ropes.

In the above consideration no account has been taken of the external wear, produced by slipping in the groove, wedging, rubbing contact and other causes of loss which affect a running rope; for a given velocity these losses will increase with an increased speed of rotation and hence will be greater with a smaller pulley, which would indicate that the diameter of the latter should not be directly proportional to the cube of the diameter of the rope, it is also evident that a rope running at 5,000 feet per minute will be subjected to a greater number of bends and a greater external wear than it would if running over the same pulleys at 2,000 feet per minute.

The first of these influences is recognized by many engineers who use a rule approximating the following:

For the least diameter of pulley, D, multiply the circumference of rope by ten times its diameter and divide by 2.† This is practically equal to $D = 15\,d^2$ inches.

While we believe in using as large a pulley as possible in any given case, conditions will arise when it is desirable to use the smallest possible diameter without excessive injury to the rope. In such case the individual circumstances should be considered by the designer.

(To be continued.)

Electrification of Air.

Lord Kelvin in a recent paper states that he found the difference of potential between the earth and an insulated burning match at a height of nine feet, to vary from 200 to 400 volts, rising in some cases to 3,000 or 4,000 volts, the potential being always positive, that of the earth being considered zero. To inventors who will immediately propose to utilize this as a cheap service of electrical energy, we suggest that it would be well to first find out how many (or better, how few) coulombs there are in back of these volts.

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* See Reports of Tests on Manilla Rope. Ex. Doc. No. 36, 1885.

†Mr. James Gamble, in *Textile Recorder*.

Electrodynamic Machinery.—XXXVII.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

244. When two or more generators are connected in parallel, it becomes necessary that the electromotive forces they supply shall be equal, within certain limits. If, for example, two generators are connected in parallel, each working at half load, then if the drop of pressure in each generator armature at full load is two per cent. of its total E. M. F., it is evident that it is only necessary to increase the pressure of one generator two per cent. above that of the other, in order that the pressure at brushes of the first shall be equal to the E. M. F. generated in the armature of the second. Under these circumstances no current will flow through the armature of the second machine, and all the load will be thrown on the first machine. If the E. M. F. of the first machine be still further raised, the pressure at its brushes will be greater than the E. M. F in the armature of the second, and a current will pass through the second armature in a direction opposite to that which it tends to produce, and, therefore, in a direction tending to rotate the second generator as a motor. In other words, the control of pressure between the two machines must be within closer limits than two per cent. Early in the history of central station practice difficulties were experienced in controlling the pressure of multiple-connected dynamos within limits necessary to avoid this unequalizing action, but at the present time the governing of the engines and the control of the field magnets are so reliable that this difficulty has practically disappeared. It is important to remember, however, that the larger the generator unit employed, and the smaller the drop in pressure taking place at full load through its armature, the narrower is the limit of speed or regulation, in which independent units will equalize their load, although as a counteracting tendency, the larger will be the amount of power which, in case of disequalizing, will be thrown upon the leading machine tending to check its acceleration.

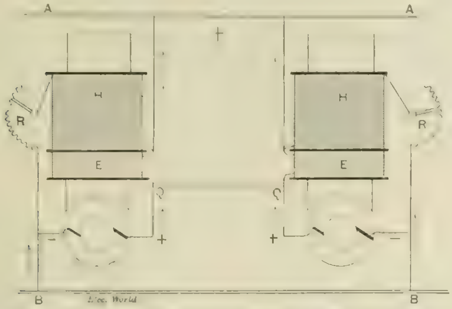


FIG. 169.—PARALLEL CONNECTION OF COMPOUND-WOUND GENERATORS.

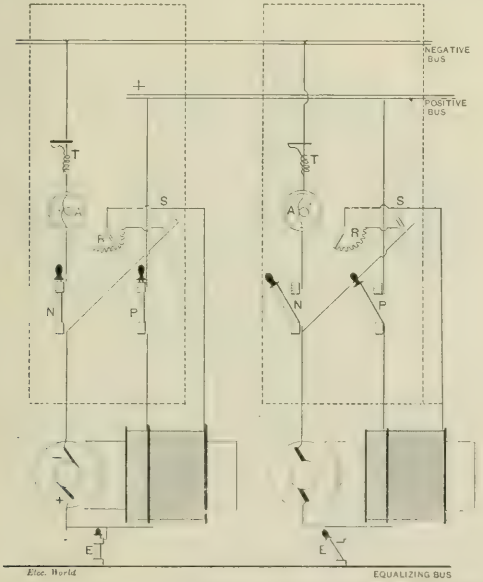


FIG. 170 —DIAGRAM OF SWITCHBOARD CONNECTIONS FOR TWO COMPOUND-WOUND GENERATORS.

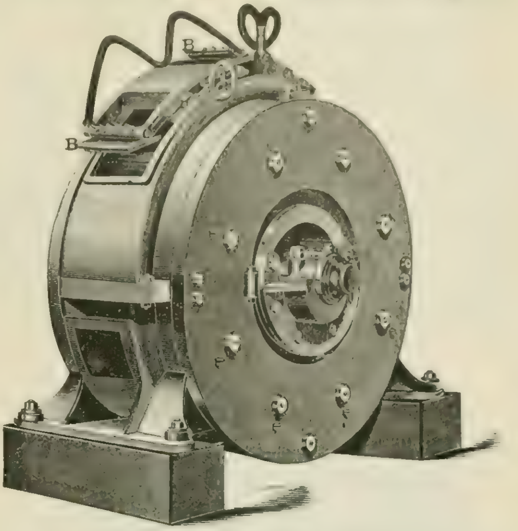


FIG. 171.—DISC-ARMATURE GENERATOR.

245. Compound-wound generators are almost invariably employed for supplying electric currents to street railway systems. This is principally for the reason that the load in a street railway system is necessarily liable to sudden and marked fluctuations, and these fluctuations would be liable to produce marked variations in the pressure at the generator terminals, if the machines were merely shunt wound. Such generators are operated in parallel units. Here, as in the case of shunt-wound machines, it is necessary that the E. M. F. generated by each machine should be nearly the same, in order that the load should be equally distributed; but instability of control is greater in the case of compound-wound machines than

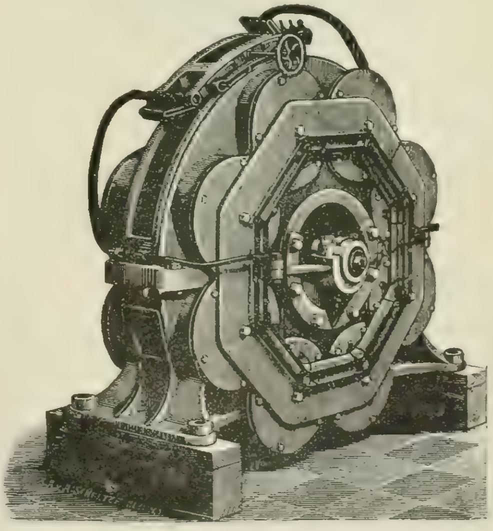


FIG. 174.

in the case of shunt machines, for the reason that when one of a number of parallel-connected shunt-wound machines accelerates, and thereby rises in E. M. F., so as to assume an undue share of the load, the drop in the armature thereby increases and tends to diminish the irregularity, so that not only does the greater load tend to retard the engine connected to the leading machine, but the drop in its armature aids in equalizing the distribution.

In the case of compound-wound machines in parallel, any acceleration tends, as before, to increase the E. M. F. of the generator and, therefore, its share of the load, but the series coil of the compound winding being excited by the additional load, tends to increase the output of the machine, and, therefore, the governing of the engine has to be entirely depended on to prevent disequalization. Of recent years, however, the plan has been widely adopted of employing an *equalizing bar* between compound-wound generating units operated in parallel. The connections of an equalizing bar are shown in Fig. 169. Here the two compound-wound generators are connected to the positive and negative *omnibus bars*, or *bus bars*, as they are generally termed, *AA* and *BB*, while the series coils are connected together in parallel by the equalizing bar *QQ*. It is evident that the equalizing bar connects all series coils of the different dynamos in parallel, so that any excess of current supplied by the armature of one machine must necessarily excite all the generators to the same extent.

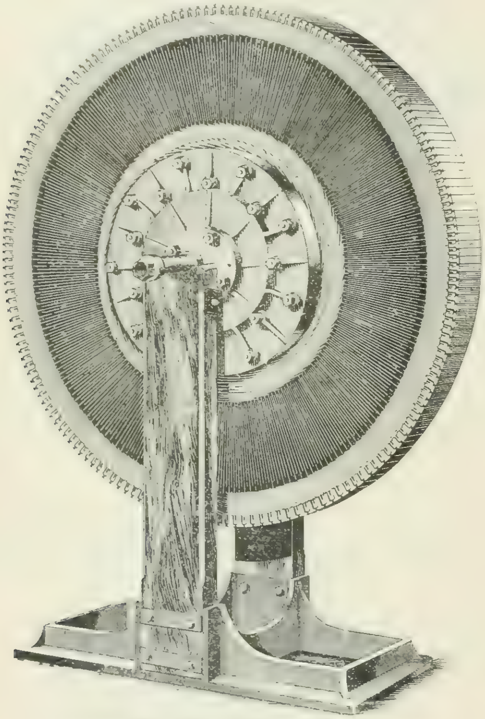


FIG. 172.—DISC ARMATURE

246. When a number of compound-wound generators are running in parallel, and the load increases so that it is desired to add another unit to the generating battery of dynamos, the engine connected with the new unit is brought up to speed, and the shunt field excited. This brings the E. M. F. of the machine up to nearly 500 volts. Its series winding is then connected in parallel with the series winding of the neighborihg machines, by the switch on the equalizing bar, so that its excitation is then equal to that of all the other machines. The E. M. F. of the machine is then brought up slightly in excess of the station pressure by the aid of the field rheostat, and, as soon as this is accomplished, the main armature switch is closed, thus connecting the armature with the bus bars. The load of the machine is finally adjusted by increasing the shunt excitation, with the aid of the rheostat, until the ammeter connected with the machine shows that its load is approximately equal to that of the neighboring generators. The same steps are taken in reverse order to remove a generator from the circuit.

247. Fig. 170 is a diagram of a street railway switchboard for two generators. It is customary, for convenience and simplicity, to erect switchboards in panels, one for each generating unit, so that each panel controls a separate unit and is in immediate connection with its neighbors. In the figure the two panels are designated by dotted lines, the one on the left, active, and the one on the right, out of use. On each panel there are two main switches, *P* and *N*, for the positive and negative armature terminals. A smaller switch, not shown, is usually located on the right of each panel and is for lighting up the station lamps from any panel and its connected machines at will. *R* is a shunt rheostat, placed at the back of the panel, with its handle extending through to the front, and *s* is a small switch for opening and closing the shunt circuit of the field coils through the rheostat, *R*. *A* is the generator ammeter brought into use by the switches *P* and *N*, and *T* is the automatic circuit-breaker for the panel. This electromagnetic circuit-breaker breaks the circuit of the machine when the current strength, owing to a short circuit or other abnormal conditions, becomes dangerously great, thereby relieving the generator of the strain. The switch connected to the equalizing bar *E* is not placed, in this instance, on the panel, but is mounted close to the generator

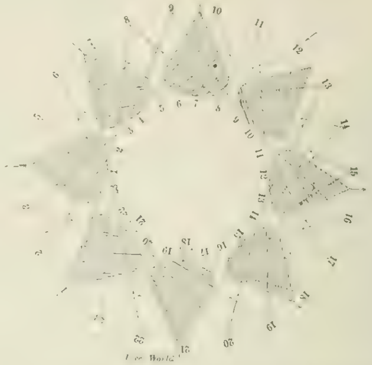


FIG. 173.—DIAGRAM OF DISC ARMATURE WINDING.

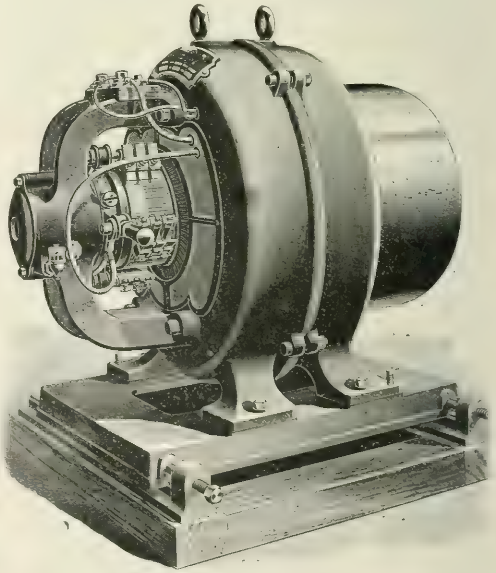


FIG. 175.—COMPOUND-WOUND GENERATOR WITH SINGLE FIELD COIL.

with the object of diminishing the amount of copper conductor required. Each panel is also provided with a voltmeter connection and lightning arrester, which have been omitted here for the sake of simplicity.

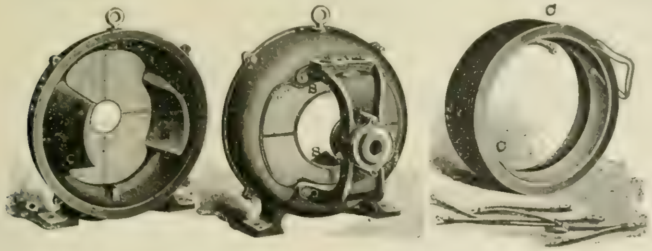


FIG. 176.—DETAILS OF MAGNET, SINGLE FIELD COIL GENERATOR.

248. The operations for introducing a unit into the battery of generators is, in this case, as follows: the generator is brought up to speed, the equalizing switch is closed, thus connecting the series coils of the machines in parallel with the machines in use. Next the positive main switch *P*, is closed, connecting one side of the armature to ground and return track feeders. The field switch *s*, is next closed, and the E. M. F. of the machine is brought up to slightly above station pressure by the aid of rheostat *R*; finally, the negative main switch *N*, is closed, throwing the armature into the battery, and the load is adjusted by the rheostat *R*, in accordance with the indications of the ammeter *A*.

249. Another arrangement for railway switchboards consists in mounting the three switches, *P*, *N* and *E*, in close proximity to each other and attaching a single handle to the three blades, so that the three connections may be made or broken by a single operation.

When the railway mains are connected with the station by several feeders, it is customary to add another section to the switchboard where switches and ammeters are provided for handling the various feeders.

250. Before leaving the subject of generators it may be well to discuss a few types of generators that do not fall under the types already discussed and which are less rarely met with in practice.

These may be described as,

(1.) Disc-armature machines.

(2.) Single field-coil machines.

(3.) Unipolar machines, or commutatorless continuous-current machines.

251. Generators employing disc armatures are frequently employed in Europe, and although they are very seldom employed in the United States, yet it is proper to describe them as being types of machines capable of efficient use. In one form of disc-armature generator, the armature is devoid of iron, and is built of conducting spokes like a wheel, which revolves in a vertical plane between opposite field magnet poles. Such a disc armature machine is shown in Fig. 171. It is to be observed that the entire machine is practically encased in iron and is provided with three windows on the vertical face; through these windows the brushes, *BB*, rest on the commutator which is placed on the periphery of the disc. The armature of this machine is shown in Fig. 172 supported on a small truck. The radial spokes are of soft iron, and are connected into loops by the copper strips leading to the commutator segments of the periphery. The object of employing iron spokes is to diminish the reluctance of the air-gap. Such an armature is evidently capable of being operated at an abnormally high temperature without danger, being constructed of practically fireproof materials. The electrical connections of an octipolar machine are represented diagrammatically in Fig. 173. The brushes, it will be observed, are applied at the centres of any adjacent pair of poles. Another form of the machine is represented in Fig. 174.

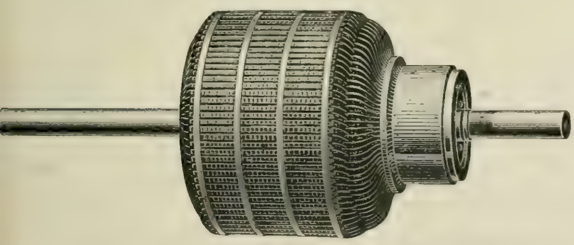


FIG. 177.—ARMATURE OF QUADRIPOLAR, SINGLE FIELD-COIL MACHINE.

252. An example of a single field coil multipolar dynamo is shown in Fig. 175. This is a quadripolar generator with four sets of brushes. The interior of the field frame, with its projecting pole pieces and exciting coil, is shown in Fig. 176. It will be seen that the field frame is made in two halves, between which are enclosed the armature and the single field magnetizing coil. Four projections *N*, *N*, and *S*, *S*, form the pole pieces of the quadripolar field; that is to say, the magnetic flux produced by the M. M. F. of the single coil *C*, *C*, passes through the field frame into the two pole faces *N* and *N*, in parallel through the armature into the adjacent pole faces *S*, *S*, thus completing the circuit through the field frame. The armature, which is a drum-wound, tooth-cored armature, is shown in Fig. 177.

(To be continued.)

Laboratory of Houston & Kennelly, Philadelphia, Pa.

Electric Lighting in Montevideo.

The following information relating to electric lighting in Montevideo, South America, is contained in a recent United States Consular report:

Until about 1888, the public lighting of Montevideo was done under contract with the Montevideo Gas Company, an English corporation, which had a monopoly. A company was then formed with home capital to furnish better lighting, either by gas or electric light, and, amidst great difficulties, an electric light plant was put up and a contract made with the municipality to furnish a part of the most populous section of the city, the so-called *Centro*, with electric lights. About two years later another plant was put up to supply the remainder of the city. The municipality imposes a separate tax for public lighting, which brings about $90,000 annually, out of which this service is paid.

The alternating system is used, the apparatus being that of Ganz, Budapest. In the central station there are three alternators of 80-kw capacity. Three thousand two hundred lamps of 12 cp are in service. Commercial houses are served until midnight. In the Arroyo Seco station there are two direct-coupled alternators of 320 kw each, and five others of 80 kw. Five thousand lamps are in service, of which 3,400 are public lights, for which latter the city pays $3.15 (gold) per month; commercial houses pay 36 cents per kilowatt-hour and private houses 48 cents.

The use of electricity as a motive power has not yet been introduced in the country. Besides Montevideo, there is no other city or town in the Republic of Uruguay, with the exception of San Jose, with electric lighting.

A Peculiar Phenomenon.

To the Editor of The Electrical World:

SIR:—In connection with the electrical jets or brush discharges observed on barbed-wire fences and on the handles of his bicycle by T. A. Peplow at Lamar, Col., on April 26, 1895, and described in THE ELECTRICAL WORLD, May 18, on page 586, it may be of interest to note that the date which he mentions was that also of an aurora and considerable prevalence of thunderstorms. There is considerable evidence that such a phenomenon as that observed at Lamar in this instance is an incident in a general increase in atmospheric and terrestrial electrification due to an inductive effect proceeding from the sun and affecting the entire earth in accordance with the laws governing the mode of operation of forces of this kind, brush discharges, or disruptive effects, appearing only at certain points where the local conditions are favorable, or the poles induced are situated. The special solar conditions on which such inductive effects depend are just coming to be understood. There appears to be a form of action entirely independent of the radiation of heat or light that requires to be identified and studied by itself. This mode of solar action appears to depend upon conditions that are accurately defined, and that are essentially dynamic. It is the turmoil of eruptive activities at a certain point on the sun as viewed from the earth that gives rise to these inductive effects.

LYONS, N. Y. M. A. VEEDER.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors, or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 927 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French, or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Calculation and Construction of Continuous-Current Dynamos.—Mr. Picou's article (see Digest last week) is continued in "L'Eclairage Elec.," May 4; he discusses a number of details and check calculations; among other things he states that 25 watts per square decimeter (1.6 watts per sq. in.) is the limit for the number of watts converted into heat in the armature, which can be dissipated from its surface without heating it too much; he compares different ways of winding armatures. The article is of a thoroughly practical nature but does not admit o being abstracted.

Construction of a Sewing Machine Motor.—An illustrated article describing the construction in detail of a small motor is published in "L'Elec.," May 11.

Theory of Synchronous Motors.—In the Digest, April 20 and March 9, mention was made of an article by Prof. Blondel; the complete article, only a portion of which was published in the French journal, is published in pamphlet form by Lahure of Paris; a brief statement of the nature of the article was given in the Digest references.

Transformer of Alternating into Continuous Currents.—A paper by Mr. Dèri read recently in Vienna and describing a transformer made by Ganz, is abstracted briefly in the "Bul. Soc. Int. des Elec." for April; it consists simply of a four-pole dynamo having ring collectors and an ordinary commutator.

LIGHTS AND LIGHTING.

Carbon Economizer.—According to "L'Eclairage Elec.," May 4, tests made by the Edison Company in Paris of the apparatus described and illustrated in the Digest, Dec. 8, have confirmed the results previously obtained. Two lamps were connected in series, one having square carbons 12 mm to the side, and the other 17 mm to the side, the former being provided with the economizer; under these conditions the carbons in both lamps lasted the same time; the illumination at 36 paces from the former was equal to that at 32 paces from the latter, corresponding to about 26 per cent. increase in the light from the lamp which contains the economizer; there is therefore no doubt that it is economical to use the apparatus; it was found, however, that with the density of the current used, namely, 1 ampere for 144 sq. mm of cross-section of carbon, the insulating material of the hood deteriorates quite rapidly. A more resisting material should therefore be used.

Incandescent Lamps.—An abstract of the article by Mr. Armagnat, mentioned in the Digest, April 6, is published in the Lond. "Proc. Phys. Soc." for May.

Solar Arc Lamp.—Mr. Sachs gives a description of the principle of this lamp, accompanied by illustrations, in the "Elec. Eng.," May 22.

POWER AND HEAT.

Dock Cranes.—Lond. "Engineering," May 10, gives a brief description accompanied by good illustrations of the electric jib crane at the Hamburg docks. It states that electric cranes are now being introduced and promise to be very successful; at first, electric cranes were a failure, but the difficulties have now been overcome; for docks only one method of operating the motors has been found satisfactory (but this method is not described); the throwing in and out of the motor must be gradual; there must be two independent motors, one for lifting and the other for turning. Long-continued tests gave the following comparative results regarding the coal consumption: with the electric crane, using a triple expansion steam engine, the consumption of a certain operation was 4 kg of steam and under the same circumstances the steam crane consumed 10 kg; the difference in coal consumption will be greater still since the small boilers of steam cranes cannot work as economically as the large boilers for central stations; a steam crane of a certain type always consumes the same amount of steam no matter what the load, while the running requirements of the electric crane are fairly proportioned to the load; the mean efficiency of a hydraulic plant measured between the accumulator and the load raised, was found to be about 60 per cent.; that of the electric crane measured between the switchboard and the load raised was about the same; the electrical energy, however, can be produced by 8 to 10 kg of steam per horse-power per hour while the hydraulic energy, as measured behind the accumulator, required not less than 15 to 20 kg; thus the electrical crane consumes only about half the steam that the hydraulic crane does.

Long Distance Transmission at Genoa.—"L'Elettricista," May 1, contains some further data regarding the well-known high tension continuous current transmission plant from Isoverde to Genoa; four large batteries of Tudor accumulators capable of storing 840 hp-hours, have been installed. The same plant now furnishes power for lighting the town of San Pier d'Arena by means of a Thury dynamo motor.

Three-phase Transmission Plant at Foligno.—According to "L'Elettricista," May 1, the plant at Foligno has been tested and has proved to be satisfactory; it is intended to be started in a few weeks; 400 hp derived from the river Menotre by means of three turbines directly coupled to dynamos making 500 revolutions, is transmitted four miles at 2,000 volts.

Transmission with Synchronous Motors.—A brief discussion of Mr. Picou's paper (see Digest, March 30), by Prof. Blondel, in which he takes exception to a number of points, is published in the "Bul. Soc. Int. des Elec." for April; among other things he states that the effect on the generators, of the current whose phase has been shifted, should be taken into consideration; "for an equal current the fall of voltage is considerably increased by the phase shifting and can exceed the limits of excitation used during normal running." Mr. Picou replied briefly stating that he believes the solutions of the problems which he gave are sufficiently approximate.

Electric Heating.—In a short article by Mr. Dowsing in the Lond. "Elec. Rev.," May 10, he refers to some recent criticisms of Mr. Crompton's paper in the "Gas World" and calls attention to the exhaustive tests made a number of years ago by Mr. D. Kinnear Clark which showed that the average efficiency of the close gas cooking stove is 16 per cent. He claims that the electric system of heating should be compared only with the hot water systems and not with the hot air system, which is not in favor in Great Britain; with the hot water systems which are uneconomical and expensive to maintain, he believes the electric system able to compete, and states that it is believed by many heating engineers that electricity will very shortly prove to be cheaper than all hot water systems; many churches are now considering the introduction of electricity for heating purposes, and if the cost of installing the new system is more—although it is usually about the same—the saving o labor and the ease of regulation will more than compensate for the difference.

Hydro-Electrothermic System.—A detailed description of this system, known abroad as the Hoho and Lagrange and in this country as the Water-pail Forge system of heating, is begun in "L'Eclairage Elec.," April 27, by Mr. Gooch. The present portion contains little that has not already appeared in the frequent references in these columns; he states that practice has shown that the best voltage to use is in general 125 to 200; a power of 35 to 40 kw during 30 to 50 seconds will readily bring the two ends of a bar of iron 4 cm (about 1.5 in.) in diameter to a welding temperature and will heat a surface of about 50 to 60 sq. cm (about 8 or 9 sq. in.) during the same time (but to what temperature is not stated).

Welding.—An abstract of Mr. Foster's recent paper (see Digest, March 9 and 16), is given in Lond. "Engineering," May 10.

Development of the Experimental Study of Heat Engines.—A reprint of a lecture by Prof. Unwin on this subject is begun in the Lond. "Elec.," May 10; it is discussed in the leading editorial.

Recent Developments of the Single Acting High Speed Engines for Central Station Work.—A reprint of an Institution paper by Mr. Robinson is begun in the Lond. "Elec. Eng.," May 10.

Long Distance Transmission.—A paper by Mr. Venable, read at a recent meeting of the Engineers' Club of Cincinnati, is published by that club; after an introduction to the subject of electrical transmission of power, he describes and discusses the various systems, their advantages and disadvantages.

Electric Power in a Quarry.—A translation of the article mentioned in the Digest, May 4, is reprinted in abstract with the illustrations in the "West. Elec.," May 18.

Electric Plowing.—A brief description of a plant in Germany is given in the "West. Elec.," May 18; it appears to be the same plant of which a brief description was given in the Digest, Dec. 15.

Thawing by Electricity.—The brief article mentioned in the Digest, March 16, is reprinted in the "West. Elec.," May 25.

TRACTION.

Accumulator Traction.—The "Bul. Soc. Int. des Elec." for April contains a paper of some length by Mr. Sarcia (a brief extract of which was given in the Digest, May 11), describing in detail the accumulator system which has been in use in Paris for nearly three years and mentions some improvements which are being introduced. The number of car kilometres which have been run on this line up to date is over 2,000,000; the accumulators used are those known as the Laurent-Cely (known in this country as the Chloride Accumulators); the battery is placed below the seats and consists of 108 cells of 11 plates each; the weight of the plates of a cell is 18 kg (about 40 pounds); it requires five hours to charge a battery which has been completely discharged; the discharge capacity is 230 ampere-hours or 52 hp-hours; the efficiency of the batteries in watt-hours is 70 per cent.; the mean current during the trips is 35 amperes which sometimes increases to 120 amperes; a battery can run with one discharge a distance of 60 km on the Broca rail and 120 on the Vignole rail; the motors are ordinarily in series but can be connected in parallel; for every car there are two sets of batteries; one charge will run two complete trips corresponding to a length of about 50 km; the time of one trip is 55 minutes; the weight of the complete car is 14,000 kg of which 3,000 are batteries and accessories and 3,500 are passengers; the mean traction effort is 12 kg per ton on the Broca rail and six on the Vignole rail; the means, per car kilometre, for two years are as follows: 1.38 hp-hours generated at the station, 3.90 ampere-hours of charge, 2,465 kg of coal consumed and 0.0039 kg. of oil; these figures are given for every month, in a table; the mean cost per car kilometre for maintaining and handling the accumulators is 16 centimes (one centime equals 0.2 cents), motive power 18, maintenance of trucks and motors 5, motormen 8, total 47; of the first item 10 is for maintenance and six for handling. He describes improvements which are being introduced; instead of 12 boxes of accumulators placed under the seats they will hereafter use one large box suspended below the car between the trucks which very greatly reduces the expense of handling; the positive plates had a life of 14,000 car-kilometres, the active material by that time having dropped out; in the new forms these plates will be made like the original Faure plates consisting of a vertical plate having inclined troughs on its surface into which the active material is placed in the form of a paste; after 14,000 car-kilometres the material has left its support and the plates are then removed and the material again introduced in the form of a paste, after which operation the plates are nearly as good as new; the frames may thus be repasted 10 times before they are completely destroyed; the minimum life of these new plates is said to be 100,000 car-kilometres; they will also stand a greater rate of discharge and therefore the batteries may be reduced to 56 cells of nine plates with a total weight of plates of 1,700 kg, that of the former battery being 3,000; the cost of maintenance and handling is thereby reduced 40 per cent.; the total weight of the new car including batteries and passengers is 11.7 tons, that of the former car being 14.5 tons; the new car requires only 70 per cent. of the power used by the old form and the maintenance of the trucks and motors is reduced to three centimes, making a total of 34 as against 47 centimes, a reduction of 30 per cent. which is said to be lower than the cost of any mechanical system of traction known except that of the overhead trolley system. "L'Energie Elec.," May 1, publishes a long, illustrated description of the same system, giving practically the same data with some additional matter, including quite a number of illustrations. Single reduction motors are used with a reduction of 5 to 1; each motor generates 10 kw at 600 revolutions with 100 volts. Two diagrams are given showing the energy consumed in mounting a grade and that returned to the battery on descending the grade; in one case the former was 976.5 watt-hours and the latter 385.0 and in another case the former was 625.8 and the latter 216.0.

Chasseral Mountain Road.—The "Rev. de L'Elec.," April 30, contains a brief description of a projected road on Mt. Chasseral in the Jura Mountains. The total length is about 7 km; the chief conditions were that it should be able to transport a large number of visitors on holidays and should be cheap, also that the service should not be interrupted by the large amount of snow which falls in winter, during which season the view from that mountain is particularly attractive. The car is suspended from a single overhead rail at various heights above the ground depending upon the contour of the surface; the pillars "also support frames between which the cars run"; the cars are long and will hold 24 passengers; the ascent will be made in three quarters of an hour at the rate of 6.2 miles per hour; it appears that it is an adhesion road and it is intimated that it ought to have been a rack road in order to permit of an increased speed; the maximum grade is 24 per cent.; the rise is 730 metres and the total length 6,800 metres. It appears that the motor is a gearless one being connected directly to the driving wheel; it is suspended in a fork connected to the car by springs; the current seems to be taken from a rod above the car and returns through the rail; the cost is said to be 82,000 fr. per km (equal to about $27,300 per mile); the current will be generated by water power. Nothing further is given in the description.

Surface Contact System.—"L'Eclairage Elec.," May 4, contains a long article forming the first part of a description of the Claret and Vuilleumie system (see Digest, May 18).

Dublin.—A brief description of this trolley road, built by the British Thomson-Houston Company, is given in Lond. "Engineering," May 10.

Accumulator Traction in Berlin.—A brief description with some illustrations of the controller connection, is published in "Elec. Eng.," May 22. It is an experimental line 3.5 miles in length, mostly level, on which two cars are run, provided with Tudor accumulators; a car makes two trips, covering a distance of 16.25 miles in three hours and 25 minutes; six sets of batteries are used for the two cars, each being grouped in four series of 22 cells, which are variously connected by the controller, the combinations being shown in the illustration; the weight of the car is nine tons without the passengers, the batteries weighing 3.3 tons; the capacity is 130 ampere-hours; for each car mile 1,050 to 1,100 watt-hours are required; only 56 per cent. of the total capacity of the battery is drawn on.

Operating Expenses of New Haven Roads.—The coal consumption and earnings of the New Haven street railways are given briefly in the "St. Ry. Gaz.," May 18, showing that the increasing gross earnings are accompanied by decreasing operating expense; in the year ending in April, 1894, the consumption was 7.26 pounds per car mile and in the year after, 4 75; the total cost of the station for the first 13 weeks of 1894 was 2 26 cts. per car mile and during the corresponding period of 1895 1.84 cts.

Liverpool Elevated Railway.—A detailed list of the costs per train mile for the last six months of the past year are given in the "St. Ry. Rev.," May 15; the total cost was 25.935 cts. per train mile; the portion for motive power including repairs of motors was 6.430; the largest item was for traffic expenses, 10.185.

High Speed Electric Line.—According to a statement in the "Elec. Eng.," May 22, a railway is to be built from Lorain to Cleveland, a distance of about 25 miles, which is intended to be the fastest electric railway in the world; the distance will be traveled in a little over half an hour.

Rapid Transit in New York City.—The statements of the Commission, accompanying the plans which were submitted to the Common Council, are given in "Eng. News," May 16, and more briefly in the "Elec. Age," May 18.

European Railway Motors.—A brief, illustrated description of the Thury (Swiss) motor, which is to be used on the Geneva railway, is given in the "St. Ry. Gaz.," May 18. A brief, illustrated description of the motors made by the General Electric Company of Berlin is given in the "St. Ry. Rev.," May 15.

Metropolitan West Side Elevated Railway of Chicago.—A long and profusely illustrated description of this road is published in the "St. Ry. Rev.," May 15. A brief description is given in the "Elec. Eng.," May 22.

Inclined Railway at Great Falls, Mont.—A brief, illustrated description is given in the "St. Ry. Rev.," May 15.

Mining Railway in France.—A brief description, including a plan and elevation of the conductor rail, of the plant mentioned in the Digest, May 18, is published in "Eng. News," May 16.

Geneva.—A brief illustrated description of this road is given in the "St. Ry. Rev.," May 15.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Brighton.—The Lond. "Elec. Eng.," May 10, reprints a paper by Mr. Wright on "Points of Interest in the Development of Electricity Supply at Brighton." He gives a brief history showing that the city of Brighton was the leader in certain features in electric supply in England; in the latest extension in 1894 the unique system was adopted of supplying electricity at light loads by the continuous current and at heavy loads through the medium of high tension alternating feeders. A table is given showing the cost per kw-hour, exclusive of redemption and interest, for a number of stations in England, from which it appears that that at Brighton, namely, 4.6 cts., is the lowest; the annual sale per inhabitant in a number of towns of over 50,000 inhabitants is given, showing it to be greatest for Brighton, namely, 9.86. He believes that it is not sufficiently well recognized that the cost to the stations of continuing to produce electricity after everything has been put in a state of readiness to do so, constitutes an extremely small proportion of the total expenditure; from the experience of the last three and a half years at Brighton, the cost of getting ready to supply electricity in 1895 will probably amount to 80 per cent of the total annual expenditure; a diagram is given showing how very slightly the total monthly cost of running the station varies as compared with the corresponding sales of the current; from the diagram it appears that the monthly costs vary on the average about one fourth as much as the monthly sales; another conclusion from these curves is that the total monthly expenditure depends much more on the maximum rate of supplying the current than on the actual amount of that which has been supplied. In Brighton the charge is reduced to six cts. as soon as the proper proportion of the cost of having to be ready to supply that individual has been paid by the revenue derived from his previous consumption in the same half year, being charged at 14 cts.; this in the year 1895 happens to be after the use of his greatest demand for one hour per day on the average. Another diagram shows how rapidly the cost of supplying diminishes according to the length of time the demand is used per day; electricity for street lighting, the demand for which averages nearly 11 hours per day, can therefore be supplied at four cts. with a fair margin of profit, and he believes there is no other suitable form of artificial illumination which can compete with electricity at this price. He believes that engineers devote too much of their time to the reduction of running costs and thereby neglect the important question of how to diminish the much greater standing costs.

Parallel Running of Compound-Wound Machines.—In a short article by Mr. Pigg in the Lond. "Elec.," May 10, he describes the system used in the North-Eastern Railway Company's station, which has been very satisfactory and which he thinks is not in use in any other installation. It consists of four over-compounded dynamos directly driven by engines and run in parallel on the bus bars; the only ammeters used are in the lamp circuits and they are not available for ascertaining the loads on the different machines; the shunt regulating resistances all work together, independent control being neither necessary nor possible. There are three ungraduated indicators, each consisting of a polarized needle with a few turns of wire around it, one being connected between the positive brushes of each pair of machines; if a current passes between the two machines part of it passes through the indicator branch deflecting the needle, the latter pointing to the machine which is giving current to the other; the speed of the engine is then increased or diminished until the pointer becomes vertical again; it is necessary, whether the machine is for the same or different outputs, that the resistance of the several machines between the brushes and the bus bars shall vary inversely as their maximum rated current outputs; unless this condition is complied with the total safe working capacity of the plant will be lowered.

Theatre Lighting.—A description of a new lighting plant at the Politeama Florentino, a theatre in Florence, is published in "L'Elettricista," May 1.

Sheffield.—An illustrated description of this alternating-current station is given in the Lond. "Elec.," May 10.

Chemnitz.—An illustrated description of this station is begun in the Lond. "Elec. Rev.," May 10.

Test of a Gas Engine Plant.—The "Eng. News," May 23, abstracts at some length a recent paper by Mr. Burchard on the "Use of Gas Engines to Drive Dynamos at Danbury, Conn." The abstract includes a very complete table of data giving the results of brake tests and another giving the output and fuel consumption of that station for the past six months; during that time the average was at the rate of 159.6 watt-hours per pound of coal after allowing 25 per cent. for fuel used in steam boiler; the average kw-hours per day was 435; producer gas is made on the premises; there are three gas engines of 100 horse-power each; a few indicator cards are given.

Municipal Ownership.—A correspondent to the "Elec. Rev.," May 22, points out certain considerations which he believes are amply sufficient to account for the differences in the conditions in New York City and in Manchester, Eng.; he believes that "private ownership of those functions breeds dishonesty as naturally as filth breeds disease." Every penny paid by citizens over the actual cost is the nucleus of a possible corruption fund and it is that which tempts the City Councils to dishonesty.

Statistics for Germany.—A few of those recently mentioned in these columns are given more in detail in the "Elec. Eng.," May 22.

Fires of Electric Origin.—The "Elec. Age," May 18, reprints in part a description of a recent series of demonstrations of Mr. McDevitt, insurance inspector of Philadelphia, of ignitions from defective and unskilful electric wiring.

Private Plants.—A description of the electrical features in the Carnegie Steel Company's building in Pittsburgh is given, accompanied by a number of illustrations, in the "Elec. Eng.," May 22. A compact gas engine plant in which a new type of gas engine is used, is described and illustrated in the "West. Elec.," May 18; the capacity is 200 incandescent lights. The electric equipment of the Rothschild store in Chicago is described and illustrated in the "West. Elec.," May 25.

Brooklyn.—An illustrated description of the new station of the Citizens' Electric Illuminating Company is published in "Elec. Age," May 18.

WIRES, WIRING AND CONDUITS.

Earthing the Middle Wire.—Mr. Sharp in the Lond. "Elec.," May 10, states that a recent report (see Digest, May 18), leads one to suppose that the middle wire "will be earthed throughout from the central station to all parts of the district, with a considerable loss in the conductor when the current in the two outer cables is not balanced"; he states that this may be overcome by protecting the middle conductor with a slight insulation on the feeders and also on the distributing network, earthing it, not at the station but only at the points where the feeders "are connected to it" (presumably to the distributing network), from where the pilot wires are carried back to the station; there can then be no difference of potential between these earthed feeding points and no injury from electrolytic action or disturbance of telegraphs and telephones will occur. He recommends the use of concentric cables with the outer conductor earthed at these points, the sheathing of the cable forming the middle conductor and being slightly insulated; he believes that this method will be largely used in the future.

ELECTRO-PHYSICS AND MAGNETISM.

Representation of Periodic Currents by Polar Diagrams.—The Lond. "Elec.," May 10, contains a short paper by Dr. Fleming on this subject in which he shows that the polar diagram is specially applicable to graphically representing simple periodic currents. In such a diagram the length of a line drawn in various positions from a common centre, represents the value of the current or the E. M. F., and the angle which it makes with the horizontal line represents the phase; a polar diagram of a simple periodic current will then be a circle tangent to the horizontal line at the point to which all the lines are drawn. Such a diagram enables one to determine very easily the square root of the mean square value of the periodic quantity; it is more difficult to do this with the ordinary wave curve diagram. This he illustrates with an example; the rule is to construct the polar diagram, which is always a closed curve, then take the area of it by means of a planimeter and then find the circle whose area is double this; the radius of this circle is the square root of the mean of the squares of the periodic quantity. The article is commented on favorably in an editorial in which it is stated that the ordinary sine curve is in these diagrams replaced by a circle, and two sine curves separated by a difference of phase become two circles intersecting at the phase angle; it suggests that some of the properties of alternating currents usually demonstrated by means of sine curve might be more easily proved by means of circles. On account of the undoubted advantages of polar diagrams it suggests that printed polar paper might be made, to be used in place of the cross-section paper, the polar paper having a pole in the middle, radial lines and a succession of thick and thin concentric circles.

Alternating and Interrupted Currents.—The beginning of Prof. Forbes' second lecture is published in the Lond. "Elec. Eng.," May 10. He gave a further description of his analogy showing what goes on in an Atlantic cable and discusses more at length the subject of induction which he compares to mechanical momentum. He gives an example of analogies of electric units which are below under "Units, Measurements, etc." The Lond. "Elec.," May 10, refers briefly in an editorial to the concluding lecture describing an experiment which was shown and which is not well known, relating to the mechanical effect of high voltage direct currents on a piece of wetted thread connecting two vessels of water; the passage of the current causes the thread to move bodily in the reverse direction of the current, while the water moves in the same direction as the current (the experiment, due to Lord Armstrong, was described in the Digest, March 18, 1893); he suggested that there may be a germ of a useful electrical instrument in this phenomenon.

Curious Vacuum Tube Phenomena.—Mr. Lomas in the Lond. "Elec.," May 10, describes the following experiments: after glowing a vacuum tube with an influence machine and after removing the tube even so far as to another room, it will still continue to glow for one or two minutes; in some cases the tube appeared dead but on placing the hand directly around the central bulb a sudden glow shot through the tube which could be repeated by removing the hand to a different position. The tube was held in the hand and one extremity connected with the machine, then after stopping the machine and touching either extremity with the other hand a sharp shock is felt; the effects are exceedingly beautiful in a dark room; he sometimes noticed a small cloudy film of light swirling around the inside of the centre bulb accompanied by crackling sounds. He believes that the cause of the phenomena is that the glass tube acts in the same way as a dielectric. In commenting on this editorially it is stated that the tube probably acts as condenser, but it is difficult to see how such small tubes can have enough capacity to give such sharp shocks; the effects are quite distinct from the Tesla effects which occur when the tube is placed in a potential gradient or in an externally excited field.

Double Electric Film.—"L'Eclairage Elec.," May 4, contains an illustrated article of some length by Mr. Brunhes in which he describes new researches with the double electric film (called by Helmholtz "Elektrische Doppelschicht") which existed on the opposite sides and surfaces separating two different bodies, either conductors, electrolytes or dielectrics. Under certain circumstances this double layer is reduced to zero and the condenser formed by the two surfaces is completely discharged; if then an alternating E. M. F. is applied the conditions will be similar to those in an idiostatic electrometer, like the absolute electrometer of Kelvin; before describing this in detail he gives a summary of the principal researches which show the existence of such double layers. A brief abstract of his recent Academy paper on the same subject is given in the Lond. "Proc. Phys. Soc." for May.

Specific Heat and Boiling Point of Carbon.—An Academy paper by Mr. Violle mentioned in "L'Elec.," May 11, contains the following results of his researches: below 1,000° C. the mean specific heat of graphite increases in a linear proportion with the temperature; the heat given off by one grain of solid graphite falling from the temperature of volatilization to 0° C. is 2,050 calories, the boiling temperature of carbon is 3,600° C.

Passage of an Oscillator Wave Train through a Plate of Conducting Dielectric.—The Physical Society paper by Mr. Yule, mentioned in the Digest, Feb. 9, is published in full in the Lond. "Proc. Phys. Soc." for May.

Waves and Vibrations.—The concluding lecture of Lord Rayleigh is abstracted in the Lond. "Elec. Rev.," May 10; no reference seems to be made to electric waves.

Refraction and Dispersion of Electric Rays.—A translation from the Italian, of an article by Messrs. Garbarso and Aschkinass is given in abstract in "L'Eclairage Elec.," April 27.

Potential Gradient in a Positive Glow Discharge.—The article by Mr. Herz, mentioned in the Digest, April 20, is abstracted in the Lond. "Proc. Phys. Soc." for May.

Resistance of Solutions.—A paper by Messrs. Kohlrausch and Heydweiller from the "Wied. Ann.," 54, p. 38, is published in the Lond. "Proc. Phys. Soc." for May; they show that the resistance of aqueous solutions and of distilled water decreases when a current passes, beginning a few seconds after the current is started and rising again two or three minutes later; for pure water the decrease is nearly 50 per cent.; an explanation is offered.

Electrical Conduction and Convection in Slightly Conducting Dilute Solutions.—The Lond. "Proc. Phys. Soc." contains an abstract of a paper by Mr. Warburg from the "Wied. Ann." 54, p. 396.

Loss of Charge of Poor Conductors When Illuminated.—An Academy paper of Mr. Branly is abstracted at some length in "L'Eclairage Elec.," April 27; it gives the results of observations of the loss of an electric charge on materials like wood, marble, heated glass, etc., under the action of light.

Photo-Electric Currents.—An article from the German by Messrs. Elster and Geitel is abstracted briefly in the Lond. "Proc. Phys. Soc." for May; when a beam of light falls on the surface of a cathode in a vacuum tube connected with a battery of about 420 volts, a current passes whose strength varies with the angle of incidence and with the plane of polarization of the light.

Contact Resistance of Metals.—A long abstract of Mr. Branly's paper, mentioned in the Digest last week, is published in "L'Eclairage Elec.," May 4.

Electrical Conduction of Rarefied Air.—An article by Mr. Mebius from the "Wied. Ann.," 54, p. 520, is abstracted briefly in the Lond. "Proc. Phys. Soc." for May.

Potential of an Electrified Surface.—A brief abstract of a French Academy paper by Mr. Andrade is given in Lond. "Proc. Phys. Soc." for May.

Electrification of Air.—A paper read before the Philosophical Society of Glasgow by Lord Kelvin is abstracted at some length in the Lond. "Elec.," May 10; he describes some experiments.

Terrestrial Magnetism.—"L'Eclairage Elec.," April 27, abstracts briefly an Academy paper by Gen. Tillo on the variations of the earth's magnetism, in which he gives the values of the declination and the inclination for 504 locations.

Magneto-optic Effect.—The Lond. "Proc. Phys. Soc." for May contains an abstract of some length of an article from the German by Mr. Wind on the Kerr effect.

Poisson's Ratio in Magnetized Iron Rods.—A paper by Mr. Bock from the "Wied. Ann.," 54, p. 442, is abstracted in the Lond. "Proc. Phys. Soc." for May.

The Effect of Light on an Electric Charge.—The article from the French by Mr. Branly, mentioned above, is abstracted briefly in the "Elec. Eng.," May 22.

ELECTRO-CHEMISTRY AND BATTERIES.

Internal Resistance of Accumulators.—The "Zeit. f. Electrochem.," May 5, contains an article by Dr. Shoop giving the results of measurements of the internal resistance of accumulators at different times during the discharge; he was lead to these tests by noticing, in a test of a series of accumulators, that the internal resistance during the discharge was only about one third of that measured on open circuit. In the present tests the internal resistance was calculated from the fall of voltage during the discharge, the voltage being measured while the current was flowing and again immediately after opening the circuit; the accumulators were discharged at two different rates, one about double the other, and the resistance calculated for successive fractional discharges; the results show that the resistance is lowest when the cell is about half discharged, after which it increases and reaches about 17 times the minimum value; owing to the methods of measurement, however, the results are not quite correct.

Antimony Accumulator.—The "Elek. Anz.," May 9, abstracts from a recent patent of Mr. Darrieus, a description of an accumulator in which the negative plates are made of spongy antimony and the positive either of peroxide of lead or of oxidized antimony, the electrolyte being dilute sulphuric acid; the advantages of antimony are said to be that the weight is less, that no sulphate is formed on the negative plates due to local action and that the mechanical strength is greater (the voltage of the cell is not given); the greater part of the description is devoted to various methods by means of which the antimony plates may be prepared.

Electrostriction by Free Ions.—An abstract of an article by Messrs. Drude and Nernst from the "Zeit. Phys. Chem.," 15, p 79, is published in the Lond. "Proc. Phys. Soc." for May.

Potential Difference between Metals and Electrolytes.—An article by Mr. Rothmund from the "Zeit. Phys. Chem.," 15, p. 1, is abstracted in the Lond. "Proc. Phys. Soc." for May.

Theory of Electrolytic Dissociation.—An article by Mr. Tanatar from the "Zeit. Phys. Chem.," 15, p. 117, is abstracted in the Lond. "Proc. Phys. Soc." for May.

Solubility and Electrolytic Dissociation.—An article by Messrs. Noyes and Abbot from the "Zeit. Phys. Chem.," 16, p. 125, is abstracted in the Lond. "Proc. Phys. Soc." for May.

Molecular Conductivities.—The Lond. "Elec. Rev.," May 10, calls attention to a paper by Messrs. Werner and Miolati from the "Zeit. f. Phys. Chem.," 14, p. 506, in which they give the conductivities of a large number of compounds and the results of their system of elucidating chemical constitution by molecular conductivity determinations.

Galvanoplastics.—Some recent improvements are summarized briefly in "La Nature," May 11, including an electrochemical process for plating metals with platinum.

Applications of the Electric Furnace for Metallurgical Purposes.—The recent paper by Mr. Moissan, mentioned in the Digest last week, is published in full in "L'Eclairage Elec.," April 27.

Books on Electrolysis.—In answer to an inquiry regarding a selection of books on this subject, the Lond. "Elec. Rev.," May 10, gives the following list: Sprague's "Electricity"; Gore on "Electro-metallurgy," and the "Art of Electrolytic Separation of Metals"; the works of Watts; in French, Fontaine's "Electrolyse"; Tommasi's works; Cadiat and Dubost on "Electricité Industrielle"; and in general the technical press.

Refining Zinc by Electrolysis.—Mr. Richards, according to the "Elec. Age," May 18, refines impure zinc by electrolysis; the current density is 100 amperes per square metre and the voltage 1.3 per bath; the solution is kept agitated by mechanical means; thick deposits of zinc of exceptional purity can thus be obtained; the accumulation of iron in the solution is prevented by blowing air through it continually, which oxidizes and precipitates the iron; the process could be operated commercially if it were not for the very low price of zinc, the margin of profit being less than in refining copper, while the expenses are greater.

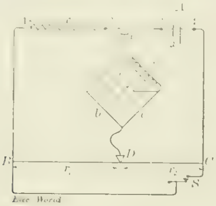
Thermo-chemical Carbon Battery.—Dr. Huber, in the "Elec. Eng.," May 22, states that about 18 months ago he made practically the same experiments as were recently described by Mr. Korda (see Digest, May 4 and 11); with an area of about two square inches, using peroxide of barium between two ordinary battery carbons, a current of 0.2 amperes and 1 volt were generated; the constancy of the cell is said to be excellent and the consumption of bar peroxide not excessive.

Limits of Electrolysis.—An abstract of the paper of Mr. LeBlanc, abstracted in the Digest, Dec. 29, is published in the "Eng. & Min. Jour.," May 18.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Effects of Railway Currents on Measuring Instruments.—The "Elek. Zeit.," May 9, contains a long article by Mr. Voller discussing the subject of the effect of electric railway currents on magnetic and electric measuring instruments, and the prevention of these effects. He describes very extended researches which were made in the city of Hamburg for determining the location of a laboratory; a photographic registering apparatus was used, some of the records of which are reproduced and discussed in detail. He believes it can be considered proved that the disturbances are due almost entirely to the earth return currents and very slightly only to the inductive action of the currents in the lines and car. The conclusions of his researches are as follows: the usual mirror instruments cannot be used for accurate measurements within distances to an electric railway up to several hundred metres, especially if located at points within a railway line making a complete circuit with the power house near the centre; that merely enclosing a mirror galvanometer with an iron ring or its equivalent will by no means protect those instruments completely from disturbances caused by electric railways; that the disturbances may be made negligibly small although at the expense of the sensitiveness of the instrument, by use of an independent magnetic field inside of an iron shield surrounding the instrument, or by the use of strong permanent magnetic fields without the iron shield; instrument makers should therefore give special attention to constructing instruments having a strong permanent magnetic field combined with as great sensitiveness as possible; such galvanometers may be calibrated by means of a voltameter or with the use of a standard cell and a known resistance; the determination of the horizontal component of the earth is therefore no longer of such importance; observations of the earth's magnetism can in the future no longer be made within the range of an electric railway except during the night.

New Method for Measuring Internal Resistance of Accumulators.—A new method is described by Prof. Grassi in "L'Elettricista," May 1. It consists of a combination of Mance's improved method and those of Hopkin and Matthiessen. Referring to the accompanying figure, A is the accumulator having an internal resistance x; a, b, c and d are four resistances, d being highly inductive, they being so proportioned that $b\ d = a\ c$; G is a galvanometer, r a standard resistance, $B\ C$ a calibrated stretched wire and D a sliding contact; the position of D is adjusted until the galvanometer remains at zero when the switch S is opened and closed; the same operation is then repeated only F is placed successively at the points 1, 2, 3 and 4 and if e, f, g and h are then the four readings on the calibrated wire $B\ C$, the resistance x of the battery is given by the formula $X = r\frac{h-g}{f-e}$.



Optical Method for Studying Alternating Currents.—An Academy paper by Mr. Pionchon is abstracted in "L'Eclairage Elec.," May 4, and "L'Elec.," May 11. Between the polarizer and the analyzer of a saccharometer a solenoid is placed encircling a glass tube filled with Thoulet solution; in connection with this the so-called stroboscopic method is used, the speed of vibration of which is slightly different from that corresponding to the frequency of the alternating current and it can therefore be adjusted so that the different phases of the phenomenon are made to appear to follow each other as slowly as one desires; the method is not only qualitative but enables measurements to be taken, which he describes briefly.

Induction Tests with Telephone and Bridge.—An article by Mr. Abraham from "Jour. Phys.," 4, p. 127, is abstracted in the Lond. "Proc. Phys. Soc." for May.

Analogies of Electric Units.—In a recent lecture by Prof. Forbes, mentioned above, he makes the following analogies: he assumes one volt to mean 1 oz. driving at a radius of 1 in., and one ampere one revolution per second; a coulomb is equivalent to one revolution; there is a farad when it makes one revolution with 1 oz. of pressure and a henry if there is a current of one ampere, gradually reducing during one second by its own self-induction to zero; the pressure that is in that interval of time being constantly exerted is the equivalent of one volt and that is obtained by the momentum of a cylinder of 1 in. radius weighing 62 oz.

Lecture and Laboratory Apparatus and Methods.—The "Zeit. f. Electrochem.," May 5, contains a continuation of the article by Dr. Borchers which was begun in that journal last year; he discusses methods for producing lithium and beryllium, and an apparatus for the electrolysis of fused substances.

Aperiodic Electrometer Free from Magnets and Elastic Fatigue.—A paper by Mr. Hallwachs describing a somewhat complicated quadrant electrometer is abstracted very briefly in the Lond. "Proc. Phys. Soc." for May.

Aperiodic Volt and Ampere Meters.—A long description of the new instrument of Messrs. Arnoux and Chauvin, described in the Digest, May 11, is published in "Bul. Soc. Int. des Elec." for April; a reprint of the whole paper is begun in "L'Elec.," May 11.

Construction and Use of Electrical Measuring Instruments.—A serial by Mr. Yeaman is continued in the successive issues of Lond. "El'ty"; in the issue of May 10 he gives a recapitulation of the simple formulas of the various quantities involved in the calculation of alternating currents.

Lecture Apparatus for Showing Resonance.—A mechanical device is described by Mr. Guillaume in "La Nature," May 11, the description being accompanied by a good illustration.

TELEGRAPHY, TELEPHONY AND SIGNALS.

World's Telegraphs.—The Lond. "Elec. Rev.," May 10, abstracts briefly statistics for Great Britain, Russia and the United States from the "Jour. Teleg.," Nov. 25.

Telegraphing Without Wires.—A recent paper by Mr. Wietz is abstracted briefly in the "Bul. Soc. Int. des Elec." for April. He gives a review of the subject covering the past 10 years.

Regulator for the Hughes Apparatus.—Two new forms, which are claimed to be improvements on those formerly used, for regulating the speed of the moving part of a Hughes telegraph apparatus, are described and illustrated in the "Elek. Zeit.," May 9.

Madagascar Cable.—A short article from the French is reprinted in the Lond. "Elec.," May 10.

Submarine Cable Work.—In Mr. Wilkinson's serial in the Lond. "Elec.," May 10, he discusses cable currents and balancing to false zero.

Practical Telephony.—Lond. "El'ty" is publishing a serial on "Practical Telephony" by Messrs. Bell and Wilson; it is written in an easily understood style and appears to contain some good matter.

Microphone.—The Mix & Genest microphone for domestic systems, in which grains of carbon are used, is described and illustrated in the "Elek. Zeit.," May 9.

Accumulators for Telegraphic Purposes.—Directions for installing and maintaining such batteries are given in an illustrated article by Mr. Hofmeister, of Germany, begun in the "Elec. Rev.," May 22.

Muench Telephone Coil.—The one described in the Digest, May 18, is illustrated and described more fully in the "Elec. Eng.," May 22.

Telephone Companies.—The "West. Elec.," May 18, contains several short articles referring chiefly to western companies; it also contains an account of the annual meeting of the New England Telephone & Telegraph Company.

Berliner Telephone Patent.—The "Elec. Rev.," May 22, publishes the full text of the American patent.

Sub-Master Clocks.—The system used in the Western Union time service is described and illustrated in the "Teleg. Age," May 16.

Vibrating Bell for Testing.—A device used by the Western Union Company is illustrated and described briefly in the "Teleg. Age," May 16.

MISCELLANEOUS.

Protection by Lightning Rods.—The "Elec. Tech.," April 15, contains a short article by Dr. Neumann in which he shows, by referring to a number of cases, that it is not correct to state that a certain area will be completely protected against lightning by a lightning rod at its centre; the real function of the lightning rod is not to form a path for a bolt of lightning, but to equalize gradually the difference in charge between the earth and the clouds, by virtue of the points on the rod; he offers proofs of the correctness of this explanation by citing several cases in which the erection of lightning rods in a town and in a city was followed by an absence of bolts of lightning which were formerly frequent and which still occurred in the neighboring districts; an experiment illustrating this action is described.

Carbide of Aluminium.—According to the Lond. "Elec. Rev.," May 10, Mr. Moissan has recently produced a crystalline carbide of aluminium by submitting aluminium, in carbon cells placed in carbon tubes in the furnace, to a current of 300 amperes at 65 volts, passing hydrogen gas through the tube during the operation and until the apparatus became cold; the gray mass contains brilliant yellow crystals of this material.

Ozone Generators.—Several forms taken from recent English patents are described and illustrated in "Zeit. f. Electrochem.," May 5.

Automatic Electric Clock.—The French system is described and illustrated at some length in "L'Elec.," May 11.

Disintegration of Animal Tissue by High Voltage Faradic Currents.—In a recent paper by Mr. Parsons, abstracted in the "Rev. Int. d'Electrotheraphie" for March he describes experiments made on fresh beef in order to study the use of electricity for the treatment of malignant tumors; he shows that the destructive action of such currents is not limited to the direct neighborhood of the poles but extends a certain distance from them; the muscular fibres are torn by the action of the current but there is no sign of any thermic caustic action. Mr. Jones believed that the action was simply one of heat and that the treatment of tumors by this method would lead to gangrene; the author replied that he used induced currents of high voltage which had practically no thermic effect.

Physiological Action of High Frequency High Tension Currents.—An article by Dr. Sletoff from the Russian, is translated in the "Rev. Int. d'Electrotheraphie" for March; he gives a review of the subject and describes experiments made on patients with his apparatus, which consists of a Leyden jar charged by an induction coil, the discharging currents of the jar being transformed up by means of a transformer.

Electrotherapy.—The Lond. "Elec Eng.," May 10, abstracts briefly an article by Dr. Hedley from the "Lance" giving a history of what has been done and what is being done and concluding that the field of electrotherapy seems to be broadening.

Electro-culture.—Some recent experiments of Mr. Lrebuenschloss with an apparatus resembling the geomagnetifère are briefly described in the "Rev. Int. d'Electrotheraphie" for March.

New Journal.—A new monthly journal is being published by Hachmeister & Thal, Leipsig, Germany, called "Literarischer Monatsbericht." Its object is to give notices, reviews and lists of new books on architecture, engineering and electricity; the price is 2 M. 50 Pfg. (about 64 cents per year.)

Applications of a Heated Wire.—Mr. Knowles, in the "Elec. Eng.," May 22, in referring to the recent article of Mr. Irish, abstracted in the Digest, May 18, states that there must be reasons why this simple device has not come into more extended use; he believes that it is because the action is too sluggish, that it is difficult to compensate the different room temperatures, and that a physical change takes place in wires under the combined action of strain and heat.

Magnetization of Steam Railway Signals from Street Railway Currents.—A peculiar case is described by Mr. Wellman in the "St. Ry. Gaz.," May 18, in which the signal levers in a switch house at the crossing of an electric line over the tracks of the steam road, were magnetized continually and with varying intensities.

Recent Advances in American Electrical Work.—The portion of the report of the Secretary of the Franklin Institute referring to electrical work, which was mentioned in the Digest, Feb. 16, is reprinted in full in the "West. Elec.," May 18; the original will be found in "Jour. Frank. Inst.," for February.

Carbide and Acetylene.—The lecture abstracted in the Digest, May 18, is reprinted in full with the illustrations in the "West. Elec.," May 18.

Biographical.—Brief biographical sketches, with portraits of the new officers of the American Institute of Electrical Engineers, are published in the "West. Elec.," May 25.

New Book.

STANDARD WIRING FOR ELECTRIC LIGHT AND POWER. By H. C. Cushing, Jr. 84 pages, illustrated. Price, $1.

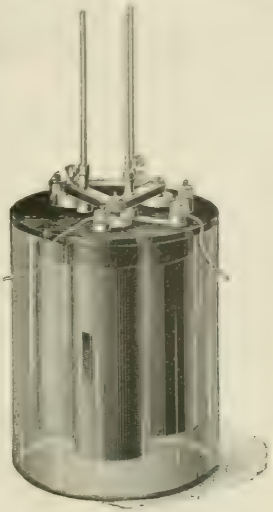
In the preface the author states that one of his objects in compiling the present work is to "standardize, as much as possible," all work relating to exterior and interior electric light and power wiring. Upon opening the book casually the first illustration that caught our eye was of Dr. Gibbon's resuscitating bellows, and the accompanying text shows that apparently the author has accepted, in all seriousness, the Syracuse doctor as an authority on the subject of resuscitation from electric shock. This was not very reassuring, but an examination of the other pages of the book, while it did not by any means justify the claim of authority implied in the preface, yet left the conviction that the book is one that will prove very useful to the wireman.

The author, who is an insurance inspector, has taken the rules of the Underwriters' National Electrical Association as a basis and added notes to show how they should be applied, that work may be most likely to meet with approval from insurance inspectors. Some tables are included and a number of illustrations from various sources of "standard" fittings, and of methods of construction work with reference to pole lines, installing up transformers, etc. A chapter on miscellaneous matter gives definitions of the electrical units (but with the henry omitted and the old and incorrect value of the ohm given), some remarks on the efficiency of the incandescent lamp and Ohm's law, and a number of mechanical formulas. To those desiring an interpretation of insurance rules on the authority of an insurance inspector this work will prove of value.

A Five-Volt Multiple Battery.

Numerous unsuccessful attempts have been made to increase the E. M. F. obtainable from a single cell of battery, hence it would seem that a real step forward has been made by Mr. E. G. Boynton, whose 5-volt battery we illustrate herewith. The battery is manufactured by the Boynton Multivolt Battery Company, 10 and 12 Whipple Street, Brooklyn, and consists practically of three carbon-zinc couples connected in series but occupying a single jar and using a single electrolyte in common. The carbon elements are cylindrical and covered on the outside by an insulating material which prevents cross-flow from one carbon cylinder to another, compelling the current to follow the path afforded by the conducting strips on the cover of the jar, which connect the couples in series.

The zinc rods and jars are the ordinary commercial articles, and have no special features. The jars are 6 x 8 inches; regular "crow-foot" size. The cylinders are perforated on one side to allow the passage of the electrolyte, and these perforations are turned radially outward, next the side of the jar, so as to make the distances as great as possible between these, the uninsulated part of the carbon cylinders. The cut shows the perforations to be long rectangular slots, but in the latest form of this battery the cylinders are perforated with a vertical row of round holes, four of them being close together near the bottom and one somewhat isolated from these and near the top. This arrangement is an important one, the result being a constant circulation of the fluid when the battery is in action. As the electrolyte inside the carbon cylinder becomes warm it rises and escapes through the upper hole and cool fluid flows in through the lower holes. The warm fluid upon escaping from the cylinder is provided with an ample radiating medium in the side of the jar, so that even under prolonged short-circuit the temperature of the cell does not rise to an uncomfortable point.

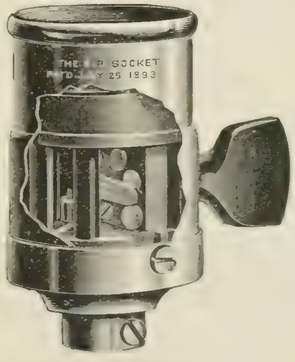


MULTIVOLT BATTERY CELL.

Readings taken with Weston instruments show that under a short-circuit of half an hour one of these cells gives an initial current of 12 amperes, which falls to five amperes during the first two minutes of the short circuit, after which the current is maintained at five amperes. The normal output of a three-element cell is two to three amperes at five volts. The zincs can be raised to reduce the activity of the cell.

A Regulating Lamp Socket.

The accompanying illustration shows a new regulating socket known as the "Economic," which is being marketed by The Electric Company, 56 Broadway, New York. The makers claim a diminution of current as the light is decreased, though the values are not proportionate. As will be noticed upon an inspection of the engraving, the socket is quite compactly made and does not differ in outward appearance from the ordinary keysocket.



REGULATING SOCKET.

These sockets are equally efficient on both alternating and continuous current circuits, and are at present furnished for use with 100 to 118-volt lamps. Sockets will shortly be manufactured for 50 to 55-volt circuits.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, May 25, 1895.

THE ELECTRICAL LIST displayed no particular activity this week, outside of American Bell. Western Union and the Tractions remained firm, while General Electric and Westinghouse showed slight reaction.

AMERICAN BELL opened strong on Monday, as was expected, but did not reach as high a point as its friends anticipated, to-day's closing figure being about the best of the week. The fact is that prior to last week's decision the stock had advanced upon the strength of increasing output and the failure of alleged competitors to enter into active work, so that there was not a great margin of sound advance left.

BALTIMORE TRACTION'S firmness continues to attract attention, and it seems to be the consensus of opinion on the Philadelphia floor that there is something more than talk in the consolidation rumors flying around.

ELECTRICAL STOCKS.	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	99	100
" " " Brooklyn	100	..	108
" " " Boston	100	129	130
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	..	28½
General Electric	100	33	33⅛
General Electric, pref	100	..	65
Westinghouse Consolidated, com	50	33½	33¾
" " pref	50	52	52½
BONDS.			
Edison Electric Ill., New York	100	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co. deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.	Par.	Bid.	Asked.
American Bell Telephone	100	202	203
American District Telegraph	100	30	40
American Telegraph & Cable	100	92½	..
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
†Erie Telephone	100	57	57½
Gold & Stock Telegraph	100	105	
New England Telephone	100	70	71
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63½	
Western Union Telegraph	100	92¾	92⅞

ELECTRIC TRACTION STOCKS.	Par.	Bid.	Asked.
Baltimore Traction	25	18¼	18½
Binghamton RR. com	100	100	..
Brooklyn Traction	100	9	12
" " pref	100	..	53
Buffalo St. Ry	100	72	..
Cleveland City Ry	100	68	70
Cleveland Electric Ry	100	59	60
Chicago City Ry	100	305	315
Columbus St. Ry	100	48½	..
Consolidated Traction of N. J	..	26	30
Electric Traction, Philadelphia	50	73	73½
Long Island Traction	100	8¼	9
Louisville St. Ry. com	100	37	39
" " " pref	100	87	88
Metropolitan Traction, Philadelphia	100	94½	94¾
New Orleans Traction	100	14½	16
" " pref	100	56	60
North Shore Traction	100	23	28
" " pref	100	80	84
People's Traction $30 pd	25	60½	60¾
‡Philadelphia Traction	50	82½	82¾
Rochester St. Ry	..	38	
Union Ry. (Huckleberry)	100	112	115
West End, Boston	100	68½	69
" " pref	100	90	..
Worcester Traction	100	13	16
" " pref	100	83	87
BONDS			
Buffalo St. Ry. 1st con. 5s	100	104	105
*Binghamton Railroad Co. 5s	100	99	100
*Columbus St. Ry. 1st 5s	100	98	
Rochester St. Ry. 1st. 5s	100	95	97
*Union Ry. 1st. mtge 6s	100	105	108
*Westchester Electric 1st. mtge. 5s	100	98	101

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* With accrued interest.

† Ex-Div.

‡ Ex-rights.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 BROADWAY, NEW YORK May, 27, 1895.

MR. NORMAN MARSHALL, vice-president of the Anchor Electric Company, of Boston, paid this office a pleasant visit last week.

A BIG DEAL —The Citizens' Electric Light Company, of Brooklyn, last week passed into the control of the Edison Electric Illuminating Company after three weeks of negotiations. Both companies will retain their separate corporate existence, and the Citizens' station will be operated from the Pearl Street station of the Edison Company.

THE MONTAUK, ORIENT AND N. Y. TELEPHONE & TELEGRAPH COMPANY, a local corporation in Mattituck, L. I., is in trouble because the N. Y. & N. J. Telephone Company is extending its lines all over Long Island. The stock of the local company was selling at a premium until the operations of the larger telephone company became known. The capital stock of the small company was $5.000. The Brooklyn company offered to consolidate and take 60 per cent. of the stock if the Mattituck company would raise its capital to $50,000. The smaller company has refused the coalition, and consequently the larger one is branching out and covering the ground which the smaller company would have covered.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
ROOM 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, May 25, 1895.

THE WADDELL ENTZ plant at Bridgeport was sold last week to Percival Knauth, of New York, for $60,000.

CHEAP RIDING —The N. Y., N. H & H. R. Ry. Company has decided upon a schedule of fares for its Nantasket Beach electric system, which will enable a passenger to ride from the Old Colony House to the Pemberton landing in Hull for five cents. The work of changing over this branch from steam to electricity is expected to be finished by June 1.

AN IMPORTANT DECISION has been rendered by Corporation Counsel Bailey to the effect that the city has the power to compel the West End (or any other) railway company to run cars when and where it may be deemed necessary for the convenience of the citizens, provided reasonable grounds can be shown for the running of such cars. The expense of operation and extent of probable patronage enter into the determination of "reasonable grounds."

CANADIAN NOTES.

TORONTO, Ont., May 23, 1895.

NIAGARA FALLS, ONT.—It has been decided to change over the Clifton & Drummondville street railway to electricity.

NESS, McLAREN & BATE, 749 Craig Street, Montreal, have succeeded to the manufacturing and supply business of the old firm of T. W. Ness & Co., and have purchased the entire stock of James L. Rankin, which they intend to dispose of at cut prices.

MONTREAL, QUE.—The Montreal General Hospital will receive tenders, first, for the plant necessary for supplying electric current in the hospital, say for 1,000 lights of 16 cp; second, for supplying the same number of lights, and in addition four motors of an average of 9 hp each.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON May 15, 1895.

ELECTRICALLY PROPELLED VEHICLES.—It was announced in the House of Commons last week that a bill regulating the propelling of vehicles by electricity on common roads would shortly be introduced.

MUNICIPAL PURCHASE OF ELECTRIC LIGHT UNDERTAKINGS.—The Liverpool Electric Supply Company is apparently about to be bought up upon very favorable terms, by the corporation of Liverpool. The present paid-up capital of this company is £250,000, and I understand that there is every likelihood of their getting £400,000 from the corporation for their business.

MUIRHEAD AND OTHERS VS. COMMERCIAL CABLE COMPANY.—The action brought by Dr. Alexander Muirhead and others to enforce the payment of royalties by the Commercial Cable Company for the use of their "Duplex" patent, which was decided in favor of the plaintiffs in the court of first instance, and against the plaintiffs on appeal, came before the House of Lords yesterday and was amicably settled, the company having agreed to pay the plaintiffs a large sum by way of damages.

ELECTRIC RAILWAY WORK.—A curious case of considerable interest to the electrical industry, recently came before the law courts. It was an application by the receiver of the Mersey Railway Company for permission to spend £800 in promoting a bill in Parliament, granting the company power to run its trains by electricity. The Court decided that money could not be legally expended in this way, at any rate unless there was unanimity on the point, which in this case there was not. Those, therefore, who desire to see this line worked electrically will have to pay the necessary parliamentary expenses out of their own pockets.

ELECTRIC TRACTION AT LEEDS.—It is now a little more than a year since the Leeds municipality took over the entire tramway system of that city. The aggregate mileage at present is 27 miles of track, and a proposal is now before the Town Council to provide the entire system and its extensions, amounting to some 14 miles, with electric traction, and this, with the exception of a few miles in the centre of the city, on the overhead trolley system. I may say that the receipts for the first year's working of the tramways by the municipality amounted to £51,000 and the expenditure to £44,000, the gross balance of nearly £7,000, owing to the necessity for provision for interest and capital redemption, being reduced to a net balance of £133. It may be urged in defence of this small return that the municipality, owing to the bad state in which the track and equipment were left by the company, has been under the necessity of effecting unusually heavy repairs out of revenue, and has of course, simultaneously reduced its employees' hours of work, and raised their aggregate wages.

ELECTRIC COMMUNICATION WITH LIGHT-HOUSES AND LIGHT-VESSELS.—The third report of the Royal Commission appointed to inquire into the subject of electrical communication with light-houses and light-vessels has just been issued, the first report having been published in December, 1892, and the second in March, 1894. The report gives some interesting particulars with regard to the liability of the cables to interruption, and with regard to the use made of the cables recently laid down. The commission state that they are satisfied that the recent telephonic connections have added in a very important degree to the effectiveness of the machinery which exists on the English coasts for the purpose of rendering aid to vessels in distress and to saving their crews from the perils of the sea; such connections not only enable light-house keepers and the crews of light-vessels to warn life-boats, as did the old visual signals, but they enable precise particulars to be sent to the shore as to the position and size of the vessel in distress. The report closes with an announcement that the members of the Royal Commission propose to proceed this summer to Denmark, and with a recommendation for further connections to cost £8 500 the new points to be connected including one light-vessel, one pile light-house, one rock light-house, and three shore light-houses.

THE WILLANS ENGINE.—An important paper "On the Recent Development of the Single-Acting High-Speed Engine for Central Station Work," was read by Mr. Mark Robinson at the Institution of Electrical Engineers on May 9. The paper, which embodies a description of the construction and action of the Willans engine deals principally with the merits of high-speed single-acting working for electric supply stations. The advantages of this type were considered in relation to economy, durability, cheapness of first cost, absence of vibration and several other points. A discussion was opened by Mr. Raworth of the Brush Company, who, in a very judicious speech, advocated the use of high-speed, but deprecated single action. Mr. Raworth paid several tributes, however, to the Willans engine. He was of the firm opinion that the high economy of this engine arises not so much from single action, as from the relative shortness of the stroke and the consequent effect of the clearance spaces. In his opinion, a bearing can be better lubricated if it is not under a constant thrust than if, as in the Willans engine, it is so maintained; for in Mr. Raworth's opinion, the alternation of thrust would enable oil to better distribute itself over the whole bearing surface. We expect to have an interesting continuation of the discussion at the next meeting, when the institution adjourns for the summer vacation.

MUNICIPAL ELECTRIC LIGHTING LOANS.—There has been a battle royal proceeding for some time past between the vestries of London on the one hand, and the London County Council and the government on the other; the former wishing to extend, as far as possible, the period over which they may spread the repayment of their electric lighting loans, and the latter wishing to curtail the same period within reasonable limits. The first proposal of the County Council was to strictly apportion the period of re-payment to the probable life of the particular item upon which each sum was to be expended. This idea was, no doubt, academically correct, but was practically impossible to carry into effect, and was withal, a somewhat irritating suggestion. Next, the government and the County Council decided that the money should be lent for 50 years in the case of loans granted for lands, buildings, culverts, bare copper mains, etc., and for 20 years only in the case of money expended on engines, boilers, dynamos, etc. The vestries of London have stood out for a period of 42 years irrespective of the object upon which the money was to be expended. This period they have at last succeeded in securing, the only proviso being that when money is granted to them for electric lighting purposes for this period, all renewals and repairs are to be paid out of the revenue. It is to be hoped that this decision is final as the requirements of sound finance seem to be met by this plan.

General News.

NEW INCORPORATIONS.

THE PEOPLE'S TELEPHONE COMPANY, Haverhill, Mass., capital stock $1,000, has been formed to transmit intelligence and to deal in telephone instruments. Ed. H. Hoyt, P. C. Sweet and Franklin Woodman are interested.

THE GUAYAQUIL GENERAL ELECTRIC COMPANY, of New York, has been incorporated to do electric lighting and all other business in which electricity is used. Maximum capital $50,000. Promoters, Manuel de J. Alvarado, Brooklyn, N. Y.; Vicente Harvie Emes, Frank E. Rogers, N. Y. City.

NEWTOWN LIGHT & POWER COMPANY, Newtown, L. I., N. Y., has been incorporated with a capital stock of $20,000, to generate and sell electricity. The promotors are I. C. Smith, Babylon, L. I., N. Y.; C. B. Gallagher, Brooklyn, N. Y.; Francis McKenna and Geo. S. Jervis, Maspeth, L. I., N. Y.

THE CITIZENS' RAILWAY COMPANY, Denver, Col., capital stock, $[illegible], has been formed to build and operate electric railway lines to connect Denver with other towns in Jefferson and Boulder counties. Milo A. Smith, Chas. E. Hawyer, E. S. Smith, Clarence M. Cobb and Thos. W. Porter all of Denver, are interested.

THE LA SALLE CONSTRUCTION COMPANY, Chicago, Ill., capital stock $100 000, has been formed to construct railways or tramways to be operated by steam, electricity, or other motive power; build bridges, boats, barges, and do a general contracting business. The promoters are W. E. McClurg, C. H. Bumstead and F. S. Donnell.

THE CITY & PROSPECT HEIGHTS STREET RAILWAY COMPANY, Peoria, Ill., capital stock $150,000, has been formed to construct, maintain and operate a street railway to be operated by horse, electric or other motive power. The promoters are W. S. Turner and Chas. Edwards, Woodbridge, Ind., and Jno. C. White.

ALAMO HEIGHTS RAILWAY COMPANY, San Antonio, Tex., has been incorporated to operate street railways and suburban or belt lines of railways within or near San Antonio, Tex., by Chas. W. Ogden, C. L. Harwood, S. K. Buchanan, San Antonio, Tex.; Edwin Packard, Spencer A. Jennings, Brooklyn, N. Y. The capital stock is $62 000.

THE BELL ELECTRIC COMPANY, Trenton, N. J., has been incorporated with a capital stock of $100,000, to manufacture and sell electric singe cutting combs and other electric apparatus and appliances. Frank M. Bell, New York; Geo. A. Westbrook, Wm. Childs, Jr., Brooklyn, and Abram V. Robinson, Trenton, N. J., are the promoters.

THE LA CROSSE, BLACK RIVER FALLS & MILLSVILLE ELECTRIC RAILWAY COMPANY, La Crosse, Wis., has been incorporated. The capital stock is $500,000. The company proposes to build an electric road from La Crosse to Millsville. The promoters are N. Clark, P. McHugh, Wm. H. Polleys, T. J. McHugh, Wm. Burns, La Crosse, Wis.

THE HARRINGTON, FREDERICA & DENTON ELECTRIC RAILWAY COMPANY, Denton, Md., has been incorporated with a capital stock of $350,000, by Robert W. Reynolds, Ezekiel Fleming, H. Harrington, B. L. Lewis and others, to build and operate an electric road extending from Frederica to Burrsville and passing through the town of Harrington, thence to Denton.

THE BISSELL, DODGE & ERNER COMPANY, Toledo, O., capital stock $25,000, has been formed to manufacture, repair and deal in all kinds of electrical and other machinery, tools, etc; also to contract for and construct all kinds of electrical and mechanical plants, etc. The promoters are Fred Bissell, Fred H. Dodge, John A. Erner, A. W. Scott and G. G. Keip.

THE MILWAUKEE & WAUKESHA STREET RAILWAY COMPANY, Milwaukee, Wis., has been incorporated with a capital stock of $1,000,000. Among those interested in the company are Max Rosenthal, James Pettro, A. B. Meyers, Stutley I. Henderson, Jacob Wellauer and Joel W. Bingham, of Milwaukee, and John J. Constantine, Charles Peltelkow and Andrew Snyder, of Waukesha.

THE SANBURN ELECTRIC RAILWAY COMPANY, Chicago, Ill., has been incorporated with a capital stock of $250,000. The incorporators are James W. Kenney, Oscar L. McMurray, Homer K. Galpin, J. S. McGlashin, of Chicago, and George O. Talbot, of DeKalb, Ill. It is the purpose of the company to construct an electric railway from Chicago to towns in Cook, Lake and DuPage counties.

THE DIGHTON, SOMERSET & SWANSEA ELECTRIC STREET RAILWAY COMPANY, Taunton, Mass., has been organized with the following officers: President, Col. B. D. Davol, Fall River; clerk, Orville A. Barker, Taunton; treasurer, S. M. Thomas, Taunton. The directors are the officers and F. M. Brightman, of Fall River; Cornelius A. Davis and Henry B. Leonard, of Somerset; N. Allen Walker, of Dighton; J. N. Beckley and George Wellman, of Rochester; N. Y., and Henry H. Crapo, of New Bedford.

TELEGRAPH AND TELEPHONE.

NEW BERNE, N. C.—The city has granted a franchise to P. H. Pelletier, James Redmond, and others to establish a telephone system.

NIAGARA FALLS, N. Y.—The Postal Telegraph Company has commenced excavating for the conduits in which to lay its wires on Fall Street.

WATERTOWN, N. Y.—The Central New York Telephone & Telegraph Company has announced a reduction of telephone rates to $24 a year for business places and $18 a year for private residences.

REYNOLDSVILLE, PA.—A $25,000 school building will be erected here, and it is proposed to put in an interior telephone system to connect the principal's room with the class-rooms. M. M. Davis is secretary of the school board.

UTICA, N. Y.—At a recent meeting of the Baxter Overland Telephone & Telegraph Company, a committee was appointed to confer with an electrical expert and secure estimates as to the probable cost of placing the plant of the company in operating order. Directors: C. W. Mather, J. N. Turnbull, Benjamin B. Gilbert.

GALVESTON, TEX.—The Southwestern Telephone & Telegraph Company will connect Marlin with all the principal points in the State. A complete system will be introduced in the city. The company will construct a four-wire line from Bremond to Waco, thus connecting Marlin with the line in course of construction from Houston to Corsicana.

ELECTRIC LIGHT AND POWER.

NORWOOD, O.—The citizens have voted to issue bonds for an electric lighting plant.

EASTPORT, ME.—H. Blanchard & Sons are in the market for a 100-light incandescent plant.

ALBION, N. Y.—A movement is in progress to extend the Morton-Troutburg telephone line to Holley.

SLEEPY EYE, MINN.—The village electric light plant was recently destroyed by fire. Loss $8,500.

BALTIMORE, MD.—The Park Board has decided to substitute arc lights for the incandescents now in use at Druid Hill Park.

MURFREESBORO, TENN.—A bill has been passed in the legislature authorizing the city to issue bonds for an electric light plant.

SPRINGFIELD, MO.—An election will be held soon to vote on the issue of $60,000 in bonds to establish a municipal electric light plant.

ST. IGNACE, MICH.—J. F. Keightley has been granted a 30-year franchise for an electric light plant and telephone system at Mackinac Island.

NORTHFIELD, VT.—At a village meeting, recently held, it was voted to purchase an engine for the electric light plant. F. L. Howe is clerk.

WILLIAMSTOWN, PA.—The Williamstown Borough Council has granted right of way to the Lykens Valley Telegraph & Telephone Company.

LANSINGBURGH, N. Y.—Sealed proposals will be received until 8 p.m., June 10, for lighting the streets by electricity. George Gramm is village clerk.

LA CROSSE, WIS.—Engineer Cole has been instructed to make plans for and estimate the cost of an electrical light plant for street and other public lighting.

MARTINS FERRY, O.—At a meeting of the City Council, the light committee was instructed to take options for 30 days for a site for the electric light plant.

MADISONVILLE, CONN.—I. Bailey wants estimates on a complete electric light plant to furnish 50 arc lights of 2,000 cp each, and 500 incandescent lights of 16 cp each.

FLUSHING, L. I., N.Y.—The Business Men's Association has passed a resolution requesting the village trustees to have Broadway and Main Street lighted by electricity.

LEXINGTON, KY.—Sealed bids will be received until June 19 for lighting the streets on an all night schedule with gas or electricity or both for five or ten years from Oct. 1.

HAMILTON, ONT.—The Hamilton & Lake Erie Power Company have made application for a charter to the Parliament to acquire a site for and to build electrical works, etc.

PORTLAND, ME.—The Dirago Telephone Company, of Maine, has made application to the city for permission to erect lines of telephone poles and to lay telephone wires underground.

EAST BRIDGEWATER, MASS.—The Whitman Electric Light Company has accepted the franchise offered it by the East Bridgewater Selectmen, and will at once commence to wire the streets of that town.

CAMDEN, N. J.—At a meeting of the Board of Freeholders, an appropriation of $2,000 for an electric plant at the asylum almshouse was made. Freeholders Young, Martin and Anderson are in charge.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the District Commissioners until 12 m., June 3, for lighting the streets of the District of Columbia, other than for present arc lamp service, beginning July 1.

BROOKLYN, N. Y.—The Department of City Works, Municipal Building. Sealed proposals will be received until 12 m., June 4, for furnishing electric lights for the streets and public buildings of the city of Brooklyn for the year 1895. Alfred T. White is commissioner.

PHILADELPHIA, PA.—The Overbrook Electric Light Company asks the Common Council for leave to erect its lines on the streets running through the property of the Drexel syndicate, and for the location of 33 public lights, for which it will maintain five free of cost to the city.

ATHENS, O.—Sealed proposals will be received until June 20, at the office of the superintendent of the Athens State Hospital for a complete electric lighting plant for that institution. Plans, etc., are on file at the hospital, or can be had on application to Dr. C. O. Dunlap, superintendent.

EL PASO, TEX.—Sealed proposals will be received at the office of the city clerk until Aug. 2, for lighting the streets of the city by electricity, for a term of five years, from Dec. 1. Not less than 50 lights to be furnished, and as many more as the City Council may order. All lights to be of not less than 1,200 candle-power, and to be run by moon schedule.

CLARE, MICH.—Mr. A. J. Doherty, president and general manager of the Clare Electric Light Company, has just completed a new central station plant consisting of a 1,000-light Wood incandescent dynamo, a 50 light Wood arc dynamo and a 150-hp Russell four-valve engine. Cost of plant, $10,000; building and pole line, $5,000. The company has a five-year contract for the city lighting. Mr. Doherty expresses himself as more than pleased with the new machinery.

THE ELECTRIC RAILWAY.

PITTSFORD, VT.—An electric road from Pittsford to Rutland by way of Proctor, is talked of.

MANCHESTER, N. H.—The Manchester Street Railway Company will extend its road to Lake Massabesic.

OSHKOSH, WIS.—The Oshkosh Street Railway Company is taking preliminary steps toward electric equipment.

DUBLIN, PA.—At a cost of $128,000, the trolley line will be built from Dublin to Souderton, a distance of eight miles.

NEWARK, N. J.—Ground has just been broken for the construction of the Passaic & Newark Electric Railway at Franklin.

EVANSBURG, PA.—F. A. Shoemaker, of Evansburg, is interested in the promotion of an electric railway from Johnstown to Evansburg.

ALLENTOWN, PA.—Lahr, Leh & Martz, surveyors for the Allentown & Reading Trolley Railway, have received orders to complete the survey

LAPORTE, IND.—The Common Council has granted a 25 year franchise for a street railway to H. B. Tuthill and A. G. Tillotson, of Michigan City.

ATLANTIC CITY, N. J.—It is proposed to construct a trolley line from Atlantic City to Camden. James Scott, of Chester, Pa., can probably give information.

UTICA, N. Y.—Clinton Beckwith, of Herkimer, N. Y., is the chief promoter of the company organized to build and operate a road between Franklin and Utica.

ORLANDO, FLA.—E. W. Henck has commenced surveying with a corps of engineers for his electric railway to parallel the South Florida Railway to Orlando.

MILWAUKEE, WIS.—The McGartney Street Railway Company of the west side has commenced running cars. This line will be extended several miles this summer.

PITTSFIELD, MASS.—The Pittsfield Street Railway Company has petitioned the city authorities for permission to extend its tracks through Orchard and other streets.

YOUNGSTOWN, O.—A special election was held at Canfield, this county, for bonding the township to build an electric street railway to this city, a distance of ten miles.

NEW BRUNSWICK, N. J.—The New Brunswick Street Railway Company has consummated the purchase of property for a power house for the trolley road to be built soon.

WILKESBARRE, PA.—At a meeting of the City Council an amendment to the ordinance was submitted, permitting the Traction Company to construct a railway over the heights.

TOLEDO, O.—The five street car lines, commonly called the Consolidated Street Railway system, have been incorporated under one head, known as the Toledo Traction Company.

WATERLOO, N. Y.—The Corporation Board of Waterloo has granted a franchise to the Geneva, Waterloo, Seneca Falls & Cayuga Lake Railway Company to extend its line to Waterloo.

PERTH AMBOY, N. J.—Edward Radell, secretary of the new trolley company that is to encircle Middlesex County, is at work upon plans for the road. Gottfried Cruger is also interested.

FLUSHING, L. I., N. Y.—The Board of Supervisors has granted permission to the Atlantic Improvement Company to extend trolley lines to the Long Island City and Newtown road to Flushing.

EAST BRIDGEWATER, MASS.—The Selectmen of East Bridgewater will grant a franchise to the Brockton and East Bridgewater companies for the construction of an electric railway through the town.

HARTFORD, CONN.—At a recent meeting of the Board of Aldermen, a petition was received from the Hartford Street Railway Company asking for privileges to build a double track on Farmington Avenue.

TROY, N. Y.—Electricity will be used as the motive power on the new road, although the roadbed will be so constructed that steam may be used when the Troy & New England scheme is entirely carried out.

KANSAS CITY, KAN.—The car house and machine shop of the West Side Street Railway Company, Third and Oakland Avenues, recently damaged by fire to the extent of $25,000, will be rebuilt on the same site.

HARTFORD, CONN.—A meeting will be held by the Common Council at the City Hall, to consider the plans of the Hartford Street Railway Company for additional tracks on various streets of the city. Henry F. Smith is city clerk.

STONEHAM, MASS.—It is proposed to build an electric street railway between Stoneham Winchester and Arlington. Hon. Onslow Gilmor, of Stoneham, and Hon. A. B. Coffin, of Winchester, will be on the board of directors.

CLINTON, N. Y.—It is proposed to build an electric railway from Clinton to New Hartford, connecting with the Utica Belt Line Road. A committee consisting of Ellery Stebbins, Francis Tasker, James L. Dempsey and others have viewed the proposed route.

CAPE ELIZABETH, ME.—The Cape Elizabeth Street Railway Company has been organized for the purpose of constructing and operating by electricity or animal power, a street railway. Directors: Jacob S. Winslow, of Portland, Me.; Albert D. Boyd, of South Portland, Me.

NEWBURGH, N. Y.—Surveyors have been making preliminary surveys of the towns of Newburgh, Marlboro and Lloyd, for the purpose of establishing a trolley route to connect the Walden extension of the Newburgh & Walden Electric Railway with the Poughkeepsie bridge.

FAIR HAVEN, CONN.—The Fairhaven & Westville road has purchased the charter of the New Haven & North Haven Electric Street Railway Company, with the right to run out Davenport Avenue to Mt Montowese, about two miles, and the construction will be commenced at once.

THE FORT MADISON WATER COMPANY has been incorporated at Portland, Me., with a capital stock of $250,000, to manufacture gas and electricity, machinery and fixtures for gas, electric and water plants. The promoters are Wm. C. Eaton, Edw. D. Noyes, and Geo. F. Noyes, Portland, Me.

RUMFORD FALLS, ME.—At a meeting of the Rumford Falls & Rangeley Lake Railway directors, held in Portland, May 11, it was voted to extend the road to Rangeley Lake this summer. The directors are desirous of receiving bids for the same, which will be opened June 10. Waldo Pettingell is resident engineer.

MILFORD, MASS.—Boston capitalists have notified Milford business men that they would help to operate a trolley road from Milford Postoffice to Hopkinton Centre, if a reasonable Milford franchise was given. C. W. Shippee, a local manufacturer, treasurer; R. B. Green, of the Milford Electric Light Company, and others are interested.

BROOKLYN, N. Y.—The Union Street Railway Company has renewed its petition of June and July, 1892, and its petition of May 22, 1893, for permission to construct, maintain and operate a street surface railway, to be operated by electric motive power, with the necessary switches, etc., from Ferry Place through Hamilton Avenue to Union Street, and thence through Union Street to Ninth Avenue.

Trade and Industrial Notes.

HARRY M. SHAW, dealer in electrical supplies, at 136 Liberty Street, New York reports a great improvement in business. Mr. Shaw has been appointed New York agent for the Eureka Tempered Copper Company.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has issued a handsome 72-page catalogue containing full data concerning its well-known "Chloride" accumulators, as well as charging switches, special switches, measuring instruments and all accessories to accumulator work.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, reports having just closed arrangements for the exclusive sale in the West of the well-known Upton arc lamps for direct and alternating constant-potential circuits and regular series arc work. The lamp is extremely simple in construction and correspondingly low in price and is meeting with favor.

A. L. BOGART, 22 Union Square, New York, has succeeded in perfecting a system of electric gas-lighting applicable to Welsbach burners which has been adopted by the parent manufacturing company. The system includes devices for lighting by plain pendant pulls, pillar cock pendants, push buttons, etc., corresponding with the standard gas lighting systems well known to the trade.

THE HUYETT & SMITH MANUFACTURING COMPANY, of Detroit, Mich., has issued a new catalogue—No. 29—of ventilating fans, cupola and forge blowers, exhaust fans, etc. These are furnished with pulleys or direct-connected to electric motors, steam engines, or water motors, as may be preferred by the purchaser. The catalogue is well illustrated and rather handsomely executed.

THE METROPOLITAN ELECTRIC COMPANY, 186-188 Fifth Avenue, Chicago reports a very good demand for the well-known P. & B. products, and the portable hose bridge recently illustrated in THE ELECTRICAL WORLD, for which several orders have been received. The company is now in position to fill orders from stock for the well and favorably known solar arc lamp for incandescent circuits.

THE M. C. BULLOCK MANUFACTURING COMPANY, 1170 Lake Street, Chicago, is distributing a fine new catalogue of its Willans "central valve" engines, in which the engines are fully described and illustrated. Some interesting curves are given, which were obtained from a test of a combined Willans engine and Siemens dynamo. The construction and action of the engine are exhaustively explained.

THE HOPPES MANUFACTURING COMPANY, of Springfield, Ohio, has just closed a contract with Russell B. Harrison, president of the Terre Haute Electric Railway Company, Terre Haute, Indiana, for two live steam feed-water purifers of 1,000 hp capacity. It also reports the following recent sales of its exhaust steam heater to electric lighting and railway stations: Columbus Central Railway Company, Columbus, O., 1,100 hp; Rochester Railway Company, Rochester, N. Y., 2,250 hp.; Sheridan Electric Company, Sheridan, Wyo., 200 hp; Kansas Light & Water Company, Lawrence, Kan., 200 hp.

THE PHŒNIX IRON WORKS, of Meadville, Pa., reports the following sales of "Dick & Church" engines, by Edward F. Austin, manager of the Pittsburgh office of the company: One 16x15 automatic cut-off engine to the National Water Works & Construction Company; two 300 hp engines to the Detroit & Mt. Clemens Electric Railway; three 14⅛x15 automatic cut-off engines to the National Tube Works Company, of McKeesport, Pa., and one 18½ x 18 automatic engine, together with two boilers, feed-water heater, pump, etc., to Robert Simons, president of the Pittsburgh, Frontenac & Suburban Railway Company, of Pittsburgh, Kan. Mr. Austin reports the boiler department running to full capacity and the outlook for business good.

THE WALKER MANUFACTURING COMPANY, Cleveland O., reports the following recent sales: Detroit Railway Company, Detroit, Mich., one 750-kw direct-connected generator, being the second machine of this size which the Detroit Railway have ordered from the Walker Company; Aurora Street Railway Company, Aurora, Ill., nine complete car equipments, and 18 25-hp steel motors (this order was awarded after a thorough test had been made of three or four of the leading makes of motors, and is the second order awarded the Walker Company by the Aurora Company); Akron Street Railway Company, Akron, O., two 200 kw direct coupled generators; three complete car equipments, six 30-hp steel motors (this is the third order received from the Akron Street Railway Company); New York, Elmsford & White Plains Railway Company, White Plains, N. Y., one 75-kw belted generator; three complete car equipments, six 25-hp steel motors; Lakeside Railway Company, Mahanoy City, Pa., two complete car equipments, four 50-hp steel motors; W. C. Thayer, Cleveland, O., two 200-kw direct coupled generators, 10 complete car equipments, 20 50-hp steel motors, one complete car equipment, two 100-hp steel motors; Ashland & Catlettsburg Street Railway Company, Ashland, Ky., two complete car equipments, two 30-hp steel motors. The shops of the Walker Company are still running both day and night, and their force is being increased almost every day.

THE BALL ENGINE COMPANY, of Erie, Pa., reports the following recent shipments: Library of Congress, Washington, D. C., three 175-hp engines, direct-connected to Mather dynamos; Rock Creek Railway Company, Washington, D. C., one 300-hp tandem-compound engine with extended sub-base and divided connecting head; Hahne & Co., Newark, N. J., one 125-hp engine; Baltimore City Jail, Baltimore, Md., one 85-hp engine; C. Jevne & Co., store building, Chicago, one 60-hp engine, direct-connected to Siemens and Halske dynamo; City of Wells, Minn., one 70-hp engine, direct-connected to General Electric dynamo; Catholic University, Washington, D. C., two 50-hp engines; Tootle, Wheeler & Motter, store building, St. Joseph, Mo., one 100-hp engine; Mount Washington Light & Power Company, Hollins, Md., one 100-hp engine. J. M. Warner, electric light plant, Oneida, N. Y.; one 60-hp engine; Tarentum Passenger Railway Company, Tarentum, Pa., one 100-hp engine; Swofford Dry Goods Company, Kansas City, Mo., one 60-hp engine; Juvenile Female Offenders' Home, Geneva, Ill., one 60-hp engine, direct-connected to C. & C dynamo; C. E. Johnson & Co., Chicago, one 40-hp engine, direct-connected to Western Electric dynamo; J. F. Weissner & Sons, brewery, Baltimore, Md., one 50-hp engine; Duquesne Electric Supply & Construction Company, Pittsburgh, Pa., one 85-hp engine; C. D. Kaier Brewing Company, Mahanoy City, Pa., one 60-hp engine; Chesapeake Light & Power Company, Hampton, Va., one 40-hp engine; Bucyrus Steam Shovel Company, Bucyrus, O., one 25-hp engine; City Bank Building, Buffalo, N. Y., one 60-hp engine; D. M. Rhea, Fulton, Ky., one 125-hp engine; Western Electric Company, Chicago, one 60-hp engine direct-connected to Western electric dynamo.

Business Notices.

ELECTRIC LEAGUE.—Meets every Thursday evening, 100 West 24th Street. Electrical engineers and electricians cordially invited.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 21, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

539,418. CONDUIT SYSTEM FOR ELECTRIC RAILWAYS; W. H. Cotton, St. Louis, Mo. App. filed Aug. 25, 1894. The combination of a conduit having therein a contact shoe consisting of a flexible central insulated web or partition having metallic sides, the said sides being provided with upright contact rollers and divided into sections having interlocking ears or lugs.

539,431. ELECTRIC BELL; F. G. Ingersoll, New York, N. Y. App filed Oct. 26, 1894. The combination of an electromagnet, an armature carrying a contact, a stationary conducting strip, an insulating block, a plate of insulating material partly covering the said strip and provided with inclined sides, and a stop to limit the movement of the armature.

539,437. MICROPHONE; E. J. P. Mercadier and J. M. Anizan, Paris, France. App. filed June 3, 1893. A microphone having a vibrating plate, rotatable carbon pencils and flexible spring wires arranged for mechanically changing the microphonic contact points of the said carbon pencils.

539,446. SYSTEM OF ELECTRICAL DISTRIBUTION; E. W. Rice, Jr., Swampscott, Mass. App. filed May 24, 1893. A system comprising separate circuits connected together in multiple; switches at intervals along said circuits whereby the main circuit is divided into sections, normally open cross-connections connecting the circuits of one section with the opposite circuits in the next section, and a two-way switch whereby either of said cross-connections may be close-circuited, and ground terminals at the ends of said sections adapted to be connected to either of the circuits.

539,450. SYSTEM OF ELECTRICAL DISTRIBUTION; C. P. Steinmetz, Schenectady, N. Y. App. filed Dec. 20, 1894. A method of electrical distribution consisting in supplying alternating currents of a given phase relation for operating light coupled in one of the branches into which the system is divided, and alternating currents of different phase relation for operating motors connected to one or more other branches of the system, and transferring energy between the lighting and motor branches through a balance wire to preserve the proper distribution of load.

539,452. ELECTRIC METER; C. P. Steinmetz, Schenectady, N. Y. App. filed Feb. 19, 1895. A meter comprising recording and braking mechanism, and two armatures on the same shaft or geared together, one in circuit across the main power leads with an appropriate resistance, and the other in circuit between the teaser wire and a neutral point dividing the voltage in the main circuit; field coils for the two armatures, and means for maintaining the excitation of the field coils proportional to the current flowing in the main and teaser circuits.

539,453 and 539,454. CARBON BRUSH. E. Thomson, Swampscott, Mass. Apps. filed Feb. 6, 1895. A brush composed of carbonized fibrous material of woven texture, the layers of which are plated with metal and assembled together to the required thickness, and are united at one end and enclosed with a strengthening case.

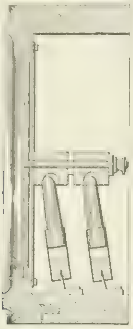
539,484. ELECTRO-THERAPEUTICAL BODY WEAR; W. J. Newton, H. L. Purbrook and H. De C. Hudson, Wellington, New Zealand. App. filed Aug. 31, 1894. The combination of a belt, a battery, the electrodes being connected therewith and arranged to different points on the belt, a breastplate having a contact surface to bear on the body.

539,500. AUTOMATIC TIME SWITCH FOR STORAGE BATTERIES; W. Biddle, Brooklyn, N. Y. App. filed May 18, 1894. The combination of two secondary batteries and an energizing dynamo, a time controlled circuit-closer formed of a disc with insulating material and metallic contacts, springs resting upon such circuit closer, a three-point switch and two electromagnets and their armatures acting in opposite directions, conductors extending from the secondary batteries to the two insulated contacts on the moving switch, and circuit connections to the stationary contacts of this switch.

539,501. ELECTRICAL INSTRUMENT FOR MEDICAL PURPOSES; B. Y. Boyd, Wichita, Kan. App. filed Aug. 27, 1894 An instrument consisting of an outer handle having the positive and negative parts, an insulator forming the lining and separating the positive from the negative, and a galvanic battery having positive and negative poles connecting the said outer casing with the battery.

539,511. SIGNAL BOX ATTACHMENT; A. Gruner, San Francisco, Cal. App filed July 28, 1894. A call box having mechanism set by outside means, an electromagnet with a local circuit, a spring-actuating lever in the box, with an extension on the lever for retaining the mechanism in a set condition, and a [illegible] connection between the armature and lever, released upon the downward movement of the armature.

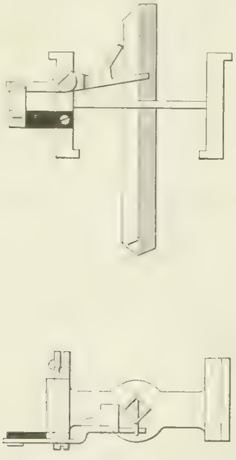
[illegible] TELEGRAPH RELAY; A. Gunner, San Francisco, Cal. App. filed July [illegible] The combination of a magnet having independently operated coils, a battery, independent wires leading from the coils to the battery, and from the battery to a main circuit, a supplemental wire leading from the battery and forming an auxiliary intermediate circuit through the ground or otherwise, and a switch in the ground circuit



No. 539,437.—Microphone.

539,516. TROLLEY FOR ELECTRIC RAILWAYS; J. W. Hoag, Newark, N. J. App. filed Jan. 19, 1895. The combination of a trolley arm, a bracket connected therewith, a tubular post having projecting arms mounted upon it, and means for connecting the arms.

539,529. ELECTRIC RAILWAY SIGNAL; H. V. & A. C. Miller, Bloomington, Ill. App. filed Jan. 5, 1895. A signal system having a ground connection adapted to be used in connection with an electrically actuated signal, having an auxiliary contact rail, an electromagnet interposed between it and the ground, a make and break armature lever for the magnet provided with an insulated contact piece, two contact posts, one of which is adapted to be electrically connected with the ground when contacted by the make and break armature lever, so constructed that when current flows from the rail through the magnet to the ground the armature lever with its contact piece is vibrated to close the ground connection.



No. 536,622.—Cut-Out for Arc Lamps.

539,559. ELECTRICAL LOW WATER INDICATOR FOR BOILERS; C. D. Tisdale, Boston, Mass. App. filed April 19, 1894. The combination of a glass tube connected with the boiler above and below the normal water level of the boiler, an auxiliary connector inserted between the lower boiler connection and the lower end of the glass tube, electrical conductors extending through the sides of the auxiliary connector, thence upwardly in the glass gauge tube, a metal float having a convex surface and adapted to form an electrical connection between the electrical conductors, and an electrical generator and alarm device.

539,576. ELECTRIC SAFETY SYSTEM FOR RAILWAY DRAWBRIDGES; E. Deming, Brooklyn, N. Y. App. filed April 4, 1894. The combination of a drawbridge having tracks and a third rail or electric conductor, different generators upon the opposite sides of the same, one being connected to the central and side rails of different tracks, and the other generator being connected to the remaining rails and a pair of magnets placed upon each locomotive having armatures which independently control the motive power of the said locomotive and connect any circuit with the central conductor and different side rails.

539,583. ELECTRIC CUT-OUT; J. R. Hersh, Denver, Col. App. filed Jan 11, 1895. The combination of a case having conductor wires connected therewith, a disc mounted to rotate therein and having a series of fusible metallic links upon one face and a series of ratchet teeth upon the other, a lever and pawl, and means for connecting the fusible links with the conductor wires.

539,585. RHEOSTAT FACE PLATE WITH SUPPLEMENTAL RHEOSTAT; F. Kreamer and M. Kruger, Chicago, Ill. App. filed Sept. 19, 1894. A rheostat having a main switching device, and an auxiliary device controlled thereby and adapted to be intermittently brought into circuit therewith, the total amount of resistance in said auxiliary switching device being approximately equal to the amount of resistance between two contact posts of the main switching device.

539,616. ELECTRICAL BOND CLAMP; A. Green, Rochester, N. Y. App. filed Aug. 27, 1894. A rail-bond comprising a loose gib provided with a groove to fit a bond wire or rod, and provided with means for tightening it upon the rail.

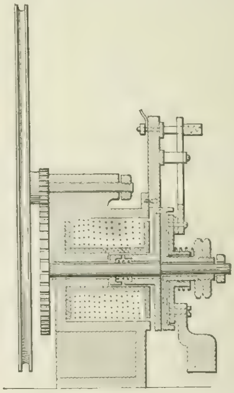
539,622. CUT-OUT FOR ARC LAMPS; P. Kirkegaard, Brooklyn, N. Y. App. filed Nov. 9, 1894. The combination of a carbon rod and a cut out lever pivoted adjacent thereto, the rod standing in the path of movement of the lever, preventing its movement, and a pin or projection at the extremity of the rod adapted to engage with the lever and swing it when the rod has moved out of the path of the lever.

539,636. TRANSMITTER DIAPHRAGM; G. A. Nellis and Florence S. Weisser, Allegheny, Pa. App. filed March 11, 1895. A transmitter diaphragm composed of aluminum with a small percentage of nickel and iron.

539,681. BASE FOR TROLLEY POLES; A. Green, Rochester, N. Y. App. filed Sept. 5, 1894. A trolley base having a base plate formed with a socket step lined with a series of rolls, a swiveling head with arbor fitted within such rolls, the head being provided with suitable tension springs adapted to engage and hold the pole in an upright position.

539,701. MULTIPLE SIGNAL TRANSMITTER; B. J. Noyes, Boston, Mass. App. filed Nov. 4, 1890. A multiple signal transmitter consisting of a units and tens group of rotatable signal wheels, a normally open signaling key for and adapted to be closed by each signal wheel, and a motor to rotate the wheels in unison, combined with a selecting device including a series of normally open contacts in electrical connection with a battery, a branch wire leading from one member of each key to a group of contacts, a single wire leading from the other member of all the keys to the battery circuit, and means for closing any one of the contacts of the selecting device, whereby the current is completed through one of the signaling keys at each revolution of the wheels.

539,712. TELEPHONE CALL; F. J. Troll, Washington, D. C. App. filed Sept. 22, 1894. The combination of a box, permanent magnets, a rotating armature arranged between the poles of the magnets, a coil spring fixed at one end of the armature shaft and directly connected to the same, a pulley attached at the other end, a metal tape wound about the pulley, and a lever connected at its inner end to the tape and extending through a slot in the box and a pull handle attached to the end of the lever outside of the box.



No. 539,778.—Rheostat Switch for Electric Motors.

539,725. CUT-OUT BLOCK; F. A. Chapman, Philadelphia, Pa. App. filed Feb. 5, 1895. A cut-out having a plug provided on each of its two sides with two chambers insulated from each other, one of them having a contact plate connected therewith, and the other a terminal to which is attached the other end of the wire, and a tap wire, and a casing enclosing the plug.

539,737. ELECTRIC TREASURE GUARD; R. A. Habersham, Portland, Ore. App. filed Jan. 3, 1895. The combination of a counter upon which money or other valuables are handled, one or more metallic plates forming a part of the said counter, a metallic floor plate adjacent to the said counter, an electric circuit including the said counter and floor plate or plates, and capable of supplying a current of dangerous strength, and a treasure box or boxes arranged to have metallic contact, and a switch for closing the circuit.

539,778. RHEOSTAT SWITCH FOR ELECTRIC MOTORS; F. B. Rae, Detroit, Mich. App. filed July 6, 1894. The combination of a stopping and starting switch, a rheostat switch whose resistance coils are upon the field magnet and connected in series with the armature coils, the said switch having also a self-closing contact device, actuating connection, and an electric clutch to make and break connection.

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TWO RUMORS.

It is reported in Wall Street that negotiations have been reopened between the General Electric and Westinghouse companies with a view to arriving at an amicable arrangement with respect to patents The recent rise of General Electric in the stock market has been ascribed to this rumor, but there does not seem to exist any ground whatever for its currency. The other rumor is that the Manhattan Elevated Railway has finally decided to supersede steam with electricity for motive power, but for this also no confirmation can be found. Periodically for some years it has been reported that this change was about to be made, but the time has now arrived when we may expect soon to hear that a really definite decision has been reached, though there seems to be no ground for believing that this has yet been done.

DIFFERENT POINTS OF VIEW.

The several different articles in this issue dealing with the reactance of alternating circuits show in what radically different ways the same matter may be treated. Taking, for instance, the subject of the neutralization of an inductance by a capacity in one place the explanation is based upon the practical conception of a choking coil and of a condenser, in which the former is considered to throttle a circuit and the latter to create a draft in it; acting in opposite directions, these two effects cancel each other when they have the same value, and the circuit acts as if it were non-inductive. By the graphical method of Messrs. Houston and Kennelly it is simple to see that in laying down the impedance diagrams for a circuit containing both inductance and capacity, since the values are applied in opposite directions they will cancel when equal; the impedance is thus made equal to the resistance, or the circuit acts as if non-inductive. The method of exposition adopted by Prof. Rosa is the analytical one, and while, perhaps, the most difficult to follow, has the advantage of more minutely considering each phase of the various phenomena and enabling quantitative expressions to be derived. It has, however, the disadvantage inherent to analytical methods, which consists in what we may call the machinery of analysis distracting the attention from the physical view, and the substitution of artificial or abstract conceptions for natural ones. The trained physicist, of course, is not misled by these ulterior considerations, but to others the introduction of conceptions not intimately connected with the subject under treatment is likely to increase rather than diminish the difficulty of understanding it. This of course does not apply so much to students whose education includes the methods of analysis, as to those who wish merely to understand a given subject without regard to other subjects with which it may be connected, and in which they have no interest.

RECENT PATENT DECISIONS.

Judging from letters we have received relating to the recent Berliner decision, considerable misconception seems to prevail as to the application of the decisions in the Bate and Miller vs. Eagle cases. We think it well, therefore, to repeat that the decision in the Bate Refrigerating case is held to have merely decided that revised statute 4887 means what it says—that a domestic patent expires with a foreign patent issued prior to the date of *issue* (not *application*) of a domestic patent granted to the same inventor for the same invention. The decision does not apply to the case of another inventor taking out a foreign patent for the same invention as an American patentee and prior to the date of issue to the latter, for this case is well covered by other principles. If the foreign patent is granted to the second inventor prior to the application for a domestic patent by the first inventor, it constitutes publication, and, therefore, bars the latter from obtaining a patent regardless of priority of invention. If, however, a foreign patent is granted one person subsequent to the application of another for a United States patent on the same invention, and the latter patent is then issued, but later than the date of issue of the foreign patent, the question of priority of invention is involved, and may be contested by either patentee in the courts. As to the Miller vs. Eagle decision, it has an importance, not on account of changing any previously existing practice, but because it authoritatively interprets the old established principle that two patents cannot be issued for one and the same invention. This principle has never been contested in its generality, but the decision above referred to is of legal interest from the fact that it gives the opinion of a court of last resort as to its application in an involved case. While a principle may be universally recognized, there are always cases in which its application is doubtful. The opinions of higher courts are, therefore, carefully studied by lawyers in such a case in order that they may strengthen their side by the great weight of precedent, thereby often exaggerating the real importance of a case appealed to, as in the present instance.

PHASE DIFFERENCES IN ALTERNATING CIRCUITS.

In another column we print a very lucid article on phase differences in alternating-current circuits, which appears to be a subject of some difficulty to those first taking up the study of alternating currents As will be seen by reference to the article, there are two distinct ways of looking at the matter of lag, one with respect to the circuit as a whole, and the other with respect to each of the parts of the circuit. The lag between the E. M. F. generated in the dynamo and the current flowing is a resultant of all the reactions in circuit, including that of the dynamo, but as to whether this total lag is great or small, the devices in the exterior circuit have, so to speak, no knowledge, the lag in each device being dependent on that device alone. However great this total lag may be, in a non-inductive portion of the circuit, such as one containing incandescent lamps, the current will be in phase with the E. M. F. between the terminals; and in a portion containing inductance, the lag between the terminal E M. F. and the current will depend only on its own reactance. A simple way of illustrating the effect of lag is to draw a sine curve representing the current in a circuit, and then to draw a smaller curve representing what we may call the "choking" effect of an inductive device included, or its reactive or counter E. M. F. due to the passage of the given current; this will also be a sine curve, but crossing the axis 90 degrees *behind* the first curve. The resultant of these two curves will give a third sine curve lagging behind the first one, and if the second curve is drawn to the same scale as the first one with respect to the E. M. Fs., the angle of lag between the current and impressed E. M. F. may be read from the scale of abscissæ. From this it will be seen that the cause of lag is the creation by the current passing through a device having inductance, of a reactive E. M. F. which, when compounded with the forward E. M. F., gives a resultant out of phase with the current. The case is to some extent comparable with that of a direct current motor; in the latter the forward and back E. M. Fs. are represented by straight lines and their resultant is a straight line, but in the case of an alternating current we have two sine curves, one 90 degrees behind the other, whose resultant is a sine curve having an intermediate lag with respect to the E. M. F. which would obtain in a non-inductive circuit, where, of course, it would be in phase with the current. If there are both a capacity and an inductance in a circuit, then we may draw another reactive E. M. F. curve representing what might be called the "sucking" effect of a condenser, which curve, however, will cross the axis 90 degrees *ahead* of the current curve. Finding, then, the resultant of the three curves, we will have a lag or advance of the E. M. F. with respect to the current, according to whether the inductance or capacity curve is the greater; if these two curves are of the same value, corresponding ordinates will have the same value, but one being positive and the other negative, they cancel and the E. M. F. remains in phase with the current. This latter case shows very clearly how a circuit having inductance, may, by the addition of a capacity, be made to act as a simple non-inductive circuit, the E. M. F. and current remaining in phase. As to the effect of lag, since the energy developed at any instant is the product of the current and E. M. F. at that instant, it has a maximum value when these are in phase and decreases until the difference in phase becomes 90 degrees, when there is no useful energy developed, notwithstanding that a large current may be flowing. As a consequence, to develop a given energy where there is lag, a greater E. M. F. and current at the dynamo are necessary, but on account of the lag, no more work is expended beyond that necessary to supply the increased C^2R loss in the line and devices on account of the increased current. Additional objections, however, are a greater E. M. F. in the generator, and, therefore, an increased strain on the insulation, and poorer regulation. It is sometimes said that the existence of lag in motor circuits will require a greater weight of line wire than if there were no phase difference; this, however, is doubtful, since the line would probably be calculated for full motor load, at which the current is nearly in phase with the E. M. F., and at any other load, or when running idle, the current would not exceed this maximum value.

Superheated Steam.

No possible improvement of the steam engine of which we have any knowledge at this moment, says Prof. Unwin, offers anything like so great a chance of important economy as the re-introduction of superheating, and especially of superheating to at least 100 degrees or more above the saturation temperature of the steam. He obtained in Alsace, on a very good 500-hp compound mill engine, with jackets and every appliance for economical working, an economy of 15 per cent. Mr. Muir Rumley has fitted a superheater to a Babcock boiler supplying a triple engine, and has obtained an economy of 10 per cent. In both cases the economy is economy of steam, and, therefore, is not due to any increase of boiler surface or increase of efficiency in generating the steam. Lately Prof. Schröter of Munich, has been experimenting with a small special compound condensing engine of only 60 hp, running at the moderate piston speed of 380 feet per minute, and with the not excessive boiler pressure of 165 lbs. per square inch. The high pressure cylinder is not jacketed. The low pressure is jacketed with receiver steam. In this case, in a tube superheater of a rather special construction, in the uptake of the boiler, the steam is superheated to 670 degrees F., or nearly 300 degrees above the saturation temperature corresponding to the pressure. In two trials of six and eight hours' duration, periods quite long enough for accurate determination of results with so accomplished an observer as Prof. Schröter, the consumption of steam was only 10.2 lbs. per indicated horse power hour, and the consumption of German coal of moderate quality only 1¼ lbs. per indicated horse-power hour.

It is often argued that as very little heat is required to superheat steam it cannot produce much effect. The answer is that a small amount of heat rightly applied in preventing initial condensation produces a disproportionately large effect. That is consistent with the strictest principles of thermodynamics. In the engine experimented with by Prof. Schröter, only 8 per cent. of the heat was used in superheating the steam, and to this 8 per cent. the remarkable economy is due. In a steam jacket acting well, about 12 per cent. of the steam used is condensed, and to this 12 per cent. the advantage of the jacket, which often reduces the amount of steam used in the cylinder by 20 to 30 per cent., is due. But the heat from a jacket is much less efficiently applied than the heat taken direct to the interior of the cylinder by superheated steam and used primarily in maintaining the temperature of the admission surface. Further, the quantity of superheat brought into the cylinder in a given time increases with the speed of the engine, while jacket heat diminishes in effect as the speed is greater. The action of the superheated steam is shown clearly enough on the indicator diagrams. In Prof. Unwin's trials in Alsace the wetness of the steam at cut-off in the high pressure cylinder with jacket, but without superheating, was 35 per cent.; with steam superheated 100 degrees it was only 15 per cent. In the trial with the Schröter engine there was no moisture at cut off in the high pressure cylinder, and the steam remained dry nearly to the end of the stroke.

On the Causes Producing Phase Differences in Alternating Current Circuits.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

Considerable difficulty is sometimes experienced by students in electricity in thoroughly understanding the circumstances leading to the difference of phase between electromotive force and current in alternating-current circuits. The authors have thought that the following brief discussion of the leading conditions controlling these influences might, perhaps, be acceptable to those who are not thoroughly familiar with the technical considerations of this subject.

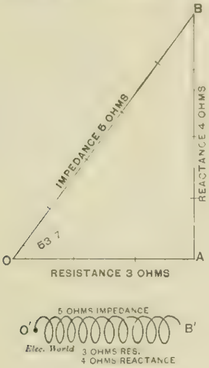


FIG. 1.

The only quality which opposes the passage of a continuous electric current is the resistance of the circuit, the current in such circuit being entirely defined by Ohm's law. In an alternating-current circuit, beside the ohmic resistance, there is also reactance, the combination of the resistance and the reactance of the circuit constituting what is called its impedance. The reactance of the circuit is always added to the resistance, but this addition is not made arithmetically but geometrically; that is to say, if resistance be represented by a straight horizontal line, the length of which stands for its numerical value, then reactance is also represented by a straight line at right angles to this. Thus, if a coil of wire, represented at *O′B′*, in Fig. 1, has a resistance *OA*, of three ohms, and a reactance *AB*, of 4 ohms, the impedance of the coil will be *OB*, or five ohms, as shown. If a continuous E. M. F. of 30 volts be connected to such a coil, it will possess only resistance and no reactance, so that the current strength passing through it will be $\frac{30}{3}$ or 10 amperes; but as soon as an alternating E. M. F. of 30 volts is applied to the coil, then the above reactance of four ohms being assumed, the impedance of five ohms will only permit $\frac{30}{5}$ = six amperes to flow through the coil. Further, the current flowing from the continuous E. M. F. will be driven by the full pressure of 30 volts, and will, therefore, exert an activity of 30 × 10 = 300 watts in the coil. The current of six amperes flowing through the coil from the alternating E. M. F. will have the same direction *OA*, Fig. 1. If the E. M. F. be considered as having the direction *OB*, that is to say, the current *OA*, lags behind the E. M. F. at an angle *BOA*, which has here the value of 53° 07′, or about 1-7th of a complete cycle of 360°. This angle *BOA*, is called the phase angle, and can in no case exceed or even equal 90°.

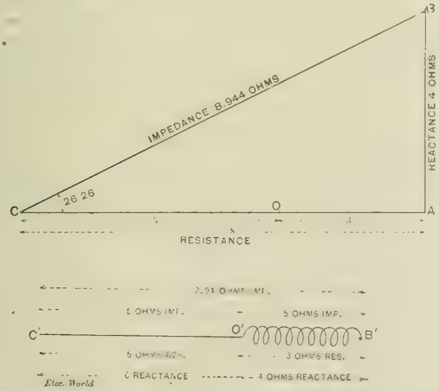


FIG. 2.

The preceding example will make it evident that although we may say generally that the impedance of a circuit is equal to its resistance, plus its reactance, yet it must be remembered that the addition is made geometrically, and that the phase angle depends upon the relative proportions of the reactance and the resistance. When the reactance is extremely small, the impedance is practically equal to the resistance, and the current strength is practically in phase with the E. M. F. On the contrary, when the reactance is very large, and the resistance small, the impedance is very much greater than the resistance, and the current strength is nearly at right angles to the E. M. F., or almost completely out of step with it. Such a current is usually described as a wattless current, that is to say, a current which requires practically no expenditure of power to maintain it.

In order to show the effect of placing impedances in series, let us suppose the preceding coil of wire to be connected in circuit with a straight length of German silver wire having a resistance of five ohms. The total resistance of the combination will now be 5 + 3 = 8 ohms, and the total reactance will be as before, 4 ohms, since the reactance of the straight wire will be negligibly small. The impedance will be 8.94 ohms, as shown in Fig. 2, and the current strength which would flow from an alternating-current pressure of 30 volts connected to such combination would, therefore, be 80 ÷ 8.94 = 3.354 amperes.

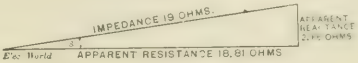


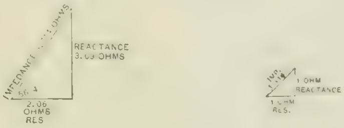
FIG. 3.

It will be observed that the angle of lag in Fig. 2 is only about half that which exists in Fig. 1. This is for the reason that while the resistance of the circuit has been increased its reactance is unaltered. The circuit taken as a whole is less reactant. Each portion, however, of the circuit, taken separately, must, of course, have the current in such phase with the pressure at its terminal, as its impedance diagram would indicate. Thus, in Fig. 2, the coil *O′B′*, will have the current lagging behind the pressure at its terminals by the angle *AOB*, of 53° 7′. The resistance *C′O′*, will have the current in step with the pressure at its terminals, while the whole circuit *C′B′*, will have the current 26° 26′ behind the pressure at terminals *C′B′*.

If, instead of adding five ohms of reactance less resistance as in Fig. 2, we had added 500 ohms, we should have obtained a circuit in which the lag was very small, and the current, therefore, very nearly in step with the pressure at terminals, but the current in the coil *O′B′*, would still be 53° 7′ behind the pressure at its own terminals.

As a practical example of the foregoing principles we may consider an alternating-current circuit consisting of

(1) A 60-kw alternator operated at 140 periods and 1,294 volts.
(2) A pair of overhead conducting wires, each two miles long.
(3) A 50-kw transformer at the receiving end.



FIGS. 4 AND 5.

If the transformer is operated at full load, it will probably have an impedance of 19 ohms, an apparent resistance of 18 81 ohms, and a reactance of 2 66 ohms, as shown in Fig. 3. It is to be observed that the apparent resistance (18.81) is always greater than the actual or ohmic resistance owing to the effect of its load, and also, in a less marked degree, to the effect of hysteresis in the iron core of the transformer. In other words, the primary coil of the iron-clad transformer behaves as though it had a resistance of 18.81 ohms without an iron core, and a reactance of 2.66 ohms. The angle of lag in the transformer is therefore 8° approximately.

If the two conducting wires are No. 3 A. W. G., and are 20 inches apart, their resistance will each be 2.06 ohms, their reactance 3.09 ohms, and their impedance 3.714 ohms each, as shown in Fig. 4. The current in each wire will, therefore, lag 56° 4′ behind the pressure at its terminals.

The alternator may be assumed to have an apparent resistance in its armature of one ohm, and an apparent reactance of one ohm, so that the current lags behind the drop in the armature by 45°, as shown in Fig. 5.

Then if we assume that 1,000 volts is maintained at the transformer primary terminals, the current in the transformer will be $\frac{1000}{19}$ = 52.63 amperes.

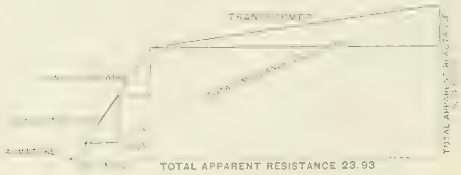


Fig. 6.

The total apparent resistance in the circuit will be

		Reactance	
Armature	1.0	Armature =	1.0
Lines =	4.12	Lines =	6.18
Transformer=	18.81	Transformer=	2.66
	23.93		9.84

The current in the circuit will, therefore, lag 22° 21′ behind the E. M. F. that is generated in the armature shown in Fig. 6.

If we omit consideration of the armature drop which will be 1.414 × 52 63 = 74.4 volts and consider only the lines and transformer, the total apparent resistance will be 22.93 ohms, and the total reactance 8.84 ohms. The current in the circuit will, therefore, lag 21°8 behind the pressure at alternator terminals.

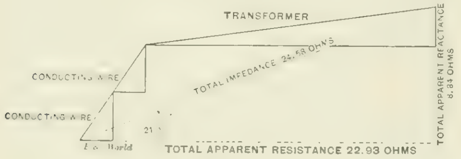

TRANSFORMER
CONDUCTING WIRE
CONDUCTING WIRE
TOTAL IMPEDANCE 24.58 OHMS
21°
TOTAL APPARENT REACTANCE 8.84 OHMS
E. W. World
TOTAL APPARENT RESISTANCE 22.93 OHMS

Fig. 7.

The drop in the lines will be 52.63×7.428 = 390.9 volts (195.45 in each line) and the currents in the lines will lag 56° 15′ behind this pressure. The lag in the transformer 8°, and the lag in the circuit of lines and transformer taken together 21° 8′.

It will be thus seen that when a coil, wire, or conducting device has given resistance and reactance, a definite phase angle is produced between the current and the pressure which acts at its terminals; but the current in the entire circuit will have phase different from the total E. M. F. in the circuit which will depend upon all the individual component parts of the circuit.

The Direct Production of Electricity from Hydrogen.

BY H. H. DOW.

The interest created by the recent articles in The Electrical World on the direct production of electricity from fuel or by various forms of gas batteries led the writer to make the following figures on the efficiency with which hydrogen is oxidized in air in the Dow air battery.

This cell contains no depolarizing agent, but depends entirely upon the oxidation of the nascent hydrogen by air to keep it from polarizing. It is composed of zinc and carbon electrodes in a saturated solution of calcium bromide. The carbon used is very porous, and by capillary action holds some of the electrolyte within its pores, although its outer surface is largely exposed to air.

The reaction that takes place on the zinc electrode is expressed by the equation

$$Zn + Ca\,Br_2 + 2H_2\,O = Zn\,Br_2 + Ca\,O_2\,H_2 + H_2.$$

The zinc bromide and calcium hydrate thus formed react on each other with the formation of zinc hydrate and the same amount of calcium bromide with which we started,

$$Zn\,Br_2 + Ca\,O_2\,H_2 = Zn\,O_2\,H_2 + Ca\,Br_2.$$

The result so far as total energy generated at the zinc electrode is concerned can, therefore, be expressed by the equation

$$Zn + 2H_2\,O = Zn\,O_2\,H_2 + H_2.$$

The H_2 would, however, when the circuit was closed, appear on the carbon electrode where it would accumulate and polarize the cell unless oxidized.

The reaction that takes place on the carbon electrode is simply the combustion of the hydrogen by the oxygen of the air, producing water.

We may, therefore, represent the original and final products by the following simple equation:

$$Zn + O + H_2\,O = Zn\,O_2\,H_2.$$

By substituting the heat of combustion for the water and zinc hydrate we find that 82.68 heat units would be developed, which corresponds in this case to almost exactly 1.8 volts if all the energy appeared as electricity.

Similarly, if all the energy was transformed into electricity in the same battery without access of air, according to the equation

$$Zn + 2H_2\,O = Zn\,O_2\,H_2 + H$$

only .3 volt would be produced. The 1.5 volts difference between the two cases is produced solely by the oxidation of the hydrogen. The actual voltage found in these air cells is 1.32, or 1.02 volts more than if no air had been present.

Therefore, in this case $\frac{102}{180}$, or about 57 per cent., of the total energy contained in the hydrogen was converted into electricity.

This result, showing five times the efficiency of our best steam engines, at first appears very remarkable, but in this case nascent hydrogen was oxidized, while in case of heat engines the free hydrogen is burned.

An experiment with a similar cell having two carbon electrodes and depending entirely on hydrogen gas and air for the production of its current gave less than one tenth of a volt E. M. F.

An American Apparatus for Measuring Hysteresis.

As the ingenious instrument devised by Prof. Ewing* for measuring hysteresis, and described by him in a paper read recently in London, was praised in the highest terms by many of the leading electricians and scientists of England, it will doubtless interest Americans to learn that a very similar instrument was suggested and used by Prof. Elihu Thomson quite a number of years ago, and which in some respects appears to have been even an improvement on the Ewing form.

As early as 1889 Prof. Thomson made some experiments with an instrument for measuring hysteresis which depended on driving sample discs of iron in a magnetic field by a small meter motor and measuring the amount of a current required to be put through the meter, which thus became a measure of the torque exerted in the magnetic field; a speed counter was included in the instrument. The discs were stamped out by a standard punch and a set of them were strung on a vertical **shaft**; the field in which the armature revolved was furnished by a definite current. He used the instrument for determining the hysteresis in different samples of iron as also in a modified way by taking the bundle of discs and winding on them a simple drum-winding provided with a commutator, by which means he was able to drive the discs, which then became the armature core, between the poles of an electromagnet, the strength of which could be made less or greater; like in the other form the armature current was measured, giving a measure of the hysteresis or the total work done in revolving the bundle in the magnetic field. The friction error was fairly constant and a correction had to be made accordingly. In the other form of apparatus in which the meter armature was driven by a current, the correction could easily be made by revolving the discs and shaft by a current passed through the meter armature while the field which magnetized the discs was removed, making readings at various speeds and noting the current required to drive the apparatus at these speeds; this current deducted from the total with the field on, at any given speed, would show at once the current required to do the work of rotating the discs, that is of supplying the energy lost in hysteresis at various speeds, allowing for eddy current effects.

A modified form of the instrument has been used by the General Electric Company for some time and we believe is still in use by them for testing the samples of iron. We hope soon to be able to furnish a description of this modified and improved form.

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*Described and illustrated in The Electrical World, May 18, p. 590, and May 25, p. 616.

A Combination Alternating and Direct Current Plant.

BUDAPEST, Hungary, is supplied with electric light service from a plant which leaves no fighting ground for the respective advocates of the alternating and direct-current systems, both being used under peculiarly favorable conditions. In designing the plant the chief requirements which had to be observed were that the generating station must be located outside the city limits, and that low-tension continuous current should be furnished to consumers.

In order to keep down the weight of copper in the conductors connecting the central station with the district where current was to be consumed, and to simplify the generating apparatus, it was decided to generate high-tension alternating currents at a voltage of 1,800, at the primary station, and transform to continuous current of low voltage at a sub-station in the consuming district, by means of rotary transformers, consisting of alternating-current motors coupled to continuous current dynamos. The two-phase system was adopted for the primary end. At the sub-station continuous-current dynamos, direct-driven by two-phase motors, deliver current directly to the distributing network, and also supply current to charge a battery of accumulators in this station. These accumulators carry the load during the lightest period so as to shorten the running time at the primary station, and they also serve to smooth out any fluctuations of voltage in the conductors. The primary station is about 3½ kilometres (2.16 miles) distant from the sub-station. The building is mostly taken up by the engine and dynamo room, which is 13 by 24 metres (42 feet 7 inches by 78 feet 8 inches). Adjoining the engine room is the boiler room, as will be seen from reference to Fig. 4; this is 12 metres (39 feet 4 inches) wide by 19 metres (61 feet 9 inches) long. Besides the main room there is a subsidiary engine and dynamo room 10 x 15 metres (32 feet 6 inches x 48 feet 9 inches), containing a sort of temporary plant which was installed prior to the completion of the regular plant in order to satisfy the clamor for service. Outside the building are the stack, water-cooling tower, coal shed and scale house.

The regular boiler plant consists of three so-called Tischbein boilers, each having 150½ square inches of heating surface, and two Steinmüller water-tube boilers, each having 166 square inches of heating surface, all being built for 165 pounds pressure.

The temporary steam plant above referred to comprises two portable boilers and engines, of about 125 hp each, the boilers being of the locomotive type, and each having its engine mounted upon it, as in the case of the familiar portable saw-mill engines and boilers in the United States. The engines are compound, the high-pressure cylinders are 14½ inches in diameter, the low-pressure 24¾ inches, and the common stroke is practically 19 inches (accurately, 48 centimetres). These engines are belted to two two-phase alternators, of 66 kw capacity each. These machines run at 400 revolutions per minute and furnish current at 1,800 volts. Their exciters are coupled to the alternator shafts.

As previously stated, this temporary plant was installed to meet the demand for current pending the completion of the large engines and dynamos, and when the latter were started up the

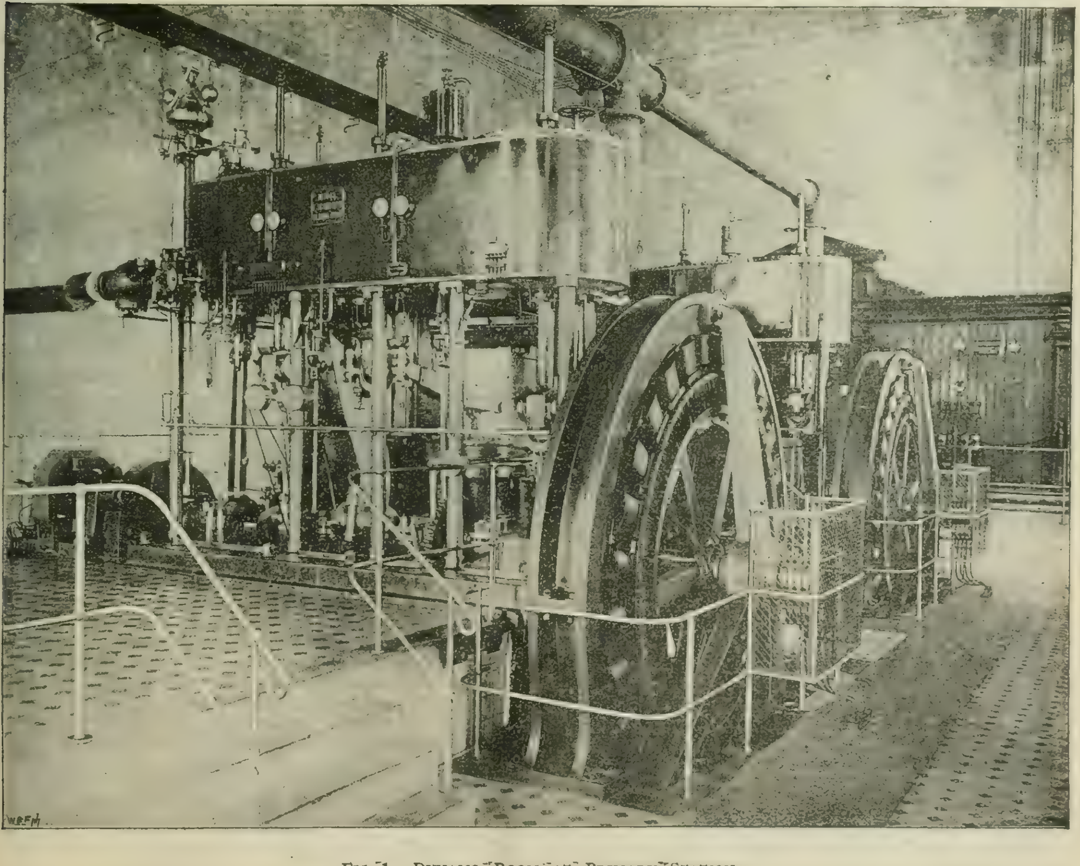


FIG. 1.—DYNAMO ROOM AT PRIMARY STATION.

temporary plant was laid aside, so to speak, as a reserve. The output of the station increased so very rapidly, however, that it soon became necessary to run the so-called temporary plant regularly, along with the large machines.

The equipment in the main dynamo room consists of three vertical triple-expansion Schichau engines, driving three two-phase Schuckert alternators, of 300 kw capacity each, which are direct-connected. The three cylinders of each engine are 46, 75 and 115 cm (substantially 18, 29½ and 45¼ inches) in diameter, respectively, and 5 cm (21⅔ inches) stroke. The engines make 120 revolutions a minute, and, at an initial pressure of 150 pounds in the first cylinder, develop 400 effective horse power normally and 500 horse-power at a maximum, with jet condensation.

The three cylinders, together with the valve chests and receivers, are enclosed by non-conducting material covered with polished tin-plate. Cylinders I and II have steam jackets fed direct from the boiler, and after leaving each cylinder jacket, the steam heats the outside of the receiver of the succeeding cylinder.

Each condenser air-pump is in the rear of its engine, and is driven by the intermediate cylinder crosshead. In case it is desired to work without condensation (which has not yet happened), the exhaust can be turned off from the condenser and opened into the air. The three cranks are set 120° apart, as usual in this type of engine.

The lubricating material for all the moving or inaccessible parts comes from a centrally located reservoir. The waste oil runs to a purifying apparatus in the cellar, from which it is pumped back to a tank in the engine room.

All the indicating and regulating devices are placed on the front side of the engines, in compact arrangement, so that the machinery can be safely and readily managed. A gallery and stairway at the back of the engines allows the higher parts to be reached without danger.

The general arrangement is such that the alternator is coupled directly to the shaft by means of a flange forged to the latter, on the low, pressure side, while the exciting machine is connected to the other end of the shaft by gearing. The flange coupling makes it possible to take out the crankshaft without dismounting other parts of the machinery.

The alternators are built to deliver 300 kilowatts at 1,800 volts, running at 110 revolutions a minute. They have 28 poles, and the number of alternations is, therefore, about 51 a second, this low periodicity being chosen because the only load is the sub-station equipment of motors. The magnet frame is of soft iron, in two parts, and is bolted to a cast-iron bedplate. The poles are cast in one piece with the magnet frame, and the pole-shoes, which are a little broader than the cores, are screwed to the latter.

The armature frame consists of a solid wheel with six spokes on the rim of which there is a bronze ring carrying the laminated armature core. The latter does not rest directly on the bronze ring, but on 16 projections from it, between which the air can circulate abundantly, so that the ventilation of the armature is provided for in the most effective manner. The diameter of the armature is three metres (9 feet 10 inches), and the outer diameter of the magnet frame 3.8 metres (12 feet 5½ inches).

The alternators, large as well as small, can be coupled in parallel with one another and among each other with the same ease as continuous-current machines, and run without the peculiar hum of alternating-current machines generally. The coupling in parallel takes place by means of a simple switch, without the aid of artificial resistances. The exciters are 13-kw machines, and run at 400 revolutions per minute, being geared to the shafts of the same engines which drive the alternators.

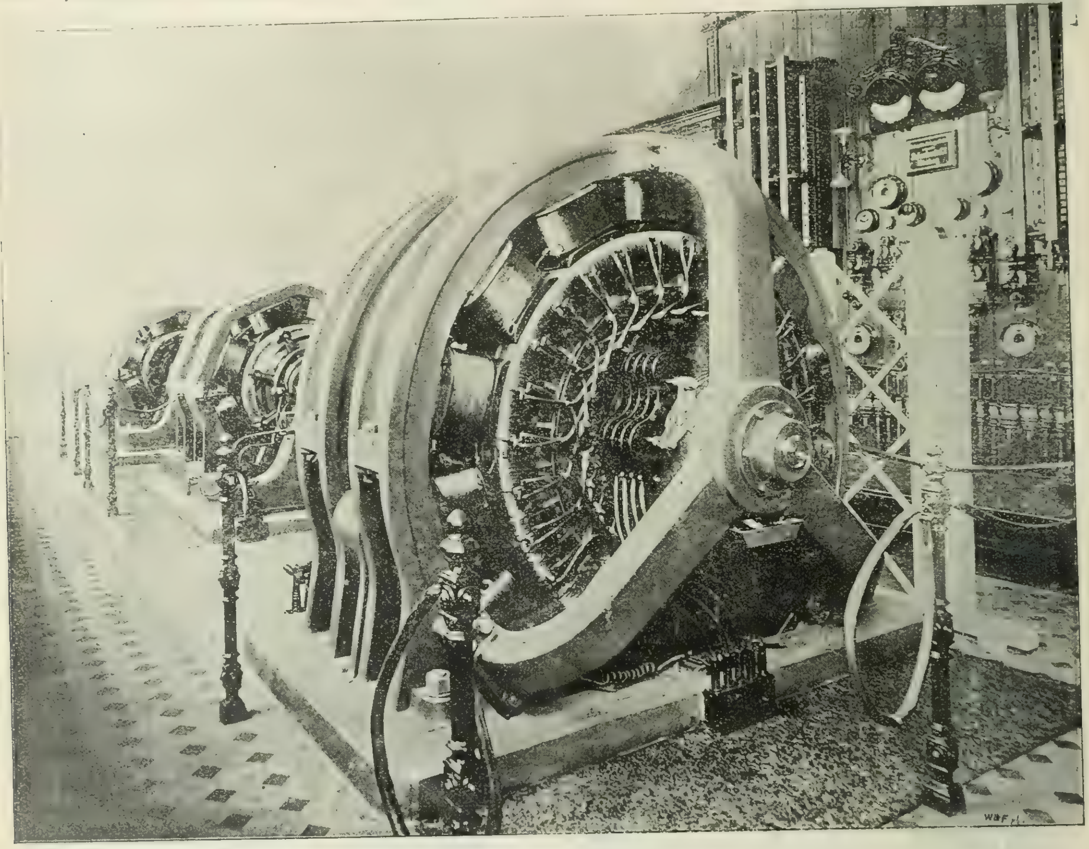


Fig. 2.—Dynamo Room at Sub-Station.

At the acceptance tests, which were most carefully conducted by Dr. Kittler, when the large alternators were run at the primary voltage of 1,780 to 1,790, the current in phase I was 85.7 amperes, in phase II, 90.2 amperes. The energy consumed by the alternator was as follows:

Loss in armature windings,	8,550 watts.
Loss in field winding,	7,450 watts.
Loss due to eddy currents, hysteresis and friction,	17,000 watts.
Total	33,000 watts.

The total energy delivered by the alternator was 284,000 watts; the efficiency of the machine was, therefore, slightly over 90 per cent.

The dynamos are all connected with the switchboard by means of cables, which descend through the ceiling of the cellar, where they are bare and are carried on porcelain insulators. There are two switchboards, one for the portable plant, the other for the main plant, but both arranged on the same system. The middle panel of the main switchboard is occupied by the apparatus for exciting and parallel switching, the left panel by the outgoing cables and their controlling instruments, and the right panel by the switches and instruments of the machines. The current from the alternators first passes through two double pole safety fuses (one for each armature winding), and thence through double pole switches and meters to four bus bars, two for each phase, which are connected through double pole switches to the line conductors.

The electrical plant at the primary station contains also a continuous-current dynamo, of 110 volts and 140 amperes capacity, which generates the current for lighting the station and running the motors of the repair shop, and two non-synchronous two-phase motors, which serve to operate the pumps. The current for these motors is transformed from 1,800 to 110 volts. The pumping plant comprises four Worthington steam pumps, two Sulzer pumps direct-driven by Shuckert two-phase motors, and one Schlick pump belt-driven by a steam engine. The Worthington pumps handle the feed-water for the boilers, and the others are used to lift the condensing water to a cooling tower 11 metres (36 feet 1 inch) high, whence the water falls through sieves to a basin from which it is taken for condensing service.

The sub-station, which is located almost exactly in the centre of the consumption district, is divided into three departments, the general offices, the dynamo room, and the accumulator rooms. The dynamo room contains two 120-kw and two 240-kw rotary transformers, consisting of two-phase motors driving continuous-current dynamos. The dynamos have cast-iron field magnets with wrought-iron shoes bolted on the cores. The two magnet frames are mounted on a common base, and the armatures are built on a single shaft. The armatures of the larger transformers are 1.62 metres (63¾ inches) in diameter, and run at 220 revolutions per minute, at which speed the continuous-current armature gives 240 volts. The acceptance tests of the rotary transformers showed a commercial efficiency of 82.8 per cent.

The switchboard was designed and built by the constructing engineer, Mr. Hubert Sauer. Particular attention has been paid to the convenient and appropriate arrangement of the apparatus, and the safe operation of all parts which have to be handled, so that all the necessary operations may be conveniently performed by one person. These considerations led to the complete separation of the alternating and continuous-current apparatus. The former is placed on the side panels of the switchboard, and in the vicinity of the motors, while the large central panel is occupied by the apparatus for the main continuous current, the exciting current and the

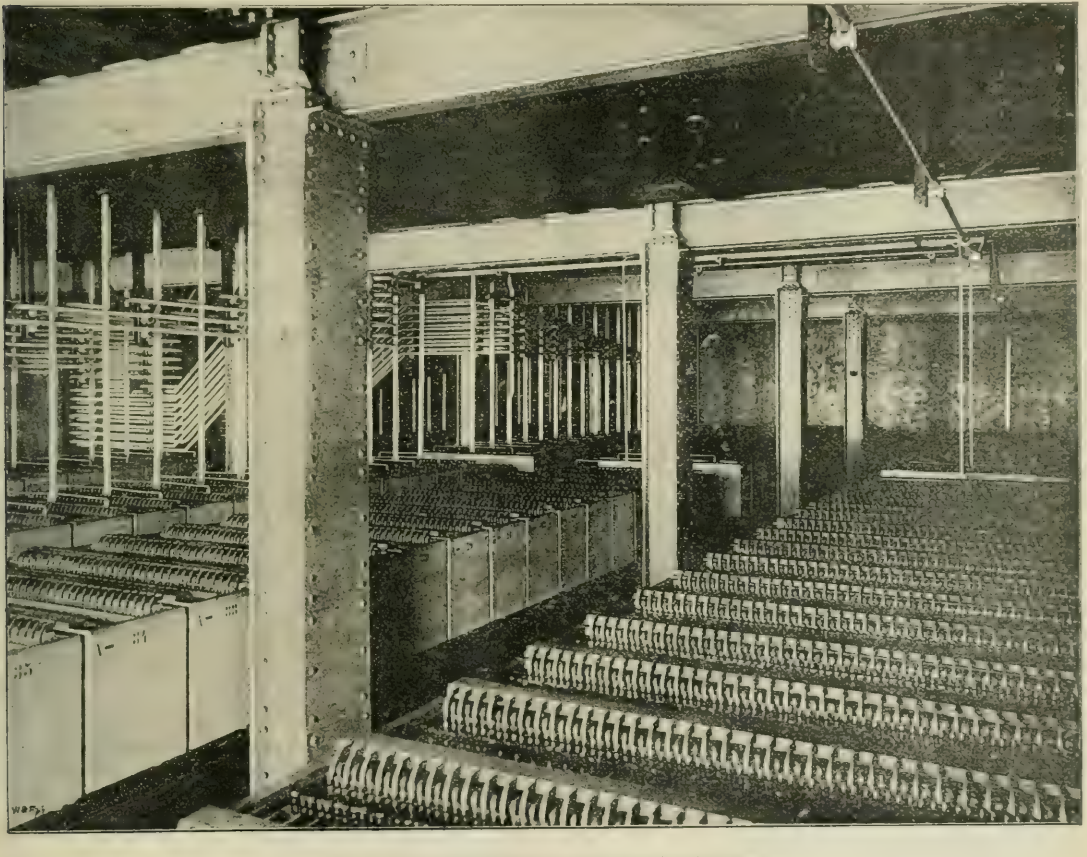


Fig. 3.—An Accumulator Room at Sub-Station.

storage battery. All contacts which carry currents of 150 amperes and upward are conical. The accumulator switching device is rather novel. The connections are so arranged that an upward movement of the sliding contact raises the potential and a reverse movement lowers it, which avoids confusion on the part of the attendant. By two complete revolutions of the regulating handle one accumulator cell is cut in or out. When the sliding contact rests on the battery contact bars in such a position that the dynamo current goes directly into the accumulators, or the accumulator current directly into the bus bars, if the handle is then given one complete turn, resistances, which can be varied to suit the current, are thrown into circuit. By this simple contrivance the gradations of potential between adjoining cells are halved, and the cutting in or out of cells is hardly perceptible at the lamps. The battery switches have two contacts, charging and discharging. By a combination reversing switch both contacts can be used for discharging, and it is then possible to divide the feeders into two groups, and to regulate the potential of each group independently. This regulation in two groups takes place particularly at the time of highest consumption, when the conducting network is fully loaded. Each sliding contact has a spark arrester to divert the sparking which occurs when cells are cut out, from the track on which the contact slides to a part easily replaced. The usual equipment of instruments is provided for indicating the pressure on the network of distributing mains, total current flow, individual current load of each rotary transformer, etc., etc.

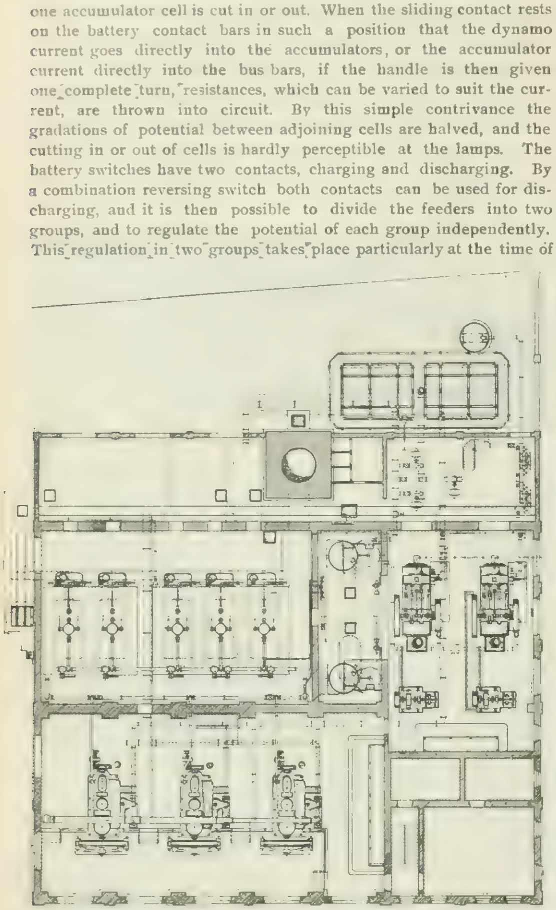


FIG. 4.—GROUND PLAN OF PRIMARY STATION.

The motors are switched in in the following manner: Current from the accumulators is led to the continuous-current dynamo; the latter runs as a motor and carries with it the alternating machine on the same shaft. When the proper speed of the alternating motor has been reached, and as soon as the latter is in step with the primary alternator, the motor is connected with the primary circuit and the accumulators are disconnected from the direct-current machine, which is then connected in on the distributing mains as a dynamo, in the usual way.

The Tudor system of accumulators is used, and the plant comprises four batteries of 148 cells each, connected in parallel. Each of these batteries has a capacity of 1,565 ampere-hours, with a discharging current of 469 amperes, or 2,245 ampere-hours with a discharging current of 268 amperes. The maximum charging current is 391 amperes. The whole accumulator plant has consequently a capacity of 6,260 ampere-hours with a discharging current of 1,876 amperes, or 8,980 ampere-hours with a discharging current of 1,072 amperes, and can, therefore, take care of 7,500 16-cp incandescent lamps for 3½ hours, or 4,288 lamps for 8⅓ hours. Of the 148 cells forming each battery, 12 (six at either end of the battery) are not yet connected up, as the necessity for raising the present normal working potential has not yet arisen.

The batteries are symmetrically set up in the four stories of the accumulator house. Each story holds a complete battery of 148 cells. The four batteries are connected in parallel by vertical conductors, passing through the four stories.

The conducting network embraces the most frequented streets of Budapest, and consists of three-wire distributing mains, interconnected. To different points of this network are led 20 feeders, whose section depends upon their length and load. Three of them go to collecting boxes, which are intended for the reception of feeder equalizing conductors. The remaining feeders lead to distributing boxes, from which the individual distributing conductors go out. The different sections of the distributing conductors are connected together by means of cross connecting boxes.

When the feeders and distributing network were designed the anticipated losses were carefully calculated, and it was thought that ample allowances had been made for the greatest probable increase in service which might occur for quite a long period. However, the unexpectedly rapid increase in the number of lamps connected to the system, made these calculated allowances inadequate, and, in consequence, differences of pressure arose rapidly between various points of the distributing network, which differences were increased by the unequal loading of the two sides of the system. In order to do away with these differences, two new equalizing conductors were laid in the city, and besides this, the feeders were divided into two groups, one lightly loaded and one heavily, whose potential could be independently regulated by means of the battery switch.

The whole conducting network was furnished by the Budapest firm of Jacottet & Co. (later Felten & Guilleaume), and the cables were made in the Budapest factory of that firm. The cables have double lead covering, double iron ribbon armor, and a layer of jute. In the cables connecting the primary with the sub-station, the two conductors are concentrically arranged; all other cables contain only one conductor each. An insulated test wire is laid in with the copper core of the feeders.

The cables are generally laid 80 to 90 cm (2 feet 7 inches to 3 feet) deep in a trench in a layer of sand, and protected from disturbance by a covering of tiles. In the sub-station the cables are placed in a special conduit. The distributing conductors are laid under both sidewalks of the streets, about 81 cm (32 inches) beneath the surface, and 1 to 1½ metres (39 to 59 inches) away from the house fronts. The number of connections made to the network is 476, and by means of these 810 places are supplied with current. The weight of the copper in all the cables laid is 306,600 kg. (301 tons).

The following requirements concerning the conducting network were laid down for the contractors: The insulation resistance of the cable, at 15° C., must be, at least, 100 megohms per kilometre (about 161 megohms per mile) at the time of acceptance in the factory, and when laid down and during the guaranteed period, five megohms per kilometre (eight megohms per mile), including all connections and soldered places up to the safety fuses at the consuming points. For the determination of the insulation resistance, a source of electricity is to be used whose E. M. F. shall equal the working potential in the conductors.

The Budapest plant was governed by the same conditions which regulate all central stations where accumulators are used. In the primary station comparatively large steam engines were chosen for working units, because they are more economical than a number of smaller ones having the same total power, take up less room, require less attendance and amount of lubricant, and have a higher efficiency. During the past working year, the engines have been almost always run at their normal capacity, and in this way the regulation at the switchboard was also made extraordinarily simple, being confined to cutting the machines in and out. When the engines are started, the charging of the accumulators begins, and this continues until the hour of greatest current consumption, when the accumulators are disconnected, leaving the dynamos only the distributing mains to supply. As soon as the consumption begins to diminish, and there is not enough direct load for the engines, the charging of the accumulators is renewed until the consumption loads so decreases that the batteries are able to take care of the lighting alone for the rest of the working day.

In order to eliminate the annoyance due to the unequal discharging of the batteries used on the two sides of the three-wire system, a so-called "compensating dynamo" was installed recently, which, when necessary, completes the charge of that half of the battery which had discharged at a greater rate than its mate on the preceding day.

The time during which the accumulators handle the whole load varies with the season. The total energy given to the conducting network came from the accumulators and the dynamos directly in the following proportions during the last half of 1894:

	From accumulators. Per cent.	From dynamos direct Per cent.
July	88.3	11.7
August	63.1	86.9
September	40.2	59.8
October	34.2	65.8
November	36.5	63.5
December	35.7	64.3

For the last half of 1894 the coal consumption was 295.65 tons for heating up, and 2,260.35 tons for running, making a total of 2,556 tons. Of this quantity 111.8 tons were lost in slack, and 44.84 tons in ashes.

The average service furnished by the accumulators for the year was 57½ per cent. total running time, so that even during the busiest season only one shift of men was needed at the primary station. The total charge for 1894 amounted to 391,179.3 kilowatt-hours, and the total discharge was 299,905.7 kilowatt-hours.

Mr. Etienne de Fodor, manager for the Budapest Electric Company, to whom we are indebted for the data herein contained, is an old Edison man, having been connected with the European Edison Company from 1881 to 1889, when he established the central station in Athens, Greece. In May of last year Mr. Fodor left Athens to take charge of the Budapest station, and it is largely to his very efficient management that the signal success of the plant is due.

Efficiency of the Steam Engine and Dynamo.

In popular writings, says Prof. Unwin in a recent lecture, nothing is commoner than to find the efficiency of electric machinery and of steam machinery contrasted to the great discredit of the latter. The dynamo, it is said, has an efficiency of 90 per cent. to 95 per cent., the steam engine an efficiency of only 10 per cent. What a barbarous machine, after all the labor of a century, the steam engine must be! The comparison is generally made by an electrical engineer, and the first reflection which occurs to one is that of all people the electrical engineer should be the last to abuse the steam engine; for, whatever may be the case in some future century, at present the dynamo is absolutely dependent on the steam engine. Without the steam engine the dynamo would be a useless mass of metal and wire. But passing over the moral aspect of the question, the ingratitude of the electrical engineer, the comparison is an unfair one, and shows a want of apprehension of that important law of the motivity of heat which is one of the two fundamental laws of thermodynamics. Heat energy is undirected or mob-energy. It lies in the nature of the terrestrial conditions in which use has to be made of it, that only a fraction is convertible into directed or mechanical energy. The task of the steam engine is to do its best with the fraction which is convertible, and in that point of view it is not an inefficient machine. The dynamo has a much easier task. Energy is supplied to it in its directed or wholly convertible form, and naturally in transforming one kind of directed energy into another kind of directed energy only a small fraction need be wasted.

Electrocution.

We have always held, says the London *Electrical Review*, that the method of executing criminals, adopted in the State of New York, is swift and sure. Others have recklessly asserted that the shock did not really kill, and that the wrongdoers paid the penalty of their crimes under the surgeon's knife on the post-mortem table. Dr. J. Mount Bleyer claims, however, to have now set all doubts aside, and he assigns the true cause of death to be dynamic apoplexy. The most convincing proof of what had been well known to him since 1888 is afforded by the case of David Hampton, who was "electrified" at Sing Sing, N. Y., on Jan. 28 last, and whose lesion of internal organs and hemorrhages show death to have been instantaneous and painless. The notes of the post-mortem made by Dr. Aug. Goelet certainly make it perfectly clear that the surgeon's knife is not the executioner. Dr. Bleyer, it is noted, substitutes "electrification" for electrocution.

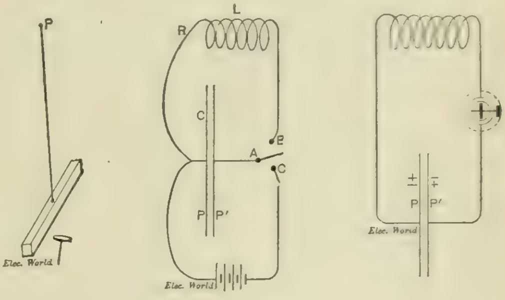
Self Induction and Capacity.

BY E. B. ROSA.

The neutralization of self induction by a capacity has been the subject of ample mathematical treatment, but to a very large body of workers in electrical fields the equations are unintelligible and the subject mysterious. Even to the mathematical student, after he has proved that a certain critical value of the capacity of a condenser will neutralize the self induction of a circuit, and the current will therefore follow the simple law of Ohm, it is often a mystery how the thing is done. In the case of the secondary circuit of an induction coil whose lines of force are opposed to those of the primary, it is easy to see that closing the secondary will reduce the self induction of the primary, for the effective self induction is proportional to the total number of lines of force passing through the coil for unit current, and whatever tends to reduce this number will reduce the self induction. But there is no such connection between a condenser and a coil; the former has no appreciable lines of magnetic force, and so can neither increase nor decrease the number in the coil. Nevertheless, the self induction *seems* to be neutralized, for the current has the same value it would have if the self induction were wholly or in part cancelled and the condenser were removed. But it is only in appearance. As a matter of fact the self induction remains unchanged. What happens is an entirely different thing.

1. SOME MECHANICAL ANALOGIES.

Before discussing the question further let us consider one or two analogies. Take the case of two stretched strings. Suppose one of them is maintained in vibration and the other, not in unison with the first, is examined. If it is found to be in motion at all, its vibrations are forced and have an exceedingly small amplitude; for the tiny forces acting upon the comparatively heavy string are able to generate only correspondingly small velocities. But as the string is lengthened (for example), it vibrates more and more freely, and when the length is exactly right it comes into perfect consonance with the other string, and the amplitude of vibration is perhaps a hundred times greater than at first. Shall we say that increasing the length of the string has neutralized its inertia, and hence that the small forces acting produce a greater amplitude of vibration? Certainly that would be a very crude explanation.



FIGS. 1, 2 AND 3.

Again, take the case of a torsion pendulum. Suppose a bar of iron is suspended by a long steel wire, and when displaced oscillates back and forth at the rate of six times per minute. If struck regularly once per second with a light mallet the oscillations of the bar would never be considerable, for the forces are not synchronous with the natural period of the bar. But if the suspending wire be shortened so that the bar oscillates 60 times per minute, then the same light blows of the mallet delivered regularly once per second will soon produce a vibration of considerable amplitude. But of course we do not say that changing the length of the wire has neutralized the inertia of the iron bar. On the contrary, it has attuned the vibrating bar to the periodic forces acting, so that the effect of the forces is cumulative, and when finally the maximum amplitude has been attained, the force of each blow of the little mallet is expended in overcoming friction, and not at all in overcoming the inertia of the iron. The latter is overcome by the torsion of the wire, which is large in proportion as the displacement is large.

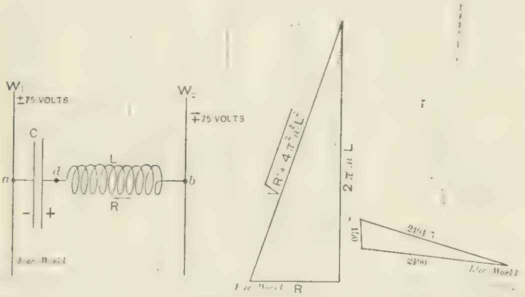
2. THE ELECTRICAL CASE.

Take now the case of a condenser which is charged and then discharged through a circuit of resistance R and self induction P. If the resistance is not too large the discharge will be *oscillatory*, and the time of a complete vibration of the electricity from P around through the coil to P^1 and back to P will be very nearly, $T = 2 \pi \sqrt{C L}$. That is, the time depends on the capacity and self induction, and not to an appreciable extent upon the resistance. Just as the time of vibration of the iron bar depends upon the moment of inertia of the bar and the torsion of the suspending wire, and not upon frictional resistance.

Now suppose the condenser and coil are joined up in series with a small coil in the centre of which is mounted on an axle a permanent magnet which can be spun in a plane perpendicular to the coil. The lines of force cutting through the coil will induce an alternating electromotive force which will charge the condenser so that each plate is alternately positive and negative. The maximum difference of potential of the plates would be very minute, being equal to the small electromotive force induced in the coil by the rotating magnet. Now let the magnet be spun fast and faster until it is synchronous with the natural period of the coil and condenser. Then, as in the case of the vibrating string and the torsion pendulum, the amplitude is greatly increased by the principle of resonance. The maximum difference of potential of the condenser is many times greater than the induced electromotive force of the coil. The charge of the condenser surges back and forth through the coil in its own natural period of $T = 2 \pi \sqrt{C L}$ and the force exerted by the revolving magnet simply overcomes the resistance of the circuit. The current is as great as though the coil had no self induction. The latter is not removed, however; the great difference of potential of the condenser when it is fully charged overcomes it.

3. COIL AND CONDENSER ON ALTERNATING CIRCUIT.

Let us now join our condenser of capacity C and coil of resistance R and self induction L across the main wires W_1 and W_2 of an alternating circuit, having a maximum difference of potential of 150 volts. The potential of each wire varies between the limits + 75 and — 75 volts. As in the last case, if the natural period of the condenser and coil ($T = 2 \pi \sqrt{C L}$) is the same as that of the alternating electromotive force, the charge of the condenser will surge back and forth in its own period and the maximum difference of potential of the plates of the condenser will be many times the impressed electromotive force of 150 volts; that is, the charge Q of the condenser will be much greater than if the coil were removed, and the current through the coil greater than if the condenser were removed. This is true to a less degree if the period T of the condenser and coil is not exactly the same as that of the current in the mains. In a particular case, an electrometer connected to b and d gave a deflection of 107 divisions; to a and d of 231 divisions, while to a and b it gave only 86 divisions. Thus the condenser has the effect of *raising the electromotive force* which acts upon the coil, and hence a greater current is forced through it. The self induction is not *neutralized;* it is overcome by an increased difference of potential at the terminals of the coil.



FIGS. 4 AND 5.

In order that the current in the coil may be a maximum, the period t of the current must be the same as the natural time of oscillation of a quantity of electricity through the condenser and coil; that is, t must equal $2 \pi n \sqrt{C L}$. Since $\frac{1}{t} = n$, the number of periods per second, $2 \pi n \sqrt{\frac{1}{C L}}$ or $C = \frac{1}{4 \pi^2 n^2} L$. (1) This is the value of the capacity which will have the effect of neutralizing the self induction, and so give the maximum current through the coil. If $L = 1$ henry and $n = 100$, C is about 2.5 microfarads.

4. KINETIC AND POTENTIAL ENERGY.

While the current flows through the coil from b to d the charge of the condenser is increasing, and hence the maximum charge Q_0 of the condenser occurs at the moment when the current is zero. On the other hand, as the charge flows out of the condenser through the coil, the current increases up to a maximum, which it reaches when the charge is zero, and ceases when the charge is $-Q_0$. The energy is all potential and resides in the condenser when the current is zero. The energy is all kinetic and is in the coil when the charge is zero. And these two quantities of energy are equal to each other. This is exactly analogous to the case of our oscillating bar (Fig. 1). Its energy is all potential when the bar comes to rest, and is resident in the twisted wire. The energy is all kinetic when the bar swings through its mean position with a maximum velocity, and there is then no torsion in the wire. And these two quantities of energy are equal to each other; being, indeed, the *same energy* handed to and fro between moving bar and twisted wire. So it is the same energy in the electrical case, handed to and fro between condenser and coil, appearing as potential energy of the stressed dieletric of the condenser in one case, and kinetic energy of the magnetic lines of force in the ether surrounding the coil in the other. The potential energy of the condenser is $\frac{1}{2} Q_0 V$ or $\frac{1}{2} C V^2$. The electro-kinetic energy of the current in the coil is $\frac{1}{2} I I_0^2$, where I is the maximum current in the coil. Hence $C V^2 = L I_0^2$. (2) But when $C = \frac{1}{4 \pi^2 n^2} L$, the self induction is apparently eliminated, for the current has the same value it would have if the self induction were removed and the condenser disconnected. Hence $I = \frac{E}{R}$. Making these substitutions,

$$\frac{V^2}{4 \pi^2 n^2 L} = \frac{L E_0^2}{R^2} \text{ or } \frac{V}{E} = \frac{2 \pi n L}{R} \quad (3).$$

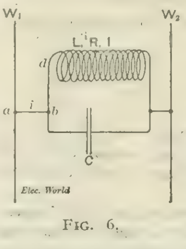
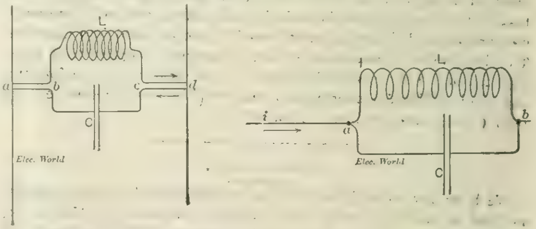


FIG. 6.

This result may be stated as follows:

The maximum difference of potential of the condenser is to the maximum impressed electromotive force as the reactance is to the resistance.

This is a most important result, for it shows that when the self induction L, (and therefore the reactance $2 \pi n L$) is large, while R is relatively small, that the difference of potential V to which the condenser is charged is much greater than the impressed electromotive force. It is this, as has already been said, which overcomes the impedence of the coil. Instead of actually neutralizing the self induction of the coil the condenser gives us a sufficiently great difference of potential to force the same current through the large impedence that the smaller impressed electromotive force could cause to flow through the ohmic resistance alone.



FIGS. 7 AND 8.

5. NUMERICAL EXAMPLE.

To illustrate this result let us take the following example:

Suppose the current has 132 complete periods per second. Let the maximum applied electromotive force be 150 volts. The voltmeter would indicate the square root of the mean square and would stand at about 105 volts. Let the coefficient of self induction L be one tenth of a henry, and the resistance R be 5 ohms. Then $2 \pi n = 830$. The impedence of the circuit consequently is

$$\sqrt{R^2 + 4\pi^2 n^2 L^2} = \sqrt{25 + (830 \times .1)^2} = 83.15 \text{ ohms.}$$

The current without the condenser is $\frac{10.5}{83.15} = 127$ amperes. The value of V given by the above expression is

$$V = \frac{2\pi n L}{R} E = \frac{830 \times .1}{5} 150 = 2490 \text{ volts.}$$

Thus we see that a maximum electromotive force of 150 volts acting upon the condenser and coil in series produces a difference of potential of 2,490 volts on the condenser, and this great value is attained because of the resonance of the condenser; each small impulse of 150 volts acts just at the right time to increase the displacement. In the pendulum a small periodic force in unison with the pendulum soon produces a large displacement. The force moving a pendulum is principally the torsion of the wire in the torsion pendulum and the force of gravity in the common pendulum, the small applied force simply overcoming friction. So in our electrical case, the force overcoming the great impedence of the coil is principally the great difference of potential of the condenser, the impressed electromotive force only overcoming friction, that is the ohmic resistance of the coil.

The difference of potential of 2,490 volts acts upon the coil together with 150 volts which is a quarter of a period different in phase. The resultant of these two forces is 2494.5, the maximum value of the difference of potential between b and c in Fig. 1. This corresponds to an average value of 1746.15 (I take here as before $\sqrt{.5}$ as .7 for convenience) acting upon an impedence of 83.15 ohms. The average current will be $\frac{1746.15}{83.15} = 21$ amperes. This is the same current that 105 volts would give through 5 ohms, in the case where the capacity and self induction are removed.

This shows also how much greater the stress on the dielectric of the condenser is than the applied electromotive force indicates. If the self induction had been one henry instead of a tenth of a henry, the difference of potential of the plates of the condenser would have been 24,900 volts.

6. RELATION OF CAPACITY TO SELF INDUCTION AND PERIOD.

One is at first thought surprised that the larger the self induction the smaller must be the capacity to neutralize it; the expression $C = \frac{1}{4\pi.2 n^2 L}$ shows this to be the case. Of course the reason is that since the time $t = 2\pi\sqrt{CL}$ in order that the period of the condenser and coil may be synchronous with that of the impressed electromotive force, the product CL must be a constant, and equal to $\frac{t^2}{4\pi^2}$. Therefore C is inversely proportional to L. As an illustration, take again the case of the vibrating string. We bring it into unison with another string by changing its length, and when that has been done it vibrates sympathetically (we say) through a wide amplitude. Now replace the string by a heavier one, and we find it must be *shorter* in order to vibrate at the same rate. Just so is the case of the condenser and coil, where capacity corresponds to length and self induction to mass; the greater the self induction the smaller must be the capacity in order that the period of oscillation may remain the same. It is evident that if, while the resistance remains the same, the self induction be increased and the capacity therefore decreased in proportion, the maximum difference of potential of the plates of the condenser will be increased. For the same current, and therefore the same quantity of electricity, flows into the smaller condenser as into the larger, and must, therefore, charge it to a correspondingly higher potential.

If, while the self induction remains constant, the period of the current be lengthened, the capacity must be increased. This is evident from the expression (1) for the period of free oscillation of the condenser and coil, and also from the consideration that if the condenser is charged less often, it requires a greater charge each time to give the same average current. But the expression (1) shows that if the period of the current be doubled, the capacity of the condenser must be increased not twice, but to four times its former value. This is explained by the fact that the condenser is charged to only one half its former difference of potential, as (3) shows. And so, with four times greater capacity, if the condenser is charged and discharged only one half as rapidly and to a difference of potential only one half as great, the average current will be just the same. The vibrating string gives us again an analogy. If the time of vibration be doubled while the total mass of the string (corresponding to the self induction) remains the same, the length (corresponding to the capacity) must be not twice but *four times* as great.

7. CONDENSER IN PARALLEL WITH COIL.

Let us now suppose that our condenser is joined *in parallel* with the inductive coil, instead of in series as we have before done. The wires W_1 and W_2 are still supposed to be the constant potential mains of an alternating circuit. By what process can the condenser now have the effect of neutralizing the self induction of the coil?

If a dynamometer be inserted between the points b and d (Fig. 6) it will be found that the *current is not changed* when the condenser is disconnected. This is a very different case from the series arrangement, where the condenser greatly increases the current in the coil. In the present case the condenser cannot increase the electromotive force acting upon the coil, for it is in parallel with it and both are directly joined to the wires W_1 and W_2. Hence, since the self induction of the coil cannot be directly altered, and the electromotive force cannot be increased, we cannot expect the condenser to increase the current in the coil. But it does affect the current flowing from the wires W_1 W_2. If the dynamometer be inserted between a and b when the condenser is joined as shown, the current will be found to be much less than when the condenser is disconnected. In other words, the condenser maintains the same current in the coil while reducing that which flows out of the mains. The amount of this reduction of the line current depends upon the ratio of the impedence to the resistance, when the condenser has the particular value $C = \frac{L}{R^2 + 4\pi^2 n^2 L^2}$. If $R = 5$ ohms and the impedence is 83.15 ohms, as before, then the current will be kept at 1.27 ampere, in the coil, while that in line will be reduced in the ratio of the impedence to the resistance; that is $83.15 \div 5 = 16.63$ times. Hence the line current will be only .076 ampere. If a hundred such coils were joined up to one dynamo circuit, the current would be 127 amperes without condensers and 7.6 amperes with condensers. If the resistance of the armature and line were 1 ohm the C^2R loss would be 16,129 watts without condensers and 58 watts with condensers. (This, of course, neglects the loss in the condensers themselves.) It is evident that to greatly reduce the so-called "wattless" current is a considerable advantage, and hence condensers may be used in this way in connection with transformers, motors, or any apparatus having a large impedence as compared with its resistance. Just how this reduction of the line current is effected may be seen from the following considerations.

8. CONDENSER AND COIL INDEPENDENT.

Suppose the coil and condenser are inserted in parallel as shown in Fig. 7, the connecting wires ab and cd being independent. The current in the coil lags behind the impressed electromotive force owing to the self induction, and if the latter is large the lag will be nearly 90 degrees. On the other hand, the charging and discharging currents of the condenser are 90 degrees ahead of the electromotive force. Thus the difference of phase of the two currents is nearly half a period, so that one is flowing to the right when the other is flowing to the left, and if the two wires ab and also cd are united, the two currents almost cancel each other. The resultant current in ab lies between the other two in phase, agreeing with the impressed electromotive force. As an illustration take the case of the Edison three-wire system. Instead of having large currents flowing in opposite directions in two parallel conductors, the two conductors are united and the current reduced to their difference.

In the case of the condenser and coil it is impossible to have the coil current and the condenser current exactly opposite in phase, unless the ohmic resistance is zero. If the resistance could be zero, then the two currents would be opposite in phase and could be made equal in amount, and so completely neutralize each other. This, of course, neglects dielectric hysteresis.

Another way of looking at this case is to think of the condenser as discharging itself continuously through the coil, the energy supplied from the line simply overcoming the ohmic resistance of the coil.

We see then that in the case of a condenser in parallel with an inductive coil between two constant potential mains, it does not really reduce the self induction of the coil any more than when in series. But it *seems* to neutralize it and at the same time to greatly increase the resistance. For where as a current of say 1.27 amperes flows out of the mains without the condenser, only .076 ampere flows out with the condenser in parallel, and this small current is in phase with the impressed electromotive force.

CONSTANT CURRENT CIRCUIT.

Let us now suppose the coil and condenser to be in parallel, not on a constant potential circuit, but on a constant current circuit, alternating as before. Then, since the average value of the current i is maintained constant, the effect of the condenser will be to greatly increase the current in the coil. For the action of the coil and condenser will be the same as before and the ratio of the currents I in the coil and i in the line will depend only on the impedence and resistance, when the capacity has the particular value $C = \frac{L}{R^2 + 4\pi^2 n^2 L^2}$. But since the coil has undiminished impedance, and the current in the coil is increased in the ratio of the impedance to the resistance, the electromotive force on the terminals a b of the coil will be correspondingly *increased*. In the case already taken, where the ohmic resistance was 5 ohms and the impedance 83.15 ohms, the electromotive force would be increased nearly 17 times. Thus we see that a parallel arrangement of coil and condenser on a constant current circuit has the same effect as a series arrangement on a constant potential circuit; it increases the electromotive force acting upon the terminals of the inductive coil, and so forces as great a current through it as though the self induction were annulled and the condenser not used.

This last arrangement in parellel is very useful on electromagnets of large self induction, as for instance in telegraph instruments on long lines, where it increases the electromotive force acting upon the electromagnet and decreases that spent upon the line, so increasing the efficiency. We see then that a condenser never actually annuls or neutralizes a self induction, although it is convenient so to speak of the effect just as we say "the sun rises." There is perhaps no harm in the expression if we always keep in mind the correct explanation.

Rope Driving—XIX.

BY J. J. FLATHER.

From the foregoing it is obvious that for a given rope and tension the least diameter of pulley which may satisfactorily be used under known conditions should be dependent upon the velocity of the rope, and should vary with the size of the latter in such a manner that, for any given speed, the pulley diameter will be proportional to some power greater than unity and less than the cube of the diameter of the rope. From an investigation of numerous examples in operation under varying conditions, some of which work satisfactorily and others very poorly, it would seem that while the value $15d^2$ may give a suitable diameter of pulley for a soft cotton rope of small diameter, such a value is entirely too small for an equal-sized manilla rope; but on the other hand, $40d$ is somewhat larger than absolutely necessary for these ropes—although it is always desirable to use such a pulley if conditions permit. If for any reason it is necessary to adopt a small pulley, the least pitch diameter for a sheave to be used with manilla rope working under an assumed tension of $200d^2$ pounds may be determined from the following empirical formula, which is believed to represent the requirements of good practice:

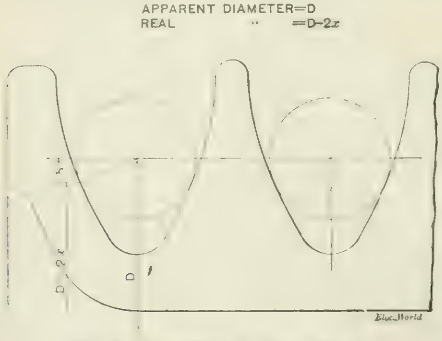


FIG. 49.—DIAMETER OF ROPE PULLEY.

$$D = d^{1.7} \times \sqrt[3]{V} + 12''$$

in which D = pitch diameter of pulley in inches;
d = diameter of rope in inches;
V = velocity of rope in feet per minute.

In order to simplify the use of this formula the following values of $(d)^{1.7}$, and $\sqrt[3]{V}$ have been calculated as given in Table XVII. Table XVIII. gives values of D for rope varying from ¾ inch to 2 inches in diameter running at 2,000 to 5,000 feet per minute. When the speed of the rope is not known the diameter given in the last column should be used for the minimum size of pulley; in fact, it would be better to use these diameters, or even larger ones, in all cases, provided the constructive features in the plant will permit their application. With an increased tension in the ropes the diameter of pulley should be increased also. In the same way if the working tension should be less than $200d^2$ pounds, then the diameter of pulley may be less than here given.

If cotton rope be used, the least diameter of pulley may also be taken somewhat less.

TABLE XVII.—VALUES OF $d^{1.7}$; AND $\sqrt[3]{V}$

Diameter of rope, d	¾	1	1¼	1½	1¾	2
Value of $d^{1.7}$	0.61	1	1.46	1.99	2.59	3.25
Velocity of rope, V in ft. per min.	1000	1500	2000	3000	4000	5000
Value of $\sqrt[3]{V}$	10	11.4	12.6	14.4	15.87	17.1

TABLE XVIII.—LEAST DIAMETER OF PULLEY FOR GIVEN DIAMETER AND SPEED OF MANILLA ROPE.

$$D = (d^{1.7}) \times \sqrt[3]{V} + 12''$$

Diameter of Rope.	Velocity of Rope in Feet per Minute.			
	2000	3000	4000	5000
¾	20	21	22	22½
1	25½	26½	28	29
1¼	30½	33	35	37
1½	37	40½	43½	46
1¾	44	49	53½	66½
2	53	58½	63½	67

TABLE XIX.—ROPE PULLEYS FOR GENERAL USE.

Diameter of Ropes	¾	1	1¼	1½	1¾	2
Diameter of Pulleys	24	36	48	60	72	84

It is well to remember that the cause of many failures and much trouble experienced in rope driving is due to the use of too small a pulley for the size of rope and tension carried, but we have yet to hear of a case where the diameter of pulley has been too great. When it is not absolutely necessary to restrict the diameter to the smallest possible which should be used, the least diameter should conform to that given in Table XIX, which has been arranged for general work, and gives least diameters to the nearest half foot, for rope pulleys suitable for all speeds within the limits of good practice.

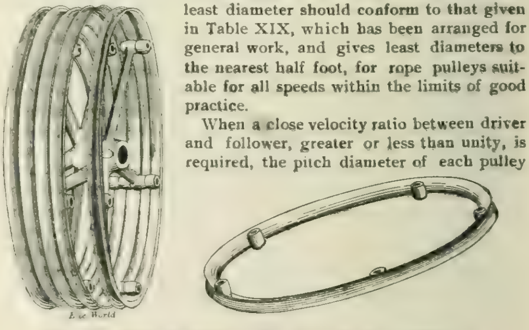


FIG. 50.—BUILT UP ROPE PULLEYS FOR LIGHT WORK.

When a close velocity ratio between driver and follower, greater or less than unity, is required, the pitch diameter of each pulley should be measured from the point of tangency of the rope in the groove, and not from the centre of the rope. For, if D represents the diameter of driver measured to centre of rope, Fig. 49, and F, the corresponding diameter of follower, the velocity ratio will be $\frac{D-2x}{F-2x}$ where x is the common vertical distance between centre of rope and point of contact. Where the pulleys are the same size, it is obvious that the velocity ratio will not be changed, but, as the difference in diameter increases, the influence of x will be more marked; thus, if $D = 3F$, the velocity ratio will be $\frac{3F-2x}{F-2x}$, —a result manifestly greater than $\frac{3F}{F}$. In any case the smaller the diameter of pulleys for a given velocity ratio, the greater the effect of the quantity x. In ordinary single transmission it will be sufficiently close to assume the diameter of pulley as measured from centre of rope.

It is evident from the previous considerations that the condition and shape of the groove is a matter of much importance; so generally is this recognized that manufacturers now almost universally turn their rims to special gauges and templets which insure uniformity in diameter and shape of groove. Special tools have been devised for turning the grooves, and one prominent manufacturer has constructed a special machine in which the rims are milled out.

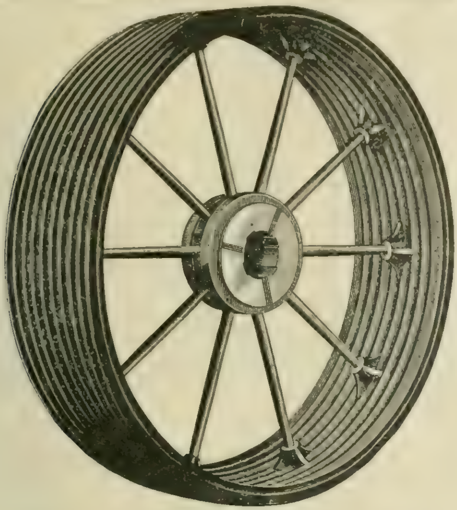


FIG. 51.—ROPE PULLEY WITH TURNED STEEL ARMS.

By this process some of the smaller pulleys are machined in one operation—as many cutters being used as there are grooves to be milled; uniformity of pitch, diameter and contour are thus insured independently of the operator.

Formerly the bottom of the groove was furnished with spikes or the sides were cut into angular teeth in order to prevent the rope from slipping,* but a greater experience with rope driving has shown that the whole surface of the groove must be perfectly smooth, and should be carefully polished as well as machined, since the fibres of the rope, if allowed to rub on a rough turned or cast surface, will gradually break, fibre by fibre, and thus give the rope a short life. It is also necessary to avoid using any pulley with sand or blow holes in the groove, as they are very destructive to a rope; when blow holes occur, if not honeycombed excessively, they should be filled in with lead, or, preferably, Babbitt's metal, otherwise the pulley should not be used. Some rope pulleys are simply cast and the rims smoothed up by holding a piece of abrasive material such as a broken emery wheel or grindstone against the surface of the groove, while the pulley revolves at a high speed. While this may produce a smooth surface, such an expedient is doubtful economy, for no matter how carefully a multiple-grooved pulley may be cast, it is almost impossible to obtain a rim all the grooves of which are true and of the same diameter; the result is that with such pulleys the ropes tend to vibrate and sway from side to side, rubbing against each other, and frequently against side posts, walls, floors, and other obstructions which rapidly destroys the rope.

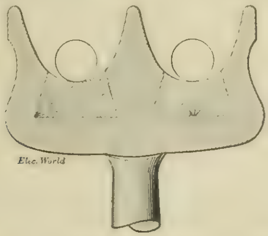


FIG. 52.—WOOD-FILLED ROPE PULLEY.

Attempts have been made to produce a finished surface in the groove by casting the rim in an accurately turned chill, but such pulleys have not been as successful as anticipated.

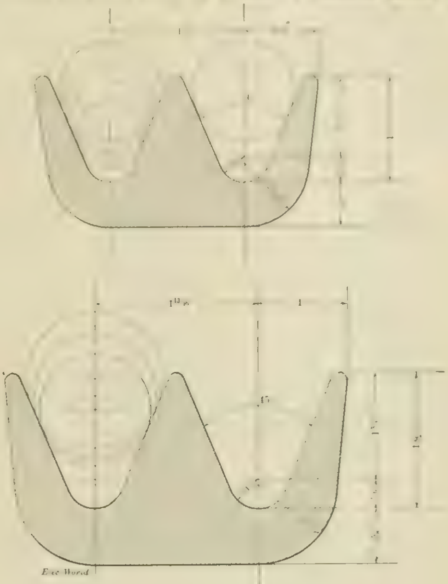


FIG. 53.—RIM SECTIONS.

A form of pulley introduced by the Link Belt Engineering Company, of Philadelphia, consists of an iron sheave cast in rings, some with and some without arms and hub, from which a complete pulley is built up having the requisite number of arms for strength, and at the same time being light and free from excessive shrinkage strains liable to exist in wheels having light arms and heavy rims and hubs.

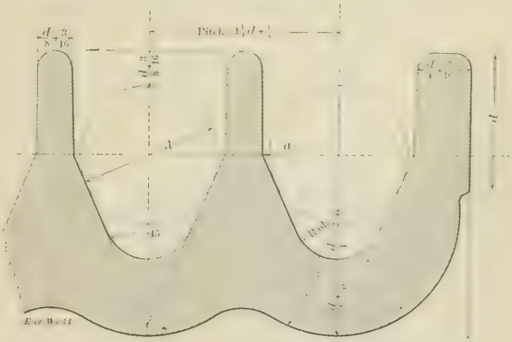


FIG. 54.—RIM SECTION—ENGLISH FORM.

The sheaves have a slight projection on one side and corresponding recess on the other, with bolt holes at the circumference, so that a multiple-grooved pulley with any number of grooves may be readily built up by bolting the sections together, as shown in Fig. 50. These wheels are made from metal patterns and moulded in a three-part iron flask. The core which makes the groove is continuous and of green sand, producing a very smooth casting. The groove is finished with an emery wheel swinging in a frame like a cut-off saw, the final finish being given by the use of emery and oil.

While this process produces a single grooved wheel more cheaply than by turning, it is doubtful whether from a manufacturing standpoint there is any economy in the built-up wheel, when we consider the degree of accuracy now obtained in moulding multiple-grooved wheels and the consequent reduction of labor in turning them.

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* Willis: "Principles of Mechanism."

Another special form of rope-driving pulley is that made by John Musgrave & Sons, Bolton, England. This pulley, Fig. 51, it will be noticed, is extremely light, but is sufficiently strong for the requirements. This lightness is attained by the use of steel arms turned tapering and firmly secured to the rim and the hub, which latter is spilt in three segments and ringed with steel. By the use of this form of pulley the shafts are relieved, to a considerable extent, of the weight and consequent friction entailed by the ordinary pulley, and there are no excessive shrinkage strains to contend with as is usually the case with the common form of single casting pulley. In pulleys of this form where wrought iron and steel rods are used for arms, the ends of the rods should be dipped in acid and tinned before setting in the mould. In addition to this, the rods are sometimes headed up and grooves turned in the ends.

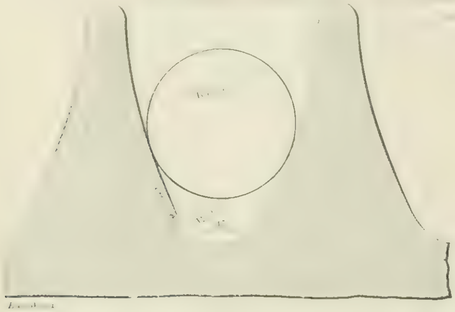
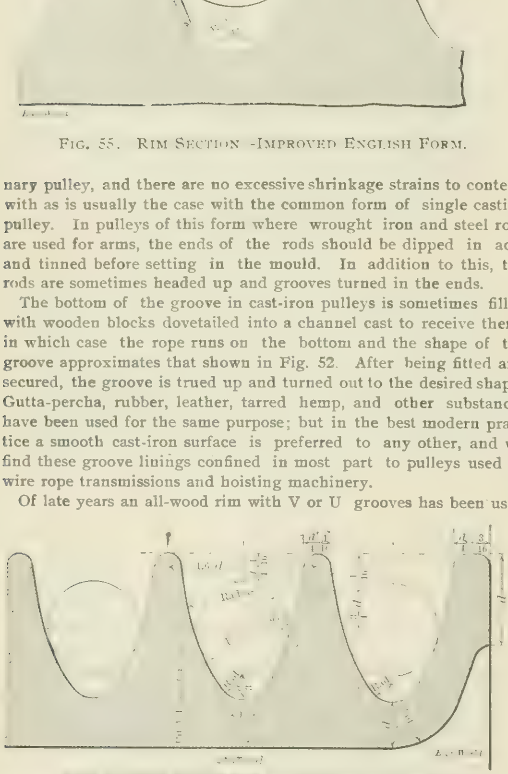


FIG. 55. RIM SECTION -IMPROVED ENGLISH FORM.

The bottom of the groove in cast-iron pulleys is sometimes filled with wooden blocks dovetailed into a channel cast to receive them, in which case the rope runs on the bottom and the shape of the groove approximates that shown in Fig. 52. After being fitted and secured, the groove is trued up and turned out to the desired shape.* Gutta-percha, rubber, leather, tarred hemp, and other substances have been used for the same purpose; but in the best modern practice a smooth cast-iron surface is preferred to any other, and we find these groove linings confined in most part to pulleys used in wire rope transmissions and hoisting machinery.

Of late years an all-wood rim with V or U grooves has been used to some extent, as it makes a cheap pulley, and is very satisfactory for light work when a semi-circular groove is adopted. Wooden rims, however, should not be used for heavy work, and the slip of the rope should be reduced to a minimum, otherwise the grooves and ropes will be rapidly cut out and the whole system will be very unsatisfactory.



ANGLE OF GROOVE 45° WHEN ROPE IS IN ITS NORMAL POSITION

FIG. 56.—RIM SECTION—GROOVES WITH CIRCULAR ARCS.

The proportions of rope pulley rims depend somewhat upon the shape of groove adopted. Some manufacturers have a standard groove with straight sides which may be used for several different sized rope, as shown in Fig. 53. For light work such a pulley is very satisfactory, and has many advantages in regard to constructive features not possessed by any other form. The groove shown in Fig. 54 is very commonly used in England, but in this country manufacturers of large rope pulleys usually prefer a form in which the abrupt change in profile (as at a) does not occur. Of these, the more common form is a modification of the English section, in which the straight sides forming the angular groove is connected to the rib between the grooves by curves as in Fig. 55.

Another form which has much in its favor, especially for the independent rope system, is the circular arc groove, in which the sides are formed by arcs of circles having a radius approximating 2½ diameters of rope. Working proportions for this groove are given in Fig. 56, in which the unit d equals the diameter of rope. It will be noticed that the centre for the curve is located at the intersection of a line drawn through the centre of the rope at an angle of 22½° with the horizontal drawn through the tops of the dividing ribs; the angle of the groove embraced by the rope is thus dependent upon the position of the latter in the groove. In its normal position the angle is one of 45°. The Walker groove as now used in rope pulleys made by Fraser & Chalmers, of Chicago, and the Walker Manufacturing Company, of Cleveland, has its sides formed with circular arcs similar to Fig. 56, but the angle of the groove is more acute; at the point of tangency when the rope simply rests in the groove the angle measures 33°.

Rope pulleys for ordinary transmissions are usually flat on the inside of the rim, or slightly tapered, as shown by the full lines in Fig. 56.

In large wheels, however, the rim is frequently swept up, and where the weight with a flat rim would be greater than required for strength or steady running, the inside is hollowed out, as shown by dotted line. This gives a more nearly uniform section, and makes a stronger and lighter wheel, but the expense of construction is greater.

(To be continued.)

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* Low & Bevis' "Machine Design," p. 156.

Practical Notes on Dynamo Calculation.—XXXIII.

BY ALFRED E. WIENER.

Part IV.: Calculation of Magnetizing Forces.

Part V.: Calculation of Magnet Winding.

In the preceding sections of this serial, Part I: Calculation of Armature; Part II: Calculation of Magnetic Flux, and Part III: Dimensioning of Field-magnet Frame, have been treated.

The formulæ and tables thus far given enable the complete design of the armature with its winding and all its details, provide the means of computing the requisite magnetic flux to be set up by the field magnet in order to obtain the required output at the given conditions; and, finally, give the best and most economical dimensions of the field magnet frame of the machine. To complete the design of a dynamo it therefore only remains to calculate the magnetizing force required to produce the necessary magnetic flux, and to find a magnet winding which furnishes the requisite magnetomotive force at the specified increase of field magnet temperature.

As time does not permit the full treatment of the remaining portion in the columns of THE ELECTRICAL WORLD, the reprint in book form of this serial being in the hands of the W. J. Johnston Company now, the application of the formulæ and tables already given, together with that of the parts not yet published, are, in the following, shown by means of a practical example.

Part VI.: Practical Examples of Dynamo Calculation.

From the numerous cases considered in Part VI. the following be selected:

To design a 300-kw bipolar horseshoe-type dynamo, Edison Type, to give 500 volts and 600 amperes at a speed of 400 revs. p. min. Armature to be a smooth drum; magnets to be of wrought iron and to have a shunt winding producing a rise of 20° C. in field coil temperature.

I. Calculation of Armature.

1. Length of Armature Conductor. In bipolar horseshoe-type dynamos not having a pole bushing or pole bridges (see Chap. 44, Vol. XXV., p. 174), the percentage of effective armature circumference varies from 67 to 80 per cent., corresponding to a polar arc of from 60° to 72°, respectively. In the present example, which is about the limit, in output, to which a bipolar design can yet be carried, the upper limit of $\beta = .80$ can safely be taken for the ratio of polar embrace, for, it follows from Table XV. (Vol. XXIII., p. 743), that the height of the winding space, and, therefore, the length of the air gaps increases in a very much smaller ratio than the diameter of the armature, in consequence of which a greater percentage of polar arc in a large diameter armature will yet produce a higher ratio of distance between pole corners to length of gap spaces (see Table XLVII., Vol. XXIV., p. 549), than a small percentage will in a small size armature.

For $\beta = .80$, Table II. (Vol. XXIII., p. 712) gives the value of $v = .013$ for the unit armature induction. Consulting Table III. (Vol. XXIII., p. 740), and Table IV. (Vol. XXIII., p. 713), we obtain the conductor velocity and the field density best adapted for the case under consideration:

From Table III.: $S = 50$ feet p. sec.
" " IV.:* $\mathfrak{H} = 30,000$ lines of force per sq. inch.

The total E. M. F. that has to be generated in the armature in order to give an output E. M. F. of 500 volts, by Table VI. (Vol. XXIII., p. 713), is:

$$E = e + .03 \times e = 1.03 \times 500 = 515 \text{ volts.}$$

By means of formula (3) we can now at once obtain the length of active conductor for the armature, viz.:

$$L_a = \frac{20,000 \times 515}{.013 \times 50 \times 30,000} = 530 \text{ feet.}$$

2. Area of Armature Conductor and Selection of Wire. From (4) the cross-section of the armature conductor is found

$$\delta_a^2 = 300 \times 600 = 180,000 \text{ circular mils.}$$

Taking three cables made up of 7 No. 13 B. W. G. wires, having .095″ dia. and 9025 C. M. area each, we have a total actual cross-section of $3 \times 7 \times 9025 = 189,525$ C. M., the excess amply allowing for the difference between the current output and the total current generated in the armature, see Chap. 6, Vol. XXIII., p. 714.

A cable is preferable in case of a large machine carrying a heavy current, on account of the better ventilation effected by air circulation in the spaces between the single wires as well as between the cables.

In accordance with Chap. 10 (Vol. XXIII., p. 772), a single covering of .007″ is selected for the single wires, and an additional double coating of .016″ is chosen for each cable of seven wires; making the total diameter of the insulated cable, see Fig. 136,

$$\delta'_a = 3 \times (.095'' + .007'') + .016'' = .322''.$$

3. Diameter of Armature Core. The diameter of the armature core is obtained from the mean winding diameter, formula (6), by means of Table VII. (Vol. XXIII., p. 714).

From (6): $d'_a = 230 \times \frac{50}{400} = 28.75$ inches.

From Table VII.: $d_a = .97 \times 28.75 = 28$ inches.

4. Length of Armature Core. The number of cables per layer, from formula (9) and Table XIV. is:

$$o = \frac{28 \times \pi \times (1 - .08)}{.322} = \frac{87.965 \times .92}{.322} = 252;$$

the number of layers, from formula (11) and Table XV.:

$$u = \frac{.8'' - 5/32''}{.322} = 2.$$

Length of core, from formula (12), three cables being in parallel ($p = 3$):

$$l_a = \frac{12 \times 530}{\frac{252 \times 2}{3}} = \frac{12 \times 530}{116} = 38 \text{ inches.}$$

5. Arrangement of Armature Winding. Number of commutator bars, from Table XVI. and formula (15):

$$n > \frac{500 \times 2}{20} < \frac{500 \times 2}{10}; \text{ or } n_{min} = 50, \text{ and } n_{max} = 100.$$

Actual number of armature coils: $n = \frac{252 \times 2}{3} \div 2 = 84.$

Difference of potential between two adjacent bars:

$$\frac{500 \times 2}{84} = 11.9 \text{ volts.}$$

Number of turns per coil, by (17): $m = \frac{252 \times 2}{2 \times 84 \times 3} = 1.$

The armature-winding, therefore, consists of 84 coils, each consisting of 1 turn of 3 cables made up of 7 No. 13 B. W. G. wires.

One armature division, containing the beginning of one coil and the end of the one diametrically opposite, is shown in Fig. 137.

6. Weight of Armature Winding. The total length of armature conductor, from formula (21) is:

$$L_t = 530 \times \left(1 + 1.4 \times \frac{28}{38}\right) = 1,075 \text{ feet.}$$

Total weight of wire, bare, from (28) and wire gauge table:

$$lb_a = 1,075 \times 21 \times .02732 = 620 \text{ lbs.}$$

Total weight, covered, formula (29) and Table XXI.:

$$lb'_a = 1.031 \times 620 = 640 \text{ lbs.}$$

7. Armature Resistance. From (31):

$$r_a = \frac{1}{4 \times 21} \times 1,075 \times .001144 = .0147 \text{ ohm, at } 15.5° C.$$

8. Useful Flux. From (92):

$$\Phi = \frac{6 \times 515 \times 10^8}{2 \times 84 \times 400} = 46,000,000 \text{ webers} = 46 \text{ megawebers.}$$

9. Radial Depth, Mean Cross-Section and Average Magnetic Density of Armature Core. Taking a maximum density of 70,000 webers per sq. inch in the smallest cross-section of the armature core, see Table XVII., formula (18) gives a radial depth of

$$b_a = \frac{46,000,000}{2 \times 70,000 \times 38 \times .9} = 9\tfrac{3}{4} \text{ inches.}$$

The maximum depth of the core, b'_a, that is, half the largest chord that can be drawn between the outer and inner core-peripheries can be obtained from Fig. 138:

$$b'_a = \sqrt{14^2 - 4\tfrac{1}{4}^2} = 13.4 \text{ inches.}$$

The mean sectional area of the armature core, therefore, is:

$$A_a = (9.75 + 13.4) \times 38 \times .9 = 792 \text{ sq. ins.,}$$

and the average magnetic density in the armature-core:

$$\mathfrak{B}_a = \frac{46,000,000}{792} = 58,000 \text{ webers per sq. inch.}$$

10. Energy Losses in Armature. From (35), the $C^2 R$ loss is:

$$w_a = 1.2 \times 600^2 \times .0147 = 6,350 \text{ watts.}$$

The frequency is $N_1 = \frac{400}{60} = 6.67$ cycles per second.

The mass of the armature core, from (38):

$$M = \frac{18\tfrac{1}{4}'' \times \pi \times 38 \times 9\tfrac{3}{4} \times .9}{1,728} = 11 \text{ cu. ft.}$$

The hysteresis factor for $\mathfrak{B}_a = 58,000$, from Table XXIV., is $\eta = 20.92$, and the eddy current factor for $\mathfrak{B}_a = 58,000$, and $\delta = .020''$, from Table XXVII., is $\varepsilon = .097$; hence the energy losses due to hysteresis and eddy currents, from (39) and (41), respectively:

$$w_h = 20.92 \times 6.67 \times 11 = 1,535 \text{ watts.}$$
$$w_e = .097 \times (6.67)^2 \times 11 = 47 \text{ "}$$

The total energy dissipation in the armature, by (42), is:

$$W_a = 6,350 + 1,535 + 47 = 7,932 \text{ watts.}$$

Fig. 136

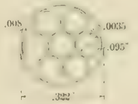


Fig. 137

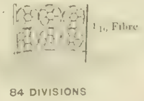


Fig. 138

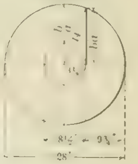


Fig. 140

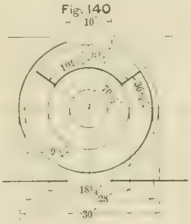
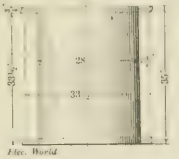


Fig. 141



FIGS. 136, 137, 138, 140 AND 141.

11. Specific Energy Loss and Temperature Increase in Armature. From Table XXIX., the length of the heads of our armature will be:

$$l_h = .35 \times 28 + 2 \times .8 = 11\tfrac{1}{2} \text{ inches.}$$

The radiating surface, consequently, from (44):

$$O_a = (28 + 2 \times .8) \times \pi \times (38 + 1.8 \times 11\tfrac{1}{2}) = 5,550 \text{ sq. ins.}$$

The pole area being about $30 \times \pi \times 38 \times .8 = 3,040$ sq. ins., the ratio of pole area to total radiating surface is $\frac{3,040}{5,550} = .55$; and since the peripheral velocity is 50 feet per second, we obtain, from Table XXX., a specific temperature increase of $\tau_a = 45.5°$ *C.* The rise of armature temperature, therefore, will be, by formula (47):

$$t_a = 45.5 \times \frac{7,932}{5,550} = 45.5 \times 1.43 = 65° C.$$

---

* See note at the head of Section III. (Vol. XXIII., p. 740).

12. Circumferential Current Density and Running Value of Armature. From (49) we obtain:

$$j = \frac{168 \times \frac{600}{2}}{28 \times \pi} = 572 \text{ amperes per inch of core circumference.}$$

This value is within the load limit given in Chap. 20; the output of the dynamos under consideration, 300 kilowatts, must, therefore, be within the limit of maximum safe output, which is really the case, for, from (53) we obtain:

$$W_{max} = 28^2 \times 38 \times .91 \times 30{,}000 \times 400. \times 10^{-6} = 325{,}000 \text{ watts.}$$

The running value of the armature is found from (54):

$$\rho = 20{,}000 \times \frac{515 \times 600}{620 \times 30{,}000} = 332 \text{ watts per lb. of armature}$$

conductor at $\mathcal{H} = 20{,}000$, which is within the practical limits given in Table XXXIII.

II. Dimensioning of Magnet Frame.

1. Total Flux Through Magnetic Circuit. From Table LII. (Vol. XXIV., p. 647), the probable leakage factor of a 300-kw upright horseshoe-type machine is $\lambda = 1.20$, and therefore the approximate total flux:

$$\Phi' = 1.20 \times 46{,}000{,}000 = 55{,}200{,}000 \text{ webers} = 55.2 \text{ megawebers.}$$

2. Area of Magnet Frame. The cores and yoke being of wrought iron, the sectional area required, according to Table LIX., is:

$$A_m = \frac{55{,}200{,}000}{90{,}000} = 614 \text{ sq. ins.}$$

3. The Magnet Cores. The cylindrical form of cross-section being chosen, the diameter of the magnets is:

$$d_m = \sqrt{614 \times \frac{4}{\pi}} = 28 \text{ ins.}$$

The length is obtained from Table LXIV. (Vol. XXV., p. 343), by interpolation, viz.: $l_m = 35$ inches. Distance apart, from Table LXVIII.: $c = 16$ inches.

4. The Yoke. The width of the yoke, in the type chosen, is equal to the diameter of the cores, therefore, its height:

$$h_y = \frac{614}{28} = 22 \text{ inches.}$$

The length of the yoke is given by the diameter of the cores and by their distance apart:

$$l_y = 2 \times 28 + 16 = 72 \text{ inches.}$$

5. The Pole-Pieces. The bore of the field is found by adding the following items:

Diameter of armature core................		= 28.000
Winding...........................	4 × .322″ =	1.288
Insulation and binding.......	2 × $\frac{5}{32}$″ =	.312
Clearance (Table XLVIII.)....	2 × .2″ =	.4
Field bore..........................		d_p = 30.000 inches.

Pole distance, from Table XLVII.: $e_p = 5 \times (30 - 28) = 10$ inches.

In Table LXX. (Vol. XXV., p. 370), the remaining dimensions of the pole-pieces for the case in question, cast iron being employed, are given as follows:

Height of pole-pieces.............	h_p = 30½	inches.
Length " "	l_p = 38	"
Thickness in centre..................	= 15	"

6. The Zinc Blocks. Table LIV. gives the height of zinc blocks for dynamos of 300 kw capacity and with a 28-inch drum armature as $h_z = 11$ inches.

Fig. 139 shows the field magnet frame thus dimensioned.

III. Calculation of Magnetic Leakage.

The permeance of the gap spaces, from (126), is:

$$P_1 = \frac{\frac{1}{4}\left(28 \times \pi + 30 \times \pi \times \frac{141^0}{180^0}\right) \times 38}{1.30 \times (30 - 28)} = \frac{1{,}540}{2.6} = 593.$$

The permeance across the magnet cores, from (129):

$$P_2 = \frac{28 \times \pi \times 35}{2 \times 16 + 1.5 \times 28} = \frac{3{,}080}{74} = 41.6.$$

Permeance across pole-pieces, by (114):

$$P_3 = \frac{\frac{1}{2} \times \left[38 \times \left(30 + \frac{30\frac{1}{2}}{2}\right) + 900^{*}\right]}{2 \times 11} + \frac{2 \times 38 \times 1}{10} = 59.6 + 7.6$$
$$= 67.2.$$

Permeance between pole pieces and yoke, by (114) and (115):

$$P_4 = \frac{500^{\dagger}}{35} + \frac{38 \times 30\frac{1}{2}}{2 \times 35 + (30\frac{1}{2} + 22)\frac{\pi}{2}} = 14.3 + 7.6 = 21.9.$$

Actual leakage factor, from (110):

$$\lambda = \frac{593 + 41.6 + 67.2 + 21.9}{593} = \frac{723.7}{593} = 1.22.$$

The actual total flux, consequently,

$$\Phi' = 1.22 \times 46{,}000{,}000 = 56{,}000{,}000 \text{ webers} = 56 \text{ megawebers.}$$

IV. Calculation of Magnetizing Force.

1. The Magnetic Circuit. The magnetic circuit of our machine consists of four different portions:

Air Gaps: Area: $A_g = \frac{1}{4}\left(28\pi + 30\pi \times \frac{141}{180}\right) \times 38 = 1{,}540$ sq. ins.

Length: $l_g = 1.30 \times (30 - 28) = 2.6$ inches.

Density: $\mathcal{H} = \frac{46{,}000{,}000}{1{,}540} = 29{,}900$ lines per sq. inch.

Armature Core:

Mean density (see above, I., 9): $\mathcal{B}_a = 58{,}000$ lines per sq. inch.

Specific magnetizing force, from Table LXXI.:

$$f(\mathcal{B}_a) = 12.2 \text{ ampere-turns per inch.}$$

Mean-length of circuit in armature core, see Fig. 140:

$$l_{(a)} = 18\tfrac{1}{4} \times \pi \times \frac{109\frac{1}{2}^\circ}{360^\circ} + 9\tfrac{3}{4}'' = 27 \text{ inches.}$$

Wrought Iron Part of Field Frame (Magnet Cores and Yoke):

Area: $A_w = 28^2 \times \frac{\pi}{4} = 616$ sq. ins.

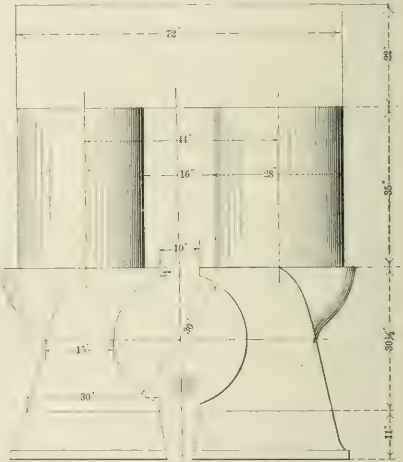
Length: $l_w = 2 \times 35 + 22 + 44 = 136$ inches.

Density: $\mathcal{B}_w = \frac{56{,}000{,}000}{616} = 91{,}000$ lines per sq. in.

Specific magnetizing force: $f(\mathcal{B}_w) = 53.8$ ampere-turns per inch.

Cast-Iron Part of Field Frame (Pole-Pieces):

Least area (in centre): $15 \times 38 = 570$ sq. ins.



1/32 SIZE

FIG. 139.

Corresponding maximum density:

$$\frac{56{,}000{,}000}{2 \times 570} = 49{,}200 \text{ webers per sq. in.}$$

Greatest area (at pole face): $\frac{30 \times \pi}{2} \times 38 \times \frac{141^\circ}{180} = 1{,}400$ sq. ins.

Corresponding minimum density:

$$\frac{46{,}000{,}000}{1{,}400} = 32{,}800 \text{ webers per sq. in.}$$

Average density in cast iron:

$$\mathcal{B}_c = \frac{49{,}200 + 32{,}800}{2} = 41{,}000 \text{ lines per sq. in.}$$

Specific magnetizing force: $f(\mathcal{B}_c) = 93.2$ ampere-turns per inch.

Mean length of circuit in pole-pieces: $l_c = 40$ inches.

2. Magnetizing Forces Required for the Various Portions of the Magnetic Circuit.

M. M. F. required for gap spaces:

$at_g = 0.3133 \times \mathcal{H} \times l_g = .3133 \times 29{,}900 \times 2.6 = 24{,}400$ ampere-turns.

M. M. F. required for armature core:

$at_a = f(\mathcal{B}_a) \times l_{(a)} = 12.2 \times 27 = 330$ ampere-turns.

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[*] Portion of bedplate opposite one pole-piece.

[†] Projecting area of pole-piece (= area, top of pole-piece—area of magnet core).

M. M. F. required for wrought-iron portion of frame:

$at_w = f(\mathfrak{B}_w) \times l_w = 53.8 \times 136 = 7,320$ ampere-turns.

M. M. F. required for cast-iron portion of frame:

$at_c = f(\mathfrak{B}_c) \times l_c = 93.2 \times 40 = 3,730$ ampere-turns.

M. M. F. required to compensate armature reactions:

$$at_r = (k) \times \frac{m \times C}{2} \times \frac{\alpha}{180^\circ} = 1.5 \times \frac{84 \times 600}{2} \times \frac{19\frac{1}{2}}{180} = 4,100 \text{ ampere-turns.}$$

Total magnetizing force required:

$AT = 24,400 + 330 + 7,320 + 3,730 + 4,100 = 39,880$ ampere-turns.

V. Calculation of Magnet Winding.

Magnet winding to be figured to give a temperature increase of $t_m = 20°$ C. over the standard temperature of 15.5° C. Extra regulating resistance at normal load to be 10 per cent. of the magnet resistance.

Radiating surface of magnets, see Fig. 141.

$$O_m = 2 \times (28 + 2 \times 2\tfrac{3}{4}{}^*) \times \pi (35 - 1\tfrac{1}{2}\dagger) = 7,050 \text{ sq. ins.}$$

The conditions of heat radiation from an electromagnet are similar to those of an armature at rest, with pole-pieces removed; for these conditions, from Table XXX. (Vol. XXIV., p. 33), the specific temperature increase of 75° C. for 1 watt of energy loss per sq. inch of radiating surface is derived.

The permissible energy loss in the magnet winding, therefore, is found from:

$$W_m = \frac{t_m}{75^\circ} \times O_m = \frac{20^\circ}{75^\circ} \times 7,050 = 1,880 \text{ watts.}$$

The total energy absorbed in the entire shunt circuit (magnet resistance + extra resistance) is:

$$W'_m = 1.1 \times 1880 = 2,070 \text{ watts.}$$

Current flowing through shunt:

$$C_m = \frac{W'_m}{e} = \frac{2,070}{600} = 3.46 \text{ amperes.}$$

Number of turns on magnets:

$$T = \frac{AT}{C_m} = \frac{39,880}{3.46} = 11,530 \text{ turns.}$$

The mean length of one turn being given by Fig. 141, the total length of the magnet wire is obtained from:

$$L_m = \frac{11,530 \times (28 + 2\frac{3}{4}) \times \pi}{12} = 93,000 \text{ feet.}$$

The total resistance of the shunt circuit, including the extra resistance, is:

$$r''_m = \frac{e}{C_m} = \frac{600}{3.46} = 173.5 \text{ ohms.}$$

The magnet resistance alone, therefore:

$$r'_m = \frac{173.5}{1.1} = 157.5 \text{ ohms at } (15.5^\circ + 20^\circ) = 35.5^\circ \text{ C.}$$

or:

$$r_m = r'_m \times \left(1 - \frac{t^\circ_m}{300}\right) = 157.5 \times .933 = 147 \text{ ohms at } 15.5^\circ \text{ C.}$$

The specific resistance of the magnet wire fulfilling the above conditions is:

$$\frac{r_m}{L_m} = \frac{147}{93,000} = .00158 \text{ ohm per foot at } 15.5^\circ \text{ C.}$$

The nearest gauge wire is No. 12 B. & S., having a specific resistance of .001581 ohm per foot; 93,000 feet of this wire will, therefore, give an actual magnet resistance of:

$$r_m = 93,000 \times .001581 = 147.1 \text{ ohms, at } 15.5^\circ \text{ C.}$$

The total weight of the magnet winding is:

$$lb_m = 147.1 \times 12,503 = 1,840 \text{ lbs. bare;}$$

or: $$lb'_m = 1.028 \times 1.840 = 1,890 \text{ lbs. covered.}$$

The given machine is consequently to be wound with 945 lbs. of No. 12 B. & S. wire (.081″ + .008″) per magnet.

The current density in the magnet wire is

$$\frac{6,530}{3.46} = 1,890 \text{ C. M. per ampere.}$$

Electrical efficiency of machine:

$$\frac{W}{W + W_a + W_m} = \frac{300,000}{300,000 + 7,932 + 1,880} = .968, \text{ or } 96.8 \text{ per cent.}$$

If a temperature increase higher than $t_m = 20°$ C. had been permitted in the field coils, more energy could be spent in exciting the magnets; the shunt current would, therefore, be correspondingly greater and the number of turns correspondingly smaller, resulting in a smaller weight of copper.

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* Height of magnet-winding space, from Table LXIII. (Vol. XXV., p. 342.)

† Allowance for core-flanges.

The Berliner Case.

To the Editor of The Electrical World:

SIR: It is to be hoped that the form of judgment or decree entered in the Berliner case by the Appellate Court will not be such as to adjudicate its validity, else it will be unfortunate, indeed, that the government ever begun proceedings. If the decree of reversal simply overrules Judge Carpenter, and does not pass on the merits of the validity of the patent, others may freely offer defenses against it on these points. If, on the other hand, the decree is not discreetly dissected by the government attorneys, the Bell attorneys may get what they evidently desire, viz.: an order which may be construed by other courts as having been passed upon after a proper consideration of the case on its merits. The charge has been made that this whole government suit was part and parcel of a Bell scheme to get an Appellate Court adjudication on this Berliner patent without submitting to a full test upon its merits from all points. It will depend upon the character of decree entered whether these suspicions will be continued. It is to be desired that the litigation necessarily to follow shall not be hampered by such limitation as could be exercised through the use of the Appellate decree in another circuit.

The seriousness of this whole matter lies in the improbability of any competing company going to the expense of defeating this Berliner patent, in view of the fact that such defeat would amount to no particular value as a victory, for all the clap-trap concerns in the business would tumble over each other in an effort to "steal the fruits" of it.

J. E. KEELYN.

CHICAGO, ILL.

Definition of Polyphased Systems.

To the Editor of The Electrical World:

SIR:—In the May 25th issue of your valuable paper, I saw a letter of Mr. A. Blondel. While the contents of this letter are such that ordinarily I should not think it proper for me to take any cognizance of it, the otherwise well-known name of the writer induces me to say a few words.

Regarding the technical side of the matter, as usual the letter under discussion is based on a mutual misunderstanding, which I hope in a short time to be able to explain completely by a paper which I promised to read before the American Institute of Electrical Engineers at its annual general meeting.

Regarding, however, the suggestion of the letter, that commercial reasons have been the cause for attempting to introduce a new definition of polyphase systems, I consider the *perversion of scientific facts or definitions for commercial purposes as dishonorable*, and I am afraid I would have to denote the action of the writer to impute such purpose without sufficient proof, *with the same name*, if I would not hope that Mr. Blondel has passed these remarks by mere inadvertency, without sufficiently considering their bearing: although I should expect from a writer of his reputation greater care in weighing the meaning of his words.

CHAS. PROTEUS STEINMETZ.

SCHENECTADY, N. Y.

The Arnold Motor.

To the Editor of The Electrical World:

SIR:—Undoubtedly you thought of bringing before your readers a new alternating-current motor, and one which may have been tried and used in practice in Europe, when you described the patent recently issued to Prof. E. Arnold.

With this very impression I started to read the interesting description, but at the close I felt disappointed. To my surprise I found in the description a motor for which a United States patent was granted to me in 1891.

In principle the motors are identical in construction. However, there are some differences, the merits of which I do not wish to discuss at this moment. Suffice it to say that the older patent broadly covers the ground.

LUDWIG GUTMANN.

CHICAGO, Ill.

[The article on Prof. Arnold's motor above referred to was confined merely to a general description of the motor, and did not cover numerous points of detail which are contained in the patent specifications.—ED.]

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

Note – The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors, or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 927 Chestnut Street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French, or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Alternating and Rotary Current Dynamos.—A translation of the paper of Mr. von Dobrowolsky, abstracted in the Digest, March 9 (see also April 20), is published with the illustrations, in the Lond. "Elec.," May 17.

Metals for Magnet Cores.—In a paper by Mr. Barry in "Proc. Cornell Elec. Soc.," Vol. 2, he gives a brief historical sketch of the development of the practical study of magnetism, calling attention to the contributions on this subject emanating from Cornell University, and giving some comparative curves. In conclusion he makes the following general statement among others: At the present time steel is used almost exclusively in field cores, armatures and transformers; it is conceded by the majority of manufacturers that there is a saving of 20 per cent. in the cost of metal in the use of cast steel over cast iron, not including the saving of copper; the consequent reduction of weight of large generators is nearly one half; carbon is the most objectionable impurity in cast steel, silicon being much less objectionable, but forms blow-holes and makes the metal much more difficult to work; annealing cast steel increases the permeability slightly at low densities; silicon prevents the improvement which would otherwise result from annealing; sulphur and manganese in very small quantities were found not to increase the hysteresis loss materially; it is essential to make an analysis of the steel in each casting used; cast steel for field yokes costs from 5 to 6 cts. per pound as against 6 to 7 cts. for its mechanical equivalent of cast iron or 5½ to 8 cts. for wrought iron formings; it should not contain more than 0.2 per cent. carbon, 0.4 per cent. manganese and 0.2 per cent. of silicon; pole pieces are best made of the finest quality of wrought iron "cast into the yoke"; wrought iron is used to advantage for the field cores of small machines, it is cheaper and more uniform than steel; cast iron can be used only in small machines; sheet steel can be used in armature cores where the number of reversals is below 125 to 150; for transformer cores with a frequency of about 100 the advantages of steel are less marked and it is doubtful if any exist; the hysteresis loss is greatly decreased by lowering the amounts of phosphorus and manganese, and to a certain extent also silicon and carbon; with sheet metal the effect of annealing is most marked; the best composition for sheet steel is about 0.08 per cent. carbon, 0.03 per cent. phosphorus, 0.4 per cent. manganese and 0.01 per cent. silicon; Mitis iron is a good metal for field cores, its disadvantage being its great roughness and the difficulty in working it.

Alternating Current Motors.—A paper of some length by Prof. Ryan is published in "Proc. Cornell Elec. Soc.," Vol. 2; he discusses synchronous, induction and monocyclic motors; the paper is illustrated with polar diagrams and diagrams of machines; it does not admit of being abstracted.

Method of Reducing Hysteresis Loss in Armature and Resistance Loss in Field.—A paper by Mr. Mann on this subject is published in "Proc. Cornell Elec. Soc.," Vol. 2.

New Automatic Regulator for the Brush Arc Dynamo.—In "Elec. Power" for May, Mr. Foster gives a well-illustrated description of the regulator for this series constant-current dynamo.

LIGHTS AND LIGHTING.

Projector Mirrors.—The Lond. "Elec. Eng.," May 17, publishes a translation of a pamphlet recently issued by Sautter, Harlé & Co., of Paris, the makers of the Mangin mirrors, giving a description of them and their properties, and comparing them with the parabolic mirrors; it is thought that the good results obtained by Schuckert (who makes the parabolic form) were attributable rather to the employment of comparatively short focal lengths and to the use of automatic horizontal arc lamps, than to the particular type of mirror, the parabolic; until recently it was thought impossible to construct a Mangin mirror having a focal length of less than two thirds of its diameter, but its makers have now succeeded in reducing it so as to admit of the use of horizontal lamps.

Illumination from Captive Balloons.—According to the "Zeit. f. Beleucht.," May 15, the German government is making some experiments to light areas for military drills by means of arc lights on captive balloons, connected by cables with the stationary generator; the candle-power will be 5,000, which will suffice for illuminating an area 500 metres in diameter; the balloons are 150 to 200 metres above the surface.

New Electrolier in the New Reichstag Building.—An illustration of this elaborately decorated electrolier is published in the "Zeit. f. Beleucht.," May 15; it is over 25 feet in diameter.

POWER AND HEAT.

Heating Metals Electrically.—The "Elek. Echo" for May contains a long anonymous article (apparently written by the inventors) describing in detail the Hoho and Lagrange process and its application to working with metals. This process has already been fully described in these columns but the following additional information may be of interest. (The metal to be heated is dipped into a liquid and a current of great density is passed over it and the liquid which heats the metal.) It is very necessary that the voltage used be regulated and adapted to the different operations, and it is therefore essential that a voltmeter be connected with the circuit; the liquid used must be adapted to the operation to be performed; for low voltages, about 100 volts, and for heating metals, a 20 per cent. solution of potash is best, but for higher voltages, up to about 350, the liquid should be made more resisting; the time of the operation depends chiefly on the voltage and it is economical to use a high voltage in order that the heating is produced as quickly as possible, the loss in the liquid being then less; the current in general does not increase materially with the voltage; in general five amperes per sq. cm. of surface to be heated can be taken as a basis and is about the same for the metals and the liquids; the temperature of the bath has a great effect on the consumption of current, the best temperature is from 50 to 70 degrees C. (122 to 157 degrees F.), as the current and the time are then at a minimum; the time is at most several seconds; the caloric efficiency is between 35 and 50 per cent., depending upon the size of the piece and the voltage, this efficiency approaching 100 the more rapidly the metal is heated. This process is specially adapted to heating to a high temperature particular portions of metals, for annealing, welding, heating, melting and for cleaning the oxidized surface of metals; the applications are considered in detail; most of them have already been described in these columns. They state that iron or steel which has been heated by this method does not oxidize as readily afterwards; steel is welded as easily as iron and either may be welded to copper or bronze; mention is made of official tests conducted by the Belgium government railway department but the results are not given; it is stated, however, that in subjecting iron or steel welds to tension tests they did not break at the weld. A short table of data is given from which the following is extracted: it refers to butt welds of round iron bars, the liquid being a 20 per cent. potash solution at a temperature of 70 degrees C.; for diameters of 10, 20, 30 and 40 the data is respectively as follows: the heated surface is 5, 15, 35 and 60 sq. cm; the voltage 110, 130, 170 and 220, the current for one rod was 20, 75, 175 and 300 amperes, the time 6, 10, 15, and 20 seconds and the horse-power-hours 0.005, 0.04, 0.17 and 0.50. The number of welds that can be made in a day is about double, as compared with what an experienced smith with several assistants could do. Its adaption to making screws, bolts and chains, and for drop forgings, is described, one of its advantages for the former being that steel can be used and that only a portion of the metal need be heated; the time and manipulation saved with drop forgings is said to be very great. It is well adapted to annealing, especially in wire drawing in which the wire is cleaned by the same operation; also the tempering, in which operation it is merely necessary to break the circuit in order to chill the metal in the same liquid in which it was heated; the tempering is said to be very regular and the heating may be localized at any particular part; it is specially adapted to superficial hardening; an interesting application is in the hardening of tires of wheels and the tops of steel rails, which is said to double their life; for such superficial hardening the heat should be generated very quickly; for this operation the voltage is from 100 to 150 and the current is five sq. cm; for cleaning the surface of oxidized metals, heating should be avoided as much as possible and therefore a lower E. M. F. should be used; for iron pieces containing less than 30 sq. cm of surface 110 volts are sufficient and five to six amperes per sq. cm, according to the degree of oxidation; the time is six to 10 seconds; when the article is connected to the positive pole its surface may be oxidized. Its application in chemical industries are briefly pointed out and it is claimed that operations become possible which formerly were impossible, as the electrolytic, chemical and caloric effects are combined.

Electric Furnaces.—A recent paper by Messrs. Girard and Street describing their new furnace and its application for the transformation of carbon into graphite, is abstracted in "L'Ind. Elec.," May 10; the carbon is converted into graphite by passing the pulverized material across a space heated by the arc; the principle of their furnace is that the arc is made to revolve by the action of a powerful magnetic field; they point out the application of this principle for heating crucibles; they made researches in which they endeavored to apply graphite for the manufacture of incandescent lamp filaments; it is possible that such filaments may be made which will enable the lamps to be forced without reducing their life and without the objectionable feature of blackening of the bulbs during their use; their researches in this direction have not yet been completed.

Power Generation and Distribution near Munich.—The "Elek. Anz.," May 12, contains a brief description of the 2,000-hp station for utilizing the water power of the Isar; it is thought that the whole power will soon be used in factories which it is believed will be located there; in the neighboring city of Thalkirchen electricity is used very largely, particularly for power purposes; the steam threshing-machine will be hereafter run electrically; it is transportable and is carried from house to house, being connected in each case to the circuit of that building.

Application of Electricity in Agriculture.—According to the "Zeit. fuer Elek.," May 15, the Prussian Minister of Agriculture is about to make some experimental tests in order to find whether such applications will give commercially satisfactory results.

Electric Motors in Workshops.—An anonymous article from the French is begun in "Elek. Echo" for May; it is intended to discuss the questions whether it is economical to replace mechanical transmission in existing factories by an electric system, and whether a new factory should be provided with motors or mechanical transmission; the results of some tests in a factory in Middlesbrough, Eng., are given.

Electric Transmission in Workshops.—A recent paper by Mr. Hillairet is published in abstract in "L'Ind. Elec.," May 10; it appears to contain little that is new; he gives the tests of Mr. Compere made two years ago showing the power and efficiency in several different kinds of manufacturing establishments; the efficiencies vary from about 30 to 50 per cent.

Crane.—A description of a method for operating a revolving and traveling electric crane, taken from a German patent, is given in the "Elek. Anz.," May 16.

Windlass.—An electrically-driven windlass, to be used on board ships, is described and illustrated in the "Elek. Anz.," May 12.

A Wheelbarrow Drill.—A convenient apparatus for use in track construction is described and illustrated in the "St. Ry. Gaz.," May 25; it consists of a ½-hp electric motor on a wheelbarrow operating a drill by means of a flexible shaft, the power for the motor being taken from the trolley wire; a hole can be bored through the web of the rail in less than a minute.

Electrical Heating.—The article by Mr. Hadaway, abstracted in the Digest, May 18, is reprinted in part in the "Elec. Age," May 18.

TRACTION.

Ordinances and Regulations.—In the regulations regarding the electric lines in Hamburgh, there is a clause stating that whenever the police department considers it necessary, the cars shall be provided with speed indicators (why not recorders?). In an ordinance granting the right for an electric trolley road in Braunschweig, Germany, there is a clause stating that if at any future time, in any German city of the same size, an underground conduit system is shown to be indisputably better than the trolley system, it must be substituted for the trolley road at Braunschweig.

Electric Locomotive Factory.—According to the "Elek. Anz.," May 12, a special factory is being built at the works of Brown, Boverie & Co., Baden, Switzerland, for the construction of electric locomotives.

Conduit Systems.—"L'Energie Elec.," May 16, publishes at some length an illustrated description of the Hoerde system (described in the Digest, March 30), including an illustration showing the contact shoe.

Comparative Value of the Rheostat and Series-Parallel Method.—"Elec. Power" for May contains an article by Mr. Sever in which he describes and gives results of tests to enable a comparison to be drawn between the two distinct methods of car control under widely varying conditions, in crowded city districts and on long runs with infrequent stops; he believes the figures given can well represent the average service. The cars were operated like those in regular use only that the load was constant; the tests were made on the Coney Island & Brooklyn Railway; he describes the methods and instruments used and gives the results in the form of a large number of curves. One of his conclusions is that there is a gain of over 40 per cent. in the power used, in favor of a one-motor car over a two-motor car with the K controller; in a comparison of the efficiencies he shows the great gain of the series-parallel controller over the rheostat in city work where stops are frequent, the saving being from 45 to 50 per cent.; the one-motor car shows a result a little better; in a district where the stops are less frequent the superiority of the controller is still shown but in less amount, being about 33.33 per cent. in the saving of energy; the one-motor car shows a gain of almost 50 per cent. over the rheostat and about 15 per cent. over the two-motor cars; in the run between the Boulevard and Coney Island the saving of the two-motor car is 10 per cent. and that of the one-motor car 42 per cent. over the rheostat and 32 per cent. over the two-motor car.

Mechanical Equipment of Power Stations.—The "Proc. Cornell Elec. Soc.," Vol. 2, contains a paper of some length by Prof. Carpenter; it is interesting in giving information and advice but does not admit of being abstracted; it refers merely to the mechanical part of power stations for electric railways. In the order of their importance, he gives the three important requisites as follows: reliability and certainty of operation, uniformity of speed, and economy; he does not recommend the line shaft system; the direct belt system is the cheapest in the first cost and in many respects the most satisfactory to operate, but the direct connected system he considers the ideal one; the cost of it, however, is about 20 per cent. over the direct belted system; he prefers the English practice in which the engine shaft is connected to the dynamo with a coupling, to the American practice of suspending the armature on the end of the shaft; the lowest first cost is attained by making the units of the largest size and fewest number, as it is more economical to run an engine with an underload; the ideal station should have about three units and one relay; it is not advisable to use a generator smaller than 100 kw. He discusses water motors, heat engines and steam engines, particularly the former, concluding with a table of steam consumption per horse-power-hour for different classes of engines, which was published in "Trans. A. I. E. E."

Conduit vs. Trolley.—The long serial by Mr. Sachs is concluded in "Elec. Power" for May; he gives briefly the general conclusions arrived at. He believes that an operative conduit system can no doubt be produced, but the first cost is quite serious; a desire to produce a cheap system has no doubt been the cause of past failures; he believes that the cost would be less than that for a cable system while it would be equally efficient in operation; he recommends the use of low voltage down to 150 to 200 volts; the alternating current would lend itself readily if suitable motors existed; with very low voltages it may be possible to operate some form of closed contact system if the switching-off of the surface conductor can be absolutely insured; he believes the solution of the problem is dependent on engineering skill and that a practical and operative system can be developed from the material already tried, but unless some new departure is made in the methods of distribution he believes the solution will be confined to the open-slot, continuous-wire conduit.

Three-Phase Railway Plant.—The "St. Ry. Gaz.," May 25, gives a brief description of the system for the Dalkey line of the Dublin Southern Company in which both three-phase and continuous currents are to be used; on account of the length of the line and other considerations several secondary feeding stations are erected along the line, the power for these being supplied from the main station by means of a high tension, three-phase alternating current; the current for the line is the usual continuous current; the voltage of the three-phase circuit is 2,500 to 3,000 and the frequency is 30; there are two three-phase machines of 120 kw each; the two motors at each of the sub-stations are synchronous and have a capacity of 60 kw each; the synchronous motors may be started either from the three-phase circuits or from the trolley wire.

Alternating Current Railway System.—The "St. Ry. Gaz.," May 25, gives a brief description of a system patented to a Mr. Strong in which three-phase alternating currents are used on the car. There are two trolley poles and wires, the rails forming the third circuit; the principal feature is the regulation of the motors, which is described in detail.

Test of an Electric Snow Sweeper.—An abstract of a thesis by Messrs. Crumb and Stocking is given briefly in "Sibley Jour." for May. The sweeper tested was built by the General Electric Company and is used in Elmira, New York; the results are given in the form of two sets of curves, one showing the electical horse-power supplied to the truck and the other that supplied to the brush motors; the latter shows quite a steady consumption while the other, the truck motor curve, shows considerable fluctuation owing to the different depths of snow and the irregularity in the running of the sweeper; the length of the run was five miles.

Test of Ithaca Street Railway Power Plant.—An abstract of a thesis by Messrs. McNeil and Manning, giving the results of a test in detail, is published in "Sibley Jour." for May; the test seems to be limited to that of the boiler and engine, very little being said regarding the electrical part and nothing regarding the line or cars.

Accumulator Traction in Paris.—Some additional data of the paper of Mr. Sarcia, abstracted in the Digest last week, is published in the "St. Ry. Gaz.," May 25; one of the cuts showing how the batteries are inserted into the car is reproduced.

Pittsburgh.—An illustrated description of the Schenly Park & Highlands Railway is published in the "St. Ry. Gaz.," May 25.

[illegible].—"El'ty," May 29, publishes at some length the records of the final hearing of the litigation between the General Electric and the Westinghouse companies, the main points of which were given in THE ELECTRICAL WORLD two years ago.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Train Lighting.—A recent paper by Dr. Buettner is abstracted briefly in the "Elek. Zeit.," May 16. The original contains descriptions and comparisons of the principal systems at present in use. Among other things he states that the weight of the apparatus, when gas is used, is much greater than that for the electric system, for the same illumination; results obtained have shown that the cost of operating is appreciably less for the electric system; on three of the lines the cost of the installations on the cars, using accumulators, is equal to that for gas, while that for the stationary part of the installation is appreciably higher for gas; for a gas plant for 170 cars, the latter is about 50,000 marks (about $12,500), while that for a charging station by the electric system of equal capacity is 25,000 ($6,250), with the additional advantage that this plant can be used for lighting the stations and the road; the cost of the electric system is therefore appreciably less especially for small lines.

Street Lighting by Series Incandescent Lamps.—The Lond. "Elec. Rev.," May 17, gives briefly a summary of what has been done in this direction; it also contains a communication pointing out the disadvantages of the Parfitt system, which was described in the Digest last week.

Accumulator Stations.—A description, taken from a German patent specification, of a new method of connecting the dynamos in a three-wire accumulator system in which only one large generator is used in connection with several smaller ones, is published in the "Elek. Anz.," May 16.

Railroad Installation.—A recent paper by Mr. Bochet on the electrical installation at a new railroad station in Paris is given in "L'Ind. Elec.," May 10; at this station, which is at the end of the new prolongation of the Sceaux railway, electricity will be used for many different purposes, but, strange to say, not for traction through the tunnels under the city street.

Sheltenham.—A very long and well-illustrated description of this municipal alternating-current station is published in the Lond. "Elec. Eng.," May 17; the station is near the existing refuse destructor, the steam generated by the necessary destruction of the house rubbish being enough to run the engines during the lightly loaded periods of the day. A brief description is published in Lond. "Lightning," May 16.

St. Pancras.—A brief description of the accounts of this station is given in the Lond. "Elec. Rev.," May 17; it criticises unfavorably the item of depreciation which it is believed was put too low.

Budapest.—The description by Mr. de Fodor is concluded in the "Zeit fuer Elek.," May 15.

Loads for Central Stations.—"Elec. Power" for May contains a second article by Mr. Perry on "Working Out Its Own Salvation," in which he describes a number of ways in which a profitable day-load may be provided for central stations. He describes the Hall process for obtaining aluminium, the manufacture of soda and bleaching powder, the production of carborandum and calcium carbide, the latter being discussed at some length including some estimates of the cost of a plant; the patents regarding the latter material are briefly discussed, and belief is expressed that it is extremely doubtful if they are worth anything at all and that they afford no protection whatever to the inventor; it is stated that not an ounce of carbide was made by the inventor until long after the patents had been issued. In conclusion he states that he does not suggest to the central station manager to undertake these industries himself as that would in many cases be impracticable, but he recommends that inducements be offered to others to locate near to the station and to use in this and other ways the surplus energy at a figure less than they could themselves produce it for, and still at a figure which would net the central station a small profit during the hours when the machinery is bringing worse than no returns.

Pennock Electric System.—The "Sibley Jour." for May contains a short article by Mr. Swann in which he gives a brief account of the Pennock system and describes tests made at the Cornell University. In this system the same current is switched successively to different lamps and motors, the claim being that a large number of them can be run by the same current without increasing the amount of energy required; the tests show that the candle-power diminishes with the time during which they have current, and that therefore the claims are not substantiated.

WIRES, WIRING AND CONDUITS.

Earthing.—In a communication by Mr. Andrews in the Lond. "Elec.," May 17, he comments favorably on a recent report (see Digest, May 18 and June 1), stating that the advantages are even greater when a two-wire system is earthed, whether continuous or alternating currents are used; feeders should be insulated up to the feeding point; the earthed conductor of the network (mains) should be uninterrupted by fuses or switches throughout; with continuous currents the negative should be insulated to a slight degree to provide against electrolysis and be earthed at each feeding point and house connection; if alternating currents are used the insulation of the earthed conductor is not a necessity; if concentric cables are used the earthed connections may be omitted; to reduce the voltage between different points on the earthed conductor the extreme ends of the branches should be connected together and, where possible, back to the mains; both wires in the houses should be well insulated except with the concentric system, and the fuses and switches should be inserted only in the non-earthed conductor. He has had sufficient experience with earthed systems to be able to say that interference in telephone and telegraph circuits is at least no greater and the same may be said with regard to electrolysis.

Underground Conduits and Cables.—In a continuation of Mr. Maver's article in "Elec. Power" for May he gives an illustrated description of a number of solid conduit systems and some bare wire conduits.

Fuse Wire.—A summary of a paper by Mr. Matthews is given in the "Proc. Cornell Elec. Soc.," Vol. 2; it was published in full in the "Trans. A. I. E. E.," Vol. 10, p. 250.

ELECTRO-PHYSICS AND MAGNETISM.

Light and Electrification.—The Lond. "Elec. Eng.," May 17, gives a brief summary of an article by Prof. Lodge in the current number of "Science Progress"; it treats of the subject of photo-electric action, the influence of illumination on electrified surfaces. Among other things he states that the order of metals in their photo-electric power, when tested by their discharging action for negative electricity, is the same as their order in the voltaic series; the facts discussed suggest some chemical or semi-chemical explanation. Regarding the effect of magnetism, he discusses the observations of Elster and Geitel who found that if the lines of magnetic force had the same direction as those of electrostatic force, they had no appreciable influence on the discharge power of light, but as soon as they cross each other the discharge power of light was diminished and interfered with.

New Method of Magnetizing.—A method of magnetizing scythes by Mr. von Wieser is described in "Zeit. fuer Elek.," May 15. The dynamo consists of a bipolar machine having an H form of armature as in the primitive forms of dynamos; the ends of the single coil are connected to a coil surrounding a laminated magnet which is secured to the end of the shaft and rotates with the armature; the scythe to be magnetized is held in front of the poles of this magnet; for each half revolution of the magnet the current will be reversed and the equivalent of the whole apparatus will therefore be that of a fixed magnet having a fixed but strongly pulsating field; the magnetization of the scythe is said to be much greater on account of the intermittent character of this magnetizing field. In another method the scythes are moved rapidly to and from the poles of a fixed magnet.

Curious Vacuum Tube Phenomena.—Referring to the experiments of Mr. Lomas (see Digest last week) Mr. Taylor in the Lond. "Elec.," May 17, states that he has often noticed the after-glowing, and thinks the explanation is not obscure, both the shock and the glow being due, he believes, to the discharge of the accumulated electrostatic strain in the glass; to show this an experiment may be made with a plate of glass without conducting coatings, which is charged by holding it between the poles of an influence machine; the discharges between the knobs will continue until the plate is fully charged; it may be discharged by placing a sheet of tin foil on each side and connecting them; he believes that the electrostatic capacity of the vacuum tubes is not at all inconsiderable on account of the amount of surface and thinness of the glass.

Alternating and Interrupted Electric Currents.—Prof. Forbes' second lecture is continued in the Lond. "Elec. Eng.," May 17, including several of the illustrations. His third lecture is abstracted in the Lond. "Elec. Rev.," May 17; the abstracts of these lectures in the latter journal, although apparently not so complete, contain better descriptions than what appears to be a stenographic report, in the former. In the third lecture a good explanation is given, with references to the original statements of the fact that the same quantity of electricity passed through wire in succeeding impulses, separated by a period of rest, heats it more than if it passes through as a continuous current.

Molecular Volume.—A lecture by Prof. Roberts-Austen, on researches with alloys, mentioned below, is abstracted briefly in the "Eng. & Min. Jour.," May 25. One of the experiments was as follows: With the aid of a Planté battery he made sodium pass from sodium amalgam through a sheet of glass several millimetres thick and enter mercury placed on the other side of the glass; the temperature of the whole was 200 degrees C.; when lithium amalgam was subsequently substituted for the sodium, the metallic lithium passing through the glass partly forced out the sodium; the conclusion from this is that atoms of lithium can pass along the tracks left in the glass by the sodium atoms; when a metal of atomic weight and volume superior to sodium was substituted, such as potassium, it was found impossible to replace the sodium, the atoms being too large to pass through the space where the sodium had been; there is therefore a molecular porosity which can in a sense be gauged and the mechanical influence of the volume of the atom is made evident.

Capacity of Electrolytic Condensers.—The "Phys. Rev." for May June contains an article of some length by Messrs. Sheldon, Leitch and Shaw, in which they give the results of extended measurements and investigations. An electrolytic cell when subjected to small voltages acts as a condenser of great capacity; in the present paper the properties of such a condenser are examined and discussed. They describe the method of measurement which in general is to find the throw of the galvanometer corresponding to the quantity of electricity necessary to depolarize the cell from a given voltage to zero, plus the quantity necessary to polarize it to the same voltage in the opposite direction; the capacity at that voltage is obtained by dividing half the quantity by the voltage. They discuss the effect on the capacity of the E. M. F., the electrode surface, the temperature, concentration and coupling of cells; they also discuss the dissipation of the charge, obtaining curves which are very similar to hysteresis curves.

Differences of Electrical Potential between Substances in Contact.—The "Proc. Cornell Elec. Soc.," Vol. 2, contains a paper by Mr. Child in which he discusses the discoveries made in this field, shows the connection between them and gives the arguments on both sides concerning the seat of the E. M. F.; he gives a general idea of how the subject stands to-day rather than a full and impartial history.

Metallic Conduction and the Influences which Affect It.—The "Proc. Cornell Elec. Soc.," Vol. 2, contains a long paper by Mr. Rogers in which he gives a summary of what is known of the influences affecting electrical conduction in metals, with a brief statement of the theory of electrical conduction.

Thermal Conductivity of Copper.—An article by Messrs. Quick, Child and Lamphear, is begun in the "Phys Rev." for May-June; the temperature and the electrical resistance were measured electrically; the article contains tables of data of the results.

Records of Electric Discharges.—The "Elec. Rev.," May 29, publishes an article from the "Literary Digest" by Mr. Karyll; it reproduces four microscopic enlargements of discharges made on a plate of smoked glass, held between two terminals of an induction coil.

Secular Motion of a Free Magnetic Needle.—A reprint of the paper of Mr. Bauer recently read before the National Academy of Science, is begun in the "Phys. Rev." for May-June. It appears to be similar to the one mentioned in the Digest, April 27.

Resonance in Transformer Circuits.—The "Phys. Rev." for May-June contains an analytical and graphical treatment of the subject by Messrs. Bedell and Crehore.

Electrical Resonance and Some Allied Phenomena.—Portions of a paper by Dr. Bedell are published in "Proc. Cornell Elec. Soc.," Vol. 2.

ELECTRO-CHEMISTRY AND BATTERIES.

Chemical Reactions in Accumulators.—Mr. Darius begins a series of articles in "L'Elec.," May 18. In the double sulphating theory of Gladstone and Tribe and of Mr. Steintz (probably Streintz, see Digest, Jan. 19), it is assumed that metallic oxides cannot exist in the presence of a free acid; if it can be shown that this is incorrect the double sulphating theory cannot be correct; he then shows that oxides of lead can exist perfectly in the presence of sulphuric acid; in general if acid acts on an insoluble oxide the product being itself insoluble, the action is never complete; he gives the results of experiments with litharge showing that in a two days' immersion it was only about half converted into sulphate, the amount varying with the concentration of the liquid; the same is true, though to a less extent, with the oxide on a positive plate; he concludes that it is therefore not correct to introduce into the thermo-chemical calculations the heat of formation of sulphate of lead on the positive plates; the sulphate found on this plate after a discharge is always variable in quantity and is due only to the local action of the acid on the oxide reduced from the peroxide, and it never is included in the principle reactions of the discharge.

New Product of Lead.—According to "Elek. Anz.," May 12, Hannay noticed that if sulphate of lead is added to molten galena a dense smoke containing lead will be produced; it will also be generated whenever galena is roasted in an atmosphere containing oxygen or gases containing oxygen (possibly there might be an application of this finely divided lead compound, in accumulators).

Reduction of Refractory Metals.—A recent Society of Arts lecture by Prof. Roberts-Austen is abstracted in the Lond. "Elec.," May 17; brief references are given to electrolysis and the use of electric furnaces, attention being called to the fact that in the latter carbides of great stability are formed from which the pure metal can be obtained only by repeated fusion with the oxide of the metal under treatment.

Purification of Drinking Water.—The Lond. "Elec. Rev.," May 17, calls attention to a paper by Mr. Oppermann in the "Elek. Rund.," 12, p. 42 and 50, in which he describes a process in which the ozone is used to oxidize organic matter in water, and convert nitrites and ammonia into nitrates; an excess of oxygen gives the water an unpleasant taste which however disappears on standing from one to two weeks; hydrogen dioxide is also produced and as it is an undesirable constituent he subjects the water to a second electrolysis, using aluminum electrodes which form aluminum hydro-oxide, and after filtration the water is fit to drink; the most suitable conditions for the production of ozone in the electrolysis of water are a temperature below five or six degrees C., small platinum electrodes and a high current density, under such conditions the gaseous product contains about six per cent. of ozone. A similar paper by the same author was abstracted in the Digest, May 4.

Electrolysis of Cuprous Chloride.—The article abstracted in the Digest, May 11, under "Metallurgy of Copper," is translated in abstract in the Lond. "Elec.," May 17, in which the illustration is also given.

Cyanide of Potassium and Electricity.—The Lond. "Elec. Rev.," May 17, contains an article by Mr. Andreoli in which he comments on the decision in the recent litigation regarding the gold extraction process.

Gold Extraction.—A description of the public trial made recently of the Haycraft process, is published in the "Eng. & Min. Jour.," May 25; in this process ordinary salt is decomposed by the current, the sodium passing to the mercury and the chlorine dissolving the gold, the chloride of gold being electrolyzed and the gold deposited on the mercury; the cost of the treatment including crushing is estimated at about 7s. 6d. per ton.

Modern Theories of Primary Batteries.—In a paper by Prof. Merritt published in the "Proc. Cornell Elec. Soc.," Vol. 2, he discusses some points in connection with the theory of electrolysis; it does not admit of being abstracted.

UNITS, MEASUREMENTS AND INSTRUMENTS.

New Method for Measuring Specific Inductive Power.—In "L'Elec.," May 18, Mr. Nodon describes methods which he used in connection with Prof. Pellat. Two metallic spheres of small capacity are placed at some distance apart and connected with a high-potential source of variable currents, such as an induction coil; a third and movable sphere is grounded through a telephone; when this sphere is moved between the other two, a position will be found at which there will be no sound in the telephone; a slab of the dielectric to be tested is then placed between the movable and one of the other spheres, then the position of the movable sphere must be altered in order that no sound be heard in the telephone, the movement being toward the dielectric; the distance through which this sphere was moved will then be proportional to the specific inductive power of the dielectric. In order to standardize the apparatus a material of known inductive capacity is first used, the specific inductive capacity of the unknown material being then obtained in terms of this standard, the two specific inductive capacities being directly proportional to the two distances (from the centre as found in the first test) measured in the two tests. This method may also be used for liquids and gases by placing them in tanks with parallel sides, made of a dielectric whose inductive power has first been determined. The method is said to be very simple and precise.

Measuring Armature Loss and Efficiency of Motors and Generators.—The "Elek. Zeit.," May 16, contains a long communication from Mr. Lenz and an answer by Mr. Grau concerning the discussion which has been going on for some time (see Digest, Dec. 1, March 9, March 23); both letters refer chiefly to personal matters and contain little of general interest; by order of the editors the discussion is herewith closed.

Submarine Cable Work.—In the continuation of Mr. Wilkinson's serial in the Lond. "Elec.," May 17, he discusses the polarization of fault or break, the improved Blavier and the Mance partial earth tests.

Universal Electro Dynamometer.—A good description, with illustrations of the Zickler instrument, described in the Digest, May 4, is published in Lond. "Elec.," May 17. In commenting on it editorially it is believed that this is one of the most successful attempts to produce a single instrument which can be used as an ammeter, voltmeter and wattmeter; it is a question however whether in adopting it to so many different functions a sacrifice of convenience has not been made which will more than counterbalance the advantages; the sacrifice to compactness is believed to have been carried too far; in making the instrument read to 100 amperes, the torsion spring must be somewhat powerful which demands a large turning moment and therefore a large self-induction for the voltmeter coils.

Zero-Torque Meter.—An illustrated description of the Edmondson meter is published in the Lond. "Elec. & Elec. Eng.," May 17. It consists of a dynamometer combined with a mechanism for measuring and integrating the torque exerted on the moving coil by the current to be measured; the motion of the coil is limited to an arc of less than one degree; a torque of about 90 degrees is given to the usual spiral spring every two minutes by a reciprocating quadrant driven by a vibrating motor consisting of a magnet and its armature, the motor being controlled by a small gravity-driven pendulum starting automatically and having a sparkless contact.

Registering Ampere and Voltmeters.—The Hartman & Braun form is illustrated and described in "L'Energie Elec.," May 16; the measuring instrument is a simple Kohlrausch apparatus consisting of a solenoid and a movable core suspended by a spring, the core being drawn into the solenoid; its position is registered on a revolving drum.

[illegible]—"L'Ind. Elec.," May 10, contains an illustrated description of these instruments.

[illegible] Intensity [illegible]—A good description with illustrations of the lumen-meter of Mr. Blondell, is published in "L'Ind. Elec.," May 10, a description of this apparatus was given in the Digest, April 13.

New Method for Testing the Magnetic Properties of Iron.—A short article by Mr. Franklin is published in the "Phys. Rev." for May-June; he describes the method for the determination of $\mathfrak{B}$ and $\mathfrak{H}$, as follows, giving the proof and experimental results: "A rod, of sectional area q, of the iron to be tested, is bent into the form of a long narrow ∩, and suspended from the (left) pan of an ordinary balance. The legs of the ∩ are surrounded by longer stationary coils, each having n turns of wire per centimetre, these coils being connected as the two coils of a horseshoe magnet. The balance is tared, a weight equal to F dynes placed on the right pan, and the current in the coils is slowly increased (or decreased) until the balance is in equilibrium, when the current, i, is measured; then

$$\mathfrak{H} = 4\pi n i$$

and

$$\mathfrak{B} = \frac{2\pi F}{q H} + \mathfrak{H}."$$

He describes the method for the direct determination of hysteresis loss as follows, giving the proof and experimental results: "The iron to be tested is taken in the form of a long straight rod, and suspended vertically from the pan of a balance. A coil of wire of medium length, of n turns per centimetre, surrounds the rod, and is arranged so that it can be moved up and down conveniently. It being required to find the energy loss per cubic centimetre of iron during a cycle in which the magnetizing field changes from $+\mathfrak{H}$ to $-\mathfrak{H}$, and back to $+\mathfrak{H}$ again, a measured current i is passed through the coil. The coil is moved up and down over the whole rod a number of times, the current being reversed each time the coil reaches top or bottom, until the changes in the rod have become cyclic. The rod is then weighed down during the upward motion of the coil, and during the downward motion of the coil. Let F be the difference of these two weights in dynes; then

$$W = \frac{F}{q}$$

in which q is the sectional area of the rod, and W is the energy per cubic centimetre lost in the iron in one cycle. The magnetizing field is calculated from the first equation given above."

Measurement of Electrical Resistance.—In a short article by Mr. Parker in "Elec. Power" for May, he discussed the present range and accuracy in such measurements. From theoretical and practical considerations he places the limits at one ten-millionth of an ohm and ten million million ohms, that is, a range from one to one hundred million million million; he makes comparisons with other physical magnitudes and their measurements. He believes that the greatest accuracy is obtained in the comparison of standard ohms by the Carey-Foster method in which an agreement of results to even .001 per cent. may be reached.

Evolution of a Connected System of Units.—"Elec. Power" for May contains an article by Mr. Wolcott on this subject; he calls attention to some salient facts and the fundamental principles underlying them, which throw light on the general development of units to the present time and which ought to guide one in future work; he deals with units in general and not exclusively with electrical units; he points out some objections to the electrical system and states that even if a logically consistent system, which is practically convenient, could be framed, there would be great difficulty in introducing it.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Electrical Communication with Light Houses—An abstract of some length of the third report of the Royal Commission is published in Lond. "Elec.," May 17; brief abstracts are given in the "Elec. Rev." and "Elec. Eng.," May 17. It describes the progress which has been made toward carrying out the recommendations made in former reports; the results arising from the work already completed are recognized by the committee as being most valuable.

Railroad Signal.—An improved control signal is described by Mr. Prasch in the "Elek. Zeit.," May 16; the improvement consists in adapting a formerly described apparatus so as to make it possible to have the batteries at the station, instead of locally along the line.

Fundamental Principles of the Telephone.—A lecture by Mr. J. Berliner is abstracted briefly in the "Elek. Zeit.," May 16.

Development of the Telephone.—A recent paper by Mr. Vollmer is given in abstract in the "Elek. Zeit.," May 16.

Muirhead vs. Commercial Cable Co.—According to Lond. "Elec.," May 17, the long litigation regarding the American Duplex patents has been decided in favor of Muirhead.

MISCELLANEOUS.

Method of Finding Flaws in Rails.—The method of de Place, which is used by the Northern Railway of France, is briefly described in the "Elek. Zeit.," May 16; the description, however, is not as clear as might be desired; the microphone is used; the description is taken from "La Revue Technique," April 10, 1894.

Electric Safety Lock.—"La Nature," May 18, contains an illustrated description of a new form of a door lock.

School for Electrical Mechanics.—The programme of a school started last September in Vienna, is published in the "Zeit. fuer Elek.," May 15.

Exhibition of 1900.—Mr. Claude in an article in "L'Ind. Elec.," May 10, suggests that the hydraulic power of some of the numerous falls of the Seine be transmitted electrically to the Exhibition, referring particularly to a falls about six miles from Paris where 1,800 hp could be obtained; the total power of that river which could be obtained even at low water is 30,000 hp; he suggests that this be used at the exhibition for operating fountains and other attractive water effects; the 1,300 hp transmitted would operate a fountain over 60 feet high with a capacity of more than 3,000 litres (800 gallons) per second.

International Exhibition.—According to "Elek. Anz.," May 16, there will be an international exhibition in Kioto, Japan, during four months of the present summer.

Physiological Effects of Alternating Currents.—"Elec. Power" for May contains an article by Mr. Gutmann in which he describes in detail the sensation experienced by himself when by accident his body was directly connected in the high-tension circuit of an alternating current; the voltage of the dynamo was 1,100; after momentary unconsciousness he found himself unable to breathe, cry or move, until accidentally released by an opening of the circuit. He states that the conclusions of Dr. Goelet that death is painless because electricity travels faster than the nerves can transmit painful impulses, seem to him to be erroneous as he believes that three times the number of alternations, as used at present, can still be clearly distinguished by the brain.

Biographical.—A biographical sketch of Mr. A. Langstaff Johnston with portrait is published in the "St. Ry. Gaz.," May 25. The "Elec. Rev.," May 29, publishes a short biographical sketch, with portrait, of Dr. Duncan.

Projectors of the Atlantic Cable.—"El'ty.," May 29, publishes a reproduction of the painting recently presented to the New York Chamber of Commerce.

Electricity in Mining.—In a short paper by Mr. Sanderson published in the "Proc. Cornell Elec. Soc.," Vol. 2, he gives results of tests made by him a year ago of two plants in coal mines.

Lightning Arresters.—In a paper by Mr Hewitt, published in the "Proc. Cornell Elec. Soc.," Vol 2, he gives a historical sketch of lightning arresters with special reference to those of Mr. Wurtz and his theories concerning them.

New Book.

MOTIVE POWERS AND THEIR PRACTICAL SELECTION. By Reginald Bolton. New York: Longmans, Green & Co. 257 pages. Price $2.25.

The object of this work is to guide the engineer and others in the selection of a motive power suited to specific conditions. To this end a compilation is made of the various facts necessary to settle the question of proper selection, the data being condensed and arranged for the easy reference of engineers, and also put in such a form as to be useful to the non-technical seeker for information on the subject.

All of the various sources of motive powers are considered—human, animal, wind, water, steam, gas, oil, hot air and electricity—and the principal practical data of each given, though electricity is rather summarily treated. Steam engines and turbines naturally receive the most attention, but considerable space is devoted to oil engines, which are viewed by the author with considerable favor.

As an example of the method of treatment we will refer to the subject of water power. To start out, a table of the relative efficiencies of different forms of wheels, turbines, jets, water engines and rams is given followed by tables of hydraulic data, instructions for the measurement of streams, directions as to what data is necessary for determining the most appropriate type and size of wheel for a given case, etc. Next are tables and data in regard to the size and cost of pipes, and then follow two chapters on tidal action and floating wheels. The two concluding chapters on this subject are on the Pelton wheel and turbines, full data being given with respect to the latter on efficiency, capacity and cost.

While the treatment of the various subjects is necessarily meagre, the book contains much data gathered from many sources, and will prove useful as a reference book for the busy engineer and of particular assistance to the non-professional man who desires practical and definite information as to the cost and selection of the best motive power for a given case.

The Brush Company and the Swan Lamp.

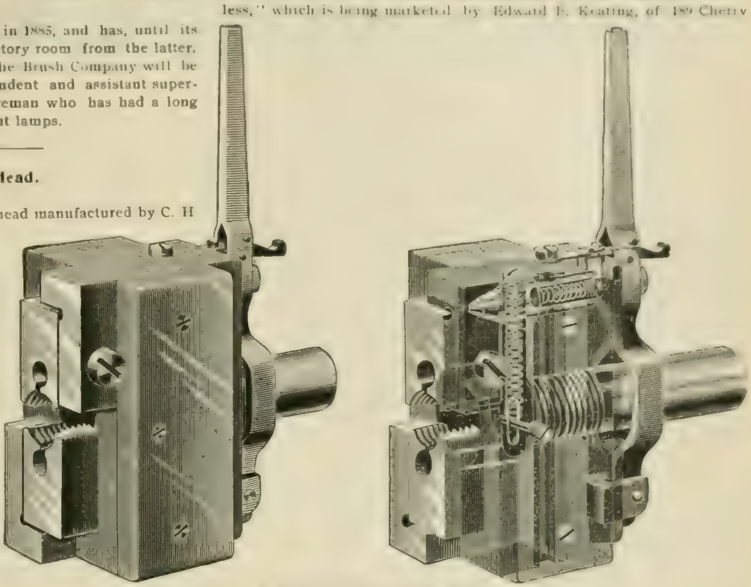
The Brush Electric Company, Cleveland, O., has recently purchased the property of The Swan Lamp Manufacturing Company, and will manufacture and sell incandescent lamps. The Swan lamp is well known throughout the trade, not only because it bears the name of the celebrated English electrician, Joseph Swan, but because of its intrinsic merits.

The Swan Lamp Company was organized in 1885, and has, until its purchase by the Brush Company, rented factory room from the latter. The new incandescent lamp department of the Brush Company will be under the direct supervision of the superintendent and assistant superintendent, but will be operated by a foreman who has had a long experience in the manufacture of incandescent lamps.

An Automatic Die Head.

The accompanying engravings show a die head manufactured by C. H Besly & Co., 10 and 12 North Canal Street, Chicago, for use on screw machines, etc., which is made to open automatically at any desired point, and yet is so arranged as to hold the dies very firmly while cutting. The special feature by which this solidity is secured consists in placing each die upon a sliding block, which extends over and has a bearing the full length of the head, the two blocks being placed side by side in the head.

The dies are closed by a taper pin, which is forced into the slides by the lever shown, and when the lever is forced back by a suitably arranged tappet, the dies open quickly by the action of a spiral spring. There are comparatively few working parts in the head, and the long bearings of the sliding blocks insure good wearing qualities. It is said that these dies will cut threads true to size, will do fine, close work, and will not clog with chips. They are made in four regular sizes, to cut screws from the smallest to 1¼ in. diameter.

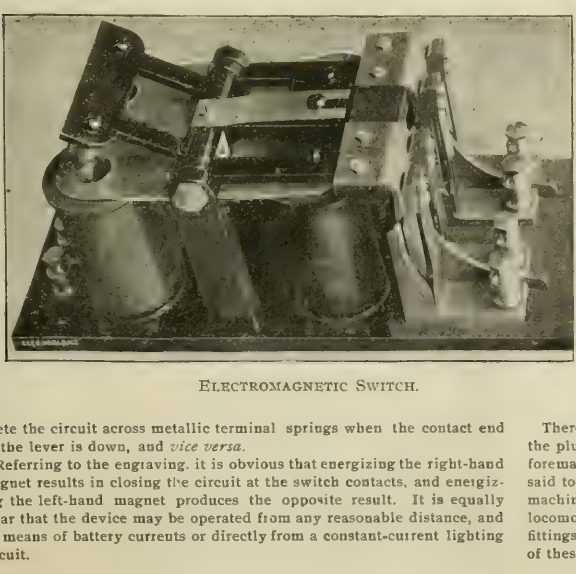


A SELF-OPENING DIE HEAD.

A "Long-Distance" Switch.

The illustration below shows a compact switch for controlling heavy current circuits from a distance. The device is manufactured by Edwards & Co., Fourth Avenue and 144th Street, New York City, and consists of two heavy electromagnets mounted side by side, with their armatures attached to opposite extremities of a lever pivoted in the centre, one end of which forms an obtuse angle with the other. Contact pieces are carried at one end of the angular lever which complete the circuit across metallic terminal springs when the contact end of the lever is down, and *vice versa.*

Referring to the engraving, it is obvious that energizing the right-hand magnet results in closing the circuit at the switch contacts, and energizing the left-hand magnet produces the opposite result. It is equally clear that the device may be operated from any reasonable distance, and by means of battery currents or directly from a constant-current lighting circuit.



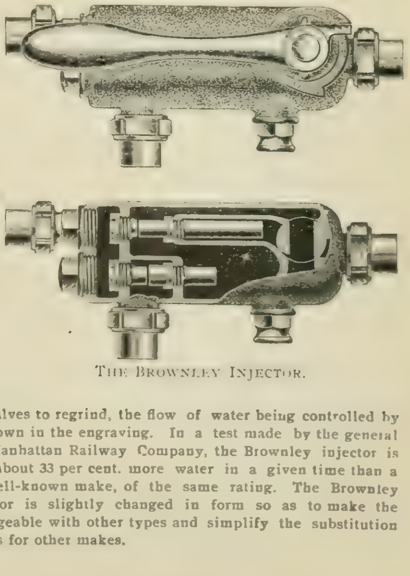
ELECTROMAGNETIC SWITCH.

The switch is a double-pole, double-break device, and the contacts and conducting pieces are liberally proportioned so as to avoid any undesirable results from heating.

A New Automatic Injector.

We illustrate herewith a new injector, known as the "Brownley valveless," which is being marketed by Edward F. Keating, of 189 Cherry Street, New York, and for which some very strong claims are made. The injector is a double-tube machine, and is very simple in construction. An ordinary mechanic can take it entirely apart and put it together again in five minutes. To start the injector, steam is given, when water will immediately appear at the overflow. The lever on the side of the machine is then turned at right angles to its position when starting, and the water is shut off from the overflow and fed into the boiler. An inspection of the lower accompanying cut will make this clear.

It is claimed that this injector will start at 15 pounds pressure and work up as high as 350 and down as low as six pounds, without breaking and without requiring any regulation whatever.



THE BROWNLEY INJECTOR.

There are no valves to regrind, the flow of water being controlled by the plug cock shown in the engraving. In a test made by the general foreman of the Manhattan Railway Company, the Brownley injector is said to have fed about 33 per cent. more water in a given time than a machine of a well-known make, of the same rating. The Brownley locomotive injector is slightly changed in form so as to make the fittings interchangeable with other types and simplify the substitution of these machines for other makes.

NEWS OF THE WEEK

Financial Intelligence.

The Electrical Stock Market.

New York, June 1, 1895.

ELECTRICAL STOCKS were notable this week chiefly for their inactivity. Notwithstanding sporadic efforts to revive the old story of a deal between the General Electric and Westinghouse companies, neither stock manifested any particular advance or reaction. Traders bid up General Electric a little on Tuesday on vague reports that the company would probably obtain a contract to equip the Manhattan Elevated, but lack of confirmation had a "staying" effect.

THE MUTUAL TELEGRAPH COMPANY, a leased tributary of the Western Union, re elected its old Board of Directors on Tuesday, consisting of Messrs. Eckert, Van Horne, Gould, Moore, Sage, Schley, Chapman, Gallaway, Page and Calef.

THE WEST END STREET RAILWAY COMPANY'S earnings on Decoration Day were $29.000—the largest known in the history of the company. Universal comment was made concerning the exceedingly small number of accidents recorded against the company.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	99	101
" " " Brooklyn	100	..	108
" " " Boston	100	129	130
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	..	27¾
General Electric	100	35⅛	35⅜
General Electric, pref	100	..	65
Westinghouse Consolidated, com	50	32	32½
" pref	50	52	52½

BONDS

	Par.	Bid.	Asked.
Edison Electric Ill., New York	100	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co. deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

	Par.	Bid.	Asked.
American Bell Telephone	100	202	203
American District Telegraph	100	30	40
American Telegraph & Cable	100	94½	..
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
†Erie Telephone	100	57¼	57¾
Gold & Stock Telegraph	100	105	..
New England Telephone	100	..	72
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63½	
Western Union Telegraph	100	92¼	92½

ELECTRIC TRACTION STOCKS

	Par.	Bid.	Asked.
Baltimore Traction	25	18¼	18½
Binghamton RR. com	100	100	.
Brooklyn Traction	100	9	12
" " pref	100	.	53
Buffalo St. Ry	100	72	..
Cleveland City Ry	100	68	70
Cleveland Electric Ry	100	59	60
Chicago City Ry	100	305	315
Columbus St. Ry	100	48½	..
Consolidated Traction of N. J	..	26	30
Electric Traction, Philadelphia	50	74	74¼
Long Island Traction	100	11	11½
Louisville St. Ry com	100	37	39
" " pref	100	87	88
Metropolitan Traction, Philadelphia	100	93¾	94⅛
New Orleans Traction	100	14½	16
" " pref	100	56	60
North Shore Traction	100	23	28
" " pref	100	80	84
People's Traction $30 pd	25	61⅞	62
‡Philadelphia Traction	50	83	83¼
Rochester St Ry	..	38	.
Union Ry. (Huckleberry)	100	112	115
West End, Boston	100	68½	69
" " pref	100	..	92
Worcester Traction	100	13	16
" " pref	100	83	37

BONDS

	Par.	Bid.	Asked.
Buffalo St. Ry. 1st con. 5s	100	104	105
*Binghamton Railroad Co. 5s	100	99	100
*Columbus St. Ry. 1st 5s	100	98	.
Rochester St. Ry. 1st. 5s	100	95	97
*Union Ry. 1st. mtge 6s	100	105	108
*Westchester Electric 1st. mtge. 5s	100	98	101

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* With accrued interest

† Ex-Div

‡ Ex-rights

LONG ISLAND TRACTION.—The committee which has been engaged for several weeks in devising a plan of reorganization for the Long Island Traction Company has virtually concluded its task, and submitted a report to the directors. It is understood that an assessment of nearly $10 will have to be made on each share of the stock in order to enable the company to hold the lease of the big trolley system. Ex-Governor Flower, who recently became largely interested in the company, said that the road is in bad shape and that there is to be a radical change in the management..

Special Correspondence.

New York Notes.

Office of The Electrical World
253 Broadway, New York, June 3, 1895.

COL. J. H. SHAY, of the Chas. Munson Belting Company, Chicago, was in the city last week.

TELEGRAPH COMPANY SOLD.—The Amagansett & Easthampton Telegraph & Telephone Company's line has been sold to Jonathan T. Gardiner, a wealthy resident of Easthampton, L. I.

MR. J. H. RHOTEHAMEL, president of the Columbia Incandescent Lamp Company, of St. Louis, was in New York last week and gave encouraging accounts of the improvement noted in the lamp trade.

UNDERGROUND WIRES.—An ordinance compelling telephone and telegraph companies to remove their poles from the streets of Jersey City and place their wires in conduits was passed by the Aldermen of Jersey City last week. The ordinance becomes operative in July.

FIRST STEINWAY CAR TO FLUSHING.—The first trolley car to Flushing on the Steinway Railway line left Long Island City at 10.30 o'clock a.m., June 1. The car was decorated with flags and bunting. It carried the officers of the railway and a crowd of passengers. Cars will be run regularly to Flushing hereafter.

TROLLEY CAR COLLISION.—Trolley car 2,012 of the Flushing Avenue line, Brooklyn, bound for Fulton Ferry, jumped a switch at the corner of Washington and Flushing Avenues on May 31 and struck car 2,001 of the same line, which was going in an opposite direction. Both cars were filled with passengers, but none was seriously hurt.

TROLLEY CONDUCTORS UNDER BONDS.—All the conductors on the Brooklyn Heights Railway have been required to furnish bonds in $150. A guarantee company becomes surety, charging the conductors $2 each. A black list of conductors discharged for dishonesty is also kept, the object being to prevent them from getting employment elsewhere.

TELEPHONE SUIT ABANDONED.—Herts Brothers, of Broadway, who, in connection with Lawyer Simon Stern, began suit against the Metropolitan Telephone Company some time ago to secure lower rates for their telephone service, have withdrawn their suit, paying all costs to date, and have signed contracts for telephone service at the regular rates established by the company.

ELECTRICAL EQUIPMENT FOR "L" TRAINS is being vigorously agitated, and rumors, purporting to be authentic, are current to the effect that the change from steam to electricity is being seriously considered by the officials of the Manhattan Company. It is thought by many that success in Chicago will mean the certain adoption of electric motors here. The public at large is heartily in favor of the change.

TROLLEY CARS FOR THE SOUTHERN BOULEVARD.—The Union Railway Company is preparing to extend its trolley lines through the Southern Boulevard from Lincoln Avenue to West Farms, but is delayed, it is said, by the Board of Electrical Control in the matter of obtaining permits. The company is doing the surface work, and says that the road will be in working order in a short time the permits can be obtained without delay.

THE FLYNN FRANCHISES.—The Kings County Grand Jury has been investigating for three weeks the action of the Brooklyn Board of Aldermen of 1893 in granting the franchises to the Flynn electric railway companies. The inquiry was started directly after the franchises had been declared void by Justice Smith of the Supreme Court. In his decision Justice Smith scored the 13 Aldermen who voted away the valuable grants without any regard to the interests of the city.

GENERAL ELECTRIC TO MOVE?—It is the general impression in Schenectady that the General Electric Company will consolidate all its works at some New Jersey town and give Schenectady the cold shoulder, but nothing reliable can be learned concerning this further than that an offer of some sort of bonus has been made the company by a New Jersey town. Director F. G. Hastings says he can see no reason why such a change should be made, as the expense involved in moving would probably offset any bonus and other advantages that might accrue.

A DECORATION DAY CASUALTY.—Trolley car No. 88, of the West End division of the Atlantic Avenue Railway, Brooklyn, drawing three open trailers, all crowded with passengers, halted on a Unionville switch at 8 o'clock p. m., Decoration Day, on a return trip from Coney Island. The rear trailer, without the knowledge of employees, rested on the main track. Trolley No. 371 of the same line, in charge of Motorman Robert Sterling, came unobserved upon the car, and a crash resulted, which overturned both cars and splintered the other cars of the stationary trains. No one was killed, but Motorman Sterling was seriously crushed.

INCREASED WAGES.—All the employees of the Brooklyn Elevated Railway Company with the exception of the engineers are to receive an advance in wages on June 1. The pay was reduced 10 per cent. in October, 1893 because of the reduced receipts, and the advance will restore the old figures. In the notice announcing the increase in pay, the general manager states that there is no danger that the wages will again be reduced, because the earnings of the company as now assured will permit of fair wages so long as the streets of Brooklyn are not used for rapid transit purposes. The notice also states that the company is only enabled to increase the wages because high speed is no longer possible on the surface lines in consequence of the new city regulation

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
ROOM 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, June 1, 1895.

FREE TRANSFERS COMPULSORY.—The Massachusetts House has passed a bill requiring the West End Company to issue free transfers. The bill, however, after considerable and heated discussion in the Senate, was defeated in that body by a 30 to 6 vote.

EXTENSIONS IN THE WEST ROXBURY DISTRICT.—A movement is progressing successfully in this section to construct an electric railway, which will start near Keyes Street, Jamaica Plain, the terminus of the West End tracks, and follow such a route as may be selected, through Roslindale and the various villages of West Roxbury. The stock subscription paper is now making its rounds with the most auspicious augury for success.

INJUNCTION REFUSED.—Chancellor Rowell has refused the injunction petitioned for by the Estey Organ Company and ex Governor Levi K. Fuller et al. to restrain the Brattleboro Street Railway from using electricity as a motive power and from extending its line in the village of Brattleboro, Vt. Judge Rowell gave as his reasons for refusing the petition that the railway had a right to use electricity as a motive power; that the preliminary steps had been taken as required by the statutes, and that the building of the street railway, as proposed, constitutes no additional burden on the soil.

CANADIAN NOTES.

TORONTO, Can., June 1, 1895.

MONTREAL, CAN.—The Lachine Council has passed a motion permitting Mr. Bickerdike to build an electric railway on St. Joseph Street.

PORT HOPE, ONT.—P. R. Randall addressed the counsel of the Corporation of Hope, at a regular meeting held at Port Hope, respecting the advisability of submitting notice of motion of introduction of a by-law at next meeting, for the purpose of granting an electric company the right to build a trolley track on the portion of the Rice Lake Gravel Road, situated within the limits of the township of Hope.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, May 22, 1895.

THE ELECTRIC LIGHTING OF FACTORIES.—A "Factories and Workshops Bill" is now before the House of Commons, and an amendment was recently made in it which should give a considerable fillip to electric lighting in factories. The bill contains a clause empowering the Home Secretary to increase the minimum number of cubic feet of space allowed per employee in the case of work by artificial light. An amendment has, however, been introduced exempting shops, etc., lit by electricity from the operation of this clause. In places where space is an object, and where night work is the rule or very frequent, the advantage of adopting electric light will be considerably increased by the passing of this act.

MUNICIPAL PURCHASE OF ELECTRIC LIGHT UNDERTAKINGS.—The electric supply of the town of Newcastle is at present undertaken by two companies, which supply current to the public at about 4½d. per kilowatt-hour. The Town Council, owing to the comparative success of these concerns, recently began to cast longing eyes upon them, and consulted Prof Kennedy as to the advisability of the concerns being immediately purchased by the Municipality, instead of waiting until the time for compulsory municipal purchase came about in the usual course. Prof. Kennedy in a lengthy report states that owing to the fact that these companies are supplying current at such a low rate, and owing to the extremely low cost of management, etc., it is difficult for him to point out where the municipality could effect a saving, and if any saving were to be effected, it would be necessary, if the municipality were to purchase the undertakings of these companies, upon the basis of the 5 per cent dividend they are now paying, to increase the price per unit from 4½d. to 6d., since otherwise the municipality would be unable to provide interest on capital, a sinking fund and a renewal fund; and even if the companies could be purchased for a price equivalent to the capital they have actually expended without any allowance for good will, such is the economy practised by them that the consumers of electricity would not gain pecuniarily by municipal purchase in this case.

INQUIRY INTO THE TELEPHONE SERVICE.—The Parliamentary inquiry into the telephone service of the United Kingdom still continues though the proceedings of Tuesday last were not of a particularly interesting or instructive description. On Tuesday, however, Mr. James Tatts Forbes, President of the National Telephone Company, made an extremely instructive and lucid statement. Among other things he brought out was that the charge in England for an exchange connection was £9 2s. 2d., which he showed was approximately 6d. per diem, and which he naturally pleaded cou'd not be considered an exorbitant tax. According to Mr. Forbes there are now over 73,000 subscribers in the United Kingdom, and 493 exchanges, a large number of which are on metallic circuits. With regard to the allegations of extravagant profits, Mr Forbes brought forward figures to show that the working of the National Company amounted to 62 per cent. of the revenue, and that the present charges made by the company might be considerably reduced were there no postoffice royalties, way-leave charges, and high wages. He further stated that at the beginning of the month his company circularized their 70,000 odd London subscribers with the result that they had received some 2,700 replies, over 2,500 expressing entire satisfaction with the company's metropolitan service. I may say that the London County Council almost simultaneously circularized the London subscribers of the National Telephone Company, receiving 2,500 replies, only 555 of which expressed satisfaction with the company's service. The evidence of Mr. Forbes was not concluded when the committee rose on Tuesday and it will be continued on Friday next.

LEGISLATION BY THE BOARD OF TRADE.—In the original electric lighting act of 1882, local authorities were given the option of purchasing electric lighting undertakings at the end of a period of 21 years, and it was this brief period, which, more than anything else, tended to retard the introduction of electric lighting into England. The Act of 1888 extended the period to 42 years, and made the terms of purchase somewhat more clear, though certainly not less onerous. It has been a general source of complaint among electrical men in this country that this extension of the period from 21 to 42 years, which was obtained after so much fighting, has been whittled away by electric light company promotors. The favor of the local authorities is a necessary antecedent to the granting of electric lighting branches, periods as short as 21 years having in some cases been stated by promoters, and now the Board of Trade has taken a step which it would seem is *ultra vires*. It has declined to grant orders for any part of the metropolitan area unless the power of purchase by the local authority is allowed to come into effect, not at the end of 42 years from the granting of the order, but at the end of 42 years from August, 1889, when the majority of the electric lighting provisional orders to the metropolis were granted. This, no doubt, is done for the purpose of ensuring that the orders of all the companies in business in the metropolis shall expire at the same date, and that the local authorities, if desirous of puchasing, shall not be obliged to take over these concerns piecemeal, as they are now being obliged to do in the case of the tramways of London. No doubt this result is one which is for the public good, but the means by which the Board of Trade is endeavoring to attain it seems decidedly outside of the law.

General News.

NEW INCORPORATIONS.

THE TEXAS ELECTRIC COMPANY, Austin, Tex., has been incorporated by C. . Hobson and others, with a capital stock of $5,000.

THE DUPLEX CAR COMPANY, Concord, N. H., has been organized by Ex-Gov. H. A. Tuttle, of Pittsfield; Hon. S. S. Jewett, Laconia, and others. Capital stock $1,000,000.

THE PLYMOUTH WATER, LIGHT & POWER COMPANY, Sheyboygan, Wis., has been incorporated with a capital stock of $50,000 by H. G. Malone, H. E. Dow and S. J. Foote.

THE WOOD COUNTY TELEPHONE COMPANY, Grand Rapids, Mich., has been incorporated by John A. Gaynor, H. H. Voss, and George L. Williams, with a capital stock of $5,000.

THE CANALES TROLLEY COMPANY, Springfield, Ill., has been incorporated by F. William Canales, Portland, Me.; A. M. Ross, L. Henry Pearse, Boston, Mass. Capital stock $100,000.

THE PHŒNIX CONSTRUCTION COMPANY, Indianapolis, Ind., has been incorporated by N. J. Clodfelter, Jacob Frankel, C. M. Waterbury, J. W. Paris, and C. A Meeker. Capital stock $100,000.

THE MORAVIA ELECTRIC POWER COMPANY, Los Angeles, Cal., incorporated by U. N. Monroe, C. T. Dorland, J. H. Partle, Moravia; H. V. Carter, and J. F. Sartori, of Los Angeles. Capital stock $100,000

THE NORTHERN ELECTRIC COMPANY, Norwalk, O., has been incorporated by Parks Foster, of Elyria; George P. Jones, of Findlay, and B. P. Foster, Mayme C. Foster and J. W. Foster, of Norwalk. Capital stock $25,000.

THE SPRINGER ELECTRIC COMPANY has been incorporated at McCordsville, Ind., with a capital stock of $10,000, to manufacture electrical appliances, construct telephones, etc. The promoters are T. L. Springer, A. C. Morrison and Seymour Morrison.

THE TICONDEROGA TELEPHONE COMPANY, Glens Falls, N. Y., has been incorporated to operate a line from Addison Junction to Rogers Rock Hotel, Fort Henry, Chilson, Schroon Lake, Whitehall, Hague, Bolton, Caldwell and Glens Falls. Capital stock $5,000.

TELEGRAPH AND TELEPHONE.

AMHERST, N. S.—The Nova Scotia Telephone Company contemplates running a line from Amherst to Oxford.

ALBION, N. Y.—The Norton-Troutburg Telephone Company is making arrangements to extend its telephone line to Holley.

MIDDLETOWN, N. Y.—City Attorney J. L. Wiggins has received from the Secretary of State's office, at Albany, the certificate of the Orange County Telephone Company.

NEW OXFORD, PA.—The Town Council has passed an ordinance granting right of way over the streets and alleys of the borough to the Hanover Telephone Company.

OCONTO, WIS.—The Oconto Electric Light & Fuel Company will enlarge its business. It intends to transform the lower story of its glass factory into a manufactory of telephone instruments.

CLARKSVILLE, N. Y.—A corporation for the purpose of building a telephone [illegible] between Clarksville and Jerusalem was organized at Houck's Hall recently. [illegible] Stinger [illegible] is president, R. C Bagley vice-president, and Charles Hammer, secretary.

ELECTRIC LIGHT AND POWER.

ARMOUR, IA.—A franchise has been granted to F. D. Day to put in an electric light plant.

WESTPORT, MO.—The City Council has passed a resolution authorizing a city gas or electric light plant.

PENSACOLA, FLA.—The Citizens' Electric Light & Power Company will largely increase the capacity of its plant.

BELLEFONTAINE, O.—The City Council has ordered that the clerk advertise for contracts to build an electric light plant.

CAMDEN, ARK.—The dynamos for the electric light company were almost totally destroyed by a runaway engine. Loss, $1,000.

SOMERSET, PA.—The Somerset Electric Light Company has decided that increase of its plant and improvements will be made at an early day.

SANDERSVILLE GA.—The City Council has ordered an election to be held July 15, to vote upon issuing $15,000 of bonds for water works and electric light plant.

CROCKETT, TEX.—The City Council has granted to F. Lockfield, of Waco, Tex., a franchise to put in an electric lighting plant, to be in operation Oct. 1.

ALEXIS, ILL.—H. S. Lafferty has been granted a franchise to establish an electric light plant at Alexis. For information address H. S. Lafferty or Ben. Strong.

FLAGSTAFF, ARI.—The proposition of J. D. Moore of Prescott, for an exclusive electric lighting franchise has been refused by the city. The city will secure estimates on the cost of a plant.

WORCESTER, MASS.—At a meeting of the Board of Aldermen recently a petition was read from the Worcester Electric Light Company asking to lay underground conduits for the accommodation of its wires.

EAST LIVERPOOL, O.—E. H. Wells & Co., of Wellsville, will put in an electric light plant in the basement of their big building. The electric plant will also be used to run electric fans in all the stores which it supplies.

OMAHA, NEB.—The South Omaha Water Works Company has been formed for the purpose of erecting and maintaining water works and electric light plant. Wm. Paxton, John A. Creighton and Louis Schroder are interested.

BATON ROUGE, LA.—The Home Electric Company has been organized by Samuel G. Laycock, as president, and C. J. Barrow, vice-president, with a capital stock of $100,000, to succeed the Baton Rouge Electric Light & Power Company.

NATIONAL HOME, CAL.—At the Pacific Branch, National Home for Disabled Veteran Soldiers, bids will be received until 2 p.m., June 20, at the office of the governor of the home, for furnishing all materials and labor and completing an electric plant to cost less than $10,000.

MECHANICSBURG, PA.—A town meeting was held May 25 to consider the electric light question. A resolution instructing the Town Council to refuse to consider any proposals that would not locate the plant within the borough limits was adopted. Col. R. H. Thomas presided at the meeting.

SPRINGFIELD, MASS.—The committee to whom was referred the petition of the telephone company for leave to erect and string poles on Main Street from State Street to Mill River, presented a report granting the locations. Mayor Long asks that action be deferred on the report, after he had explained the prospects of inducing the company to place its wires in conduit. The committee prepared a new report giving the company leave to withdraw.

THE ELECTRIC RAILWAY.

DEFIANCE, O.—A power house of the Defiance Lake Railway Company was partially burned recently; loss $7,000; fully insured.

PLATTSBURGH, N. Y.—A proposition has been made to the people to build and equip a trolley road from Kanona to Plattsburgh.

MERIDIAN, MISS.—S. H. Gehlman and L. B. Bradley are interested in a project to build an electric street railway five miles long.

NEW BRITAIN, CONN.—The Central Railway & Electric Company has petitioned for permission to extend their line to Hartford.

HARTFORD, CONN.—It was voted at a recent meeting of the Board of Alderman to double-track the line of the Hartford Street Railway Company.

PENN'S GROVE, N. J.—It is reported that work will soon be commenced on a trolley line from Penn's Grove to Salem. A charter has been secured.

SKOWHEGAN, ME.—It is reported that the managers of the Skowhegan & Norridgwock Electric Railway have voted to expend $5,000 in improvements on their road.

NEWARK, N. J.—The Passaic & Newark Electric Railway Company has broken ground and work will shortly commence on the construction of its road at Franklin.

CLARKSVILLE, TENN.—The Clarksville Street Railway Company is prepared to receive proposals for machinery, cars, etc., for an electric railway. Wm. N. Daniel is president.

WATERLOO, N. Y.—The Village Board of Trustees has granted the right of way to Main Street, connecting the Geneva & Waterloo Railway, with the road running to Seneca Falls.

SOUTH AMBOY, N. J.—Representatives of the proposed electric railway will appeal to the Mayor and Council of South Amboy for a franchise to run the road through certain streets of the borough.

PORT HURON, MICH.—Mayor Boynton and other Port Huron capitalists propose to build an electric railway from Port Huron to Algonac along the river, thence to Chesterfield, so as to connect with the Grand Trunk road.

WRENTHAM, MASS.—The Board of Selectmen has refused to give to the Interstate Consolidated Railway Company a franchise to run electric cars in this town, until the company grants certain concessions, which it is not inclined to do.

WYOMING, PA.—The project to build an electric branch at Mt. Lookout, back of Wyoming, is again being revived. John Graham, of the Traction Company, Builder Phil. Rafe Chris Stemeyer, and John A. Hutchins, Wilkesbarre, are interested.

CHARLESTON, S. C.—John R. Hoefgen and Edgar Moxham, of Brooklyn, N. Y., represent the syndicate which is said to have purchased a controlling interest in the Enterprise & City Street Railways, and which will convert them into a trolley system.

BRAINTREE, MASS.—The Braintree, Randolph & Holbrook Street Railway Company has reorganized its directory. J. F. Sheppard, W. O. Chapman and Charles H. French have been elected. It is said that the connection with Quincy will be built soon.

STONEHAM, MASS.—The plan for an electric street railway between Stoneham, Winchester and Arlington, which was agitated about a year ago, is being revived. Onslo Gilmor, of Stoneham, and A. D. Cochran, of Winchester, will be on the board of directors.

TOLEDO, O. The Council committee on Railways and Telegraphs met and approved an ordinance to grant the Toledo Consolidated Street Railway, or Toledo Traction Company, right to operate an underground system of conduits for the transmission of electricity for light and power purposes.

TROY, N. Y.—A meeting was recently held in Troy which assures at least an electric road from Albia to Averill Park, and is said to be the beginning of the Troy & New England railway line, as it is upon the charter of that company that the road begins. President, George T. Lane; vice-president, Wm. A. Thompson.

BROCKTON, MASS.—Another electric railway in all probabilities will soon be built. The name of the corporation will be the Brockton & Northeastern Street Railway Company, and the line will be practically an extension of the present one. John P. Morse, Judge B. Reed and Horace B. Rogers, of Brockton, are interested.

PERSONAL NOTE.

MR. STEPHEN LEIDY COLES, of the *Electrical Review*, was married to Miss Sallie E. Field, at New York, on Saturday, June 1. While the bachelor portion of the electrical fraternity is thus deprived of one of its most jovial and sympathetic members, now that the deed is beyond recall they will all join with the benedicts in wishing the happy couple all the bliss that matrimony holds in store for the most fortunate of its devotees.

MISCELLANEOUS NOTES.

MR. PHILANDER BETTS, of Hackensack, N. J., who for a number of years has been prominently engaged in electrical construction work, has been appointed electrician at the Washington Navy Yard. Mr. Betts secured the appointment in competition with 27 other applicants.

THE HENRY ELECTRICAL CLUB.—At a regular meeting of the Henry Electrical Club held at the rooms of the American Institute, New York, on May 28, the following officers were elected for the ensuing year: W. H. Freedman, president; L. H. Landy, first vice-president; Max Osterberg, second vice-president, and Geo. Whitefield, secretary. A resolution was adopted expressing the regret of the members of the club at the untimely death of Mr. George M. Phelps, and referring in high terms to his services in the interests of the electrical profession in this country.

Trade and Industrial Notes.

THE ERIE CITY IRON WORKS has removed its Chicago office from 1510 Old Colony Building to 34-38 West Monroe Street.

W. H. MACKAY has been appointed New York agent for the Columbia Incandescent Lamp Company, of St. Louis Mo., with offices at 1103 Havemeyer Building.

AN EXTENSIVE LIST OF ENGINE USERS is incorporated in a little pamphlet which the Ball Engine Company, of Erie, Pa., is distributing, which includes electric light and power companies in every State from California to Maine and between Lake Superior and the Gulf of Mexico.

AN ARTISTIC CATALOGUE.—Good taste and sound argument are embodied in the Robb Engineering Company's new engine catalogue. From the fine embossed front cover through the detailed description of the Robb-Armstrong engines to the last blank fly leaf, these two features are conspicuous.

A MOST GRATIFYING LETTER has been received by the General Electric Company from a western central station testifying to the satisfaction experienced in the operation there of a monocyclic plant. The writer states that the system has been in constant operation for two months without a single hitch, and that the dynamos and motors run cool and practically without attention.

W. C. KIDD, 239 Broadway, New York, general sales agent for Coe's grate bars, reports that wherever these bars have been used they have given entire satisfaction. As an evidence of this assertion he has a large number of complimentary letters from purchasers which can be seen at his office, and which speak in high terms of the efficiency, economy and convenience of these grate bars.

LARGELY INCREASED FACILITIES have been found necessary by the Philadelphia Electrical & Manufacturing Company, 20th and Jones Streets, Philadelphia, owing to the constantly increasing demand for its improved cut-outs and spark arresters. Additional machinery has, therefore been put in the factory and several extra men added to the force, so that the company will now be able to fill orders more promptly.

TASTEFUL DESIGN characterizes the new catalogue of H. E. Collins & Co., Pittsburgh, Pa., in which detailed information is presented concerning the "Cahall" vertical water-tube boiler. The book is handsomely illustrated and is replete with data obtained from exhaustive tests of Cahall boilers and thorough analyses of the coal used during the tests. Ten features of advantage are pointed out as being embodied in these boilers. The catalogue, however, makes interesting reading aside from trade considerations.

"INTERESTING FACTS" is the title of a well-prepared pamphlet which the Packard Electric Company, Warren, O., is distributing. The title is by no means a misnomer; the pamphlet contains curves showing the maintenance of candle-power and increase in efficiency with use, which are peculiar to Packard lamps, and also calls attention to the relative values of high-grade and cheap lamps which is of vital interest to users of incandescent lamps. Packard transformers are not neglected in the pages of this unique little circular.

THE ADVENT OF SUMMER has given an impetus to the fan business generally and particularly to that of the Metropolitan Electric Company, Chicago. Dayton ceiling fans, Victor direct-current desk fans and Ries-Scott alternating desk fans are tumbling over each other in the rush to fill orders. Comfortable orders are being received, too, for Keystone ammeters and voltmeters and Ayer arc-lamp windlasses, for which the Metropolitan Company is western agent. Metropolitan arc lamps for incandescent circuits are likewise in demand. The company will soon issue a comprehensive and handsomely prepared catalogue.

THE HESSIAN FLIES, which have caused so much damage to wheat, says the Central Electric Company, of Chicago, stand in awe of Lundell fan motors and maintain a most respectful distance from them. The sudden advent of summer temperature has caused vigorous inroads to be made upon the company's stock of fans, but the vacancies are filled about as soon as they are made. The prospects for the fan trade this season are reported as exceedingly promising. A steady demand is also reported for "Interior" conduit and kindred supplies; a recent order for an Illinois postoffice building covered several thousand feet of conduit.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, in its new catalogue B presents such full instructions for the installation and care of accumulators as to make the book almost a technical treatise. Exhaustive descriptions are given of the "Chloride" batteries made by this company, following which there are curves showing the variation in E. M. F. during charge and discharge and capacity at different discharge rates. Then there are eight different diagrams of connection and other data too numerous to mention. The book is executed elegantly and substantially. Owing to the great expense of production a charge of $1 is made for the catalogue.

THE BURNLEY CARTRIDGE BATTERY, manufactured by the Miamisburg (Ohio) Electric Company, has been adopted exclusively by some of the largest telephone companies in the country, the makers say, after a competitive test with other batteries on the market. The company offers these batteries on their merits and invites those interested to test them. The Imperial dry battery still maintains its high reputation and is rapidly overcoming the prejudices against dry batteries caused by experimental and defective goods put on the market from time to time. The Miamisburg Electric Company is the only manufacturer of Burnley's improved dry battery, which is put on the market under the name "Imperial."

AN ATTRACTIVE CATALOGUE has been issued by the Columbia Incandescent Lamp Company, of St. Louis, in which are described all styles, sizes and shapes of lamps. The Columbia company calls attention to the fact that notwithstanding the reduction in prices during the past year, nothing has been omitted in the construction of Columbia lamps which was at all essential to the maintenance of the high standard by the company at the outset some six years ago. A point is also made of the fact, too often ignored by purchasers, that low first cost is by no means a criterion of merit. The Columbia company claims to have effectually overcome the difficulty at first experienced with high voltage lamps, and that a most gratifying demand is being made for the 220-volt lamps.

Business Notices.

ELECTRIC LEAGUE.—Meets every Thursday evening, 100 West 24th Street. Electrical engineers and electricians cordially invited.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 28, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

539,786. CONDUIT ELECTRIC RAILWAY SYSTEM; F. Barrell, New York, N. Y. App. filed July 19, 1894. The combination of a lateral wire conductor formed in sections within a conduit, with cushioning devices interposed between adjacent sections, preventing jarring or any vibration of the parts.

539,796. COUPLING; T. J. Close, Philadelphia, Pa. App. filed July 10, 1894. The combination of two or more sections of a rod or tube, one part having a recess, side bars and cross bars, and the other provided with tongues and recesses, the said parts being adapted to interlock with each other. (See Illustration.)

539,798. COMBINED TROLLEY HEAD AND WHEEL; Wm. H. Dalbey, Indianapolis, Ind. App filed Oct. 11, 1894. A self-lubricating trolley wheel containing an interior reservoir for graphite and provided with a bushing having holes therein for the admission of lubricant.

539,799. LANTERN FOR BICYCLE RIDERS; W. K. L. Dickson, Orange, N. J. App. filed Aug. 4, 1894. The combination of a lantern having a reflector secured to support an incandescent lamp mounted on a base of insulating material, having a switch, binding posts, circuit wires and a resistance.

539,804. ELECTROMAGNETIC GOLD SEPARATOR; J. D. Gibbens and W. B. Murray, Portland, Ore. App. filed Oct. 20, 1894. The combination of a stepped extension, a sluice-box having grooved copper plates adapted to be filled with mercury for amalgamating purposes, electromagnets arranged in gangs having a common armature, set screws projecting through the armature to the under side, upon which magnets are adapted to rest, so that the same may be adjusted.

539,825. ELECTRICAL CONNECTION; P. Rieth, Chicago, Ill. App. filed Feb. 28, 1895. An electrical connector having tubular tapered cones adapted to engage with cylindrical terminals open at both ends; the said ends being capable of being swaged so as to rest against the rail.

539,832. CEILING BOARD; H. O. Stillwell and J. D. Broman, Chicago, Ill., App. filed July 10, 1894. The combination of a binding post connected with one side of the mains and provided with two contact terminals, a second post connected with the opposite side of the mains and also provided with two contact terminals arranged opposite the contact terminals of the first binding post; a switch lever adapted in one position to close together the opposed terminals to afford two paths for the current from one binding post to the other, the second position of the switch being adapted to connect the lamp terminals one with each of the posts, the switch lever closing the opposed terminals of the posts before opening the circuit through the said lamp.

539,838. PROCESS OF PRODUCING INCANDESCING BODIES FOR ELECTRIC LAMPS. K. O. E. Troback, Pankow, Germany. App. filed April 18, 1894. The process of producing carbon bodies for electric lamps, consisting in subjecting the substance to a preliminary purifying treatment, then immersing the same in an acid, and subsequently carbonizing the said substance.

539,840. SAFETY SYSTEM FOR RAILWAYS; A. L. Ware, Cambridge, Mass. App. filed Oct. 15, 1894. The combination of two parallel main conductors, one of which is of high resistance, a plurality of cross-connections, each carried by a car, and two of them requisite to complete a circuit of which the main conductors form a part; an alternating dynamo as a current generator in each cross-connection and a translating device, all constructed and arranged to form circuits the resistance in which varies with the distance apart of the trains.

539,849. ELECTRIC MOTOR; J. B. Atwater, Chicago, Ill. App. filed Sept. 24, 1894. The combination of cam rings, formed with acute and obtuse inclined surfaces, connected to power-transmitting means, a plurality of electrically operated traction levers provided with a friction wheel and adapted to engage with the cam rings, a switch and means for operating the same, and a fly-wheel.

539,864. TROLLEY BREAKER; W. G. Carey and A. A. Ball, Jr., Schenectady, N. Y. App. filed Nov. 15, 1894. A body having a rectangular section for trolley breaking, composed of insulating material having its ends sloped off, and a slot in each end for securing the metallic end-pieces in position.

539,863. CONTROLLER FOR ELECTRIC SEARCH LIGHTS. E. F. G. H. Faure, J. MacHaffie and S. H. Libbey, Schenectady, N. Y. App. filed Jan. 29, 1895. The combination of a controller having a switch handle adapted to move simultaneously in a horizontal plane and vertical plane imparting a diagonal motion to the handle and springs to bring the handle back to its normal position. (See Illustration).

539,870. ANNUNCIATOR; F. A. Jennings, Ithaca, N. Y. App. filed Mar. 23, 1893. An annunciator comprising a case, a rotatable cylinder, a ratchet and pawl for rotating it, and a cam actuating the mechanism; a dial provided with a series of notices, a pointer mounted upon a rotating shaft, with a motor rotating the said shaft, and adapted to shift the said pointer from one notice to another, by the making and breaking of the circuit, and an aperture in the dial exposing a title on the said cylinder.

539,871. GALVANIC BATTERY; H. T. Johnston, New York, N. Y. App. filed Nov. 10, 1893. The combination of a metal vessel forming the positive electrode, a negative electrode therein, a semi-solid filling between the electrodes, a seal closing the top of the positive electrode and a projection engaging with the seal.

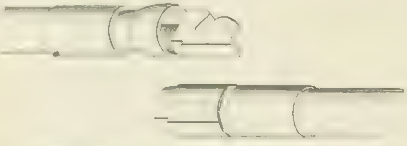
539,876. STATIONARY TRANSFORMER; W. S. Moody, Lynn, Mass. App. filed May 15, 1894. A transformer having a core composed of laminæ having registering notches upon their inner edges, forming oil channels in combination with primary and secondary windings arranged within the core.

539,877. ELECTRIC ARC LAMP; J. A. Mosher, Chicago, Ill. App. filed May 1, 1893. The combination of an upper carbon rod, pivoted frame carrying a feeding train, a shunt solenoid having a core, connected to the frame, a rocking plate with notches at its upper end, a dog adapted to enter said notches, pellets carried by the said rocking plate and means for raising the core.

539,881. ARMATURE COIL AND METHOD OF MAKING SAME; O. F. Persson and D. P. Thomson, Schenectady, N. Y. App. filed Oct. 6, 1894. An armature coil having an hexagonal figure, four of the sides of which are curved to conform to the shape of the armature core, the other two parts lying in different planes and joined by a part radial to the curved sides.

[illegible] ELECTRIC METER; E. Thomson, Swampscott, Mass. App filed Feb. [illegible] stationary and shunt coils, an oscillating coil or armature arranged transversely to the stationary coils and acted upon [illegible] a circuit breaker in the shunt circuit controlled by the movement of the oscillating coil.

[illegible] RAIL BOND; [illegible] Buxton, Worcester, Mass. App filed April 15, 1895. An electric rail bond comprising a wire having cone-shaped heads upset at either end and two loose collars having conical bores of slightly smaller diameter than the said heads.



No. 539,796.—Coupling for Electric Conductors.

539,939. ELECTRIC CABLE; W. D. Gharky, Philadelphia, Pa. App. filed Oct 18, 1894. A cable consisting of a conductor forming a core and an insulating wrapper surrounding the core, a testing wire extending along the cable outside of the insulating wrapper.

539,943. ARMATURE WINDING AND METHOD OF MAKING SAME; W. Hochhausen, Brooklyn, N. Y. App. filed Feb. 10, 1888. The combination of a cylindrical or drum armature, a multiple conductor having its strands assembled into a cable on the said armature periphery and flattened upon the armature head so as to cover a less superficial area on the head than upon the periphery.

539,966. ELECTRIC BELL; C B. Sterling, New York, N.Y. App. filed March 14, 1895. The combination of a bell, hammer, and a solenoid having a core, a circuit maker and breaker loosely connected to the said core and movable vertically, stationary contacts insulated from each other to engage the circuit maker, guides and springs for the same, to keep it in its raised position.

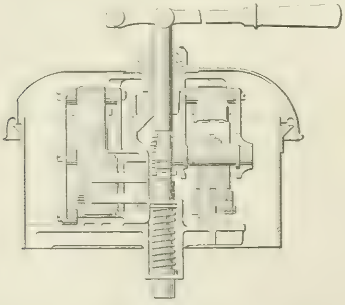
540,010. CONDUIT ELECTRIC RAILWAY; F. B. Widmayer, New York, N. Y. App. filed Aug. 3, 1894. The combination of a conductor encased in a suitable covering, a series of circuit-completers normally open and arranged at intervals along the road, an electrically-propelled car provided with means for successively throwing into operation said circuit completers.

540,012. TELEPHONE CENTRAL SYSTEM; G. D'Adhemar, Paris, France. App. filed June 20, 1894. The combination of a calling annunciator of an electromagnet, a local circuit, and means for automatically breaking the circuit of the electromagnet of the annunciator and at the same time returning the drop of the said annunciator.

540,025. CONTROLLING MECHANISM FOR LOCKS; R. A. Palmer, Boston, Mass. App. filed Feb. 4 1895. A lock mechanism consisting of a two part spindle adapted to be extended through the lock, one member of which is adapted to be operatively connected with a latch-bolt; a spindle coupling, an actuator for the same, and an electromagnet to positively move the actuator into operative position to couple the two members of the spindle.

540,029. MEANS FOR CONNECTING MOTORS TO CAR AXLES; S. H. Short, Cleveland, O. App. filed Oct. 19, 1893. The combination of an axle and truck frame, a swinging frame, slotted bearings at the free ends of the arms of said swinging frame, and a motor having trunnions adapted to enter said bearings and move therein.

540,035. BRUSH HOLDER FOR DYNAMO-ELECTRIC MACHINES; E Thomson, Swampscott, Mass. App. filed Feb. 20, 1893. The combination of a brush clamp and a support for the same, one swinging upon the other and means for maintaining the clamp always parallel to a given plane.



No. 539,863.—Controller for Electric Search Lights.

540,054. LOCATING FAULTS IN ELECTRIC RAILWAYS; J. C. Henry, Westfield, N. J. App. filed Jan. 24, 1894 In combination a supplemental return conductor for an electric railway connected at intervals to the track or ground return and divided into sections normally connected together, and means adapted to measure the current flow between the sections.

540,060. CONDUIT ELECTRIC RAILWAY; W. E. M. Jackson, San Francisco, Cal. App. filed Oct. 25 1893. The combination of a conductor and an insulating support comprising an open spiral, or other form in which a piece of small cross-section is bent upon itself, with a long continuous free surface formed of insulating material.

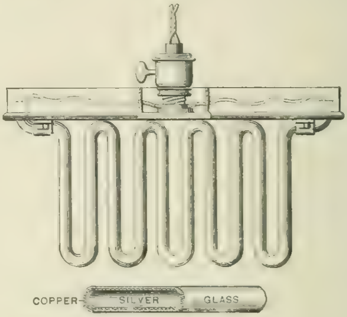
540,073. ELECTRIC HEATER; C. J. Reed, Philadelphia, Pa. App filed June 5, 1894. A heater consisting of a non-conducting tube having a thin film or coating of silver attached to its inner surface, the said film being connected at its opposite ends to conductors leading to a source of current supply. (See Illustration.)

540,076. SECONDARY BATTERY; W. L. Silvey, Dayton, Ohio. App. filed Jan. 21, 1895. The combination of a screw-threaded battery connector or post, battery plates and battery collars, the battery post passing through the plates and collars, porous plates surrounding the collars, porous sheets between the battery plates, the collars, plates and post connected together by a yielding strip.

540,090. ELECTRIC PASSENGER REGISTER AND RECORDER; Jos. W. Ellis, Albany, N. Y. App filed Jan. 12, 1895. An electric registering and recording system, comprising a series of vertically movable step-plates, circuit closers controlled by these step-plates, two registers having electro magnetic actuators in circuit with the respective circuit-closers and provided with record cards, markers and magnetic maker-actuators, a clock provided with circuit-closing devices including a series of electric contacts, and an electric circuit connecting all these contacts with the electromagnets last named of both registers.

540,094. WATER WHEEL GOVERNOR; A. Giesler, Dayton, Ohio. App. filed Aug. 13, 1894. The combination of a shaft adapted to operate the gates of a water wheel, a centrifugal governor and train, and an electric governor and train, each geared to turn the gate shaft, and adapted to work independently or in unison to control the gate.

540,117. CONDUCTOR DISTRIBUTING FRAME; T. Spencer, Cambridge, Mass. App. filed Jan. 24, 1895. The combination of a series of fixed contacts arranged in groups along, and each projecting at its ends from, an insulating fixed support, each contact representing and forming the terminal of a loop or branch of the respective lines extending to the switchboard appliances, portable insulating strips; metallic contacts arranged in groups along said strips, and means for removably securing the portable strips in proximity to the fixed support bringing the other or free ends of their respective contacts into electrical connection.



No. 540,073.—Electric Heater.

540,153. PHASE INDICATOR FOR ALTERNATING CURRENTS; Michael von Dolivo-Dobrowolski, Berlin, Germany; assignor to the Allgemeine Elektricitäts-Gesellschaft, of the same place. App. filed Oct 27, 1893. In an apparatus for indicating and measuring differences between the phases of two electric alternating currents of like number of alternations, the combination, with a coil or set of coils for each current, the two coils or sets of coils being set at an angle to each other, and a metallic body rotatably arranged in the magnetic fields of said coils, of a device for opposing a counterforce to the rotation of said metallic body, and means for indicating the amplitude of the latter.

540,168. ELECTRICAL EXCHANGE; A. E. Keith, F. A. Lundquist and J. Erickson, Chicago, Ill. App. filed Nov. 7, 1894. The combination of a switchboard having a series of rows of contact points, a series of connectors arranged to co-operate therewith, each connector being normally connected with but one of the rows of contact points, and means for making and breaking the normal connection as soon as the connector is operated for making connection with any of the rows, whereby communication between any two of the subscribers is entirely secret from the others.

540,185. SECONDARY BATTERY; C. Payen, Philadelphia, Pa. App. filed Aug. 17, 1893. The combination of a central vertically ribbed conducting plate, with independent plates of crystallized active material on opposite sides of the conducting plate and in contact with its ribs.

540,187. CLOSED CONDUIT SYSTEM FOR ELECTRIC RAILWAYS; H. A F. Peterson, Milwaukee, Wis. App. filed Mar. 26, 1894. The combination of a conduit having conductors arranged to extend through it, a section at one side of the said conduit, supported upon pivotal connections, and carrying short sections of the conductors and adapted to be swung back into a position to simultaneously open the conduit for the removal of the contact devices and move said short sections of the conductors out of line of movement of the contact devices.

540,216. SYSTEM OF ELECTRICAL DISTRIBUTION; E. G. P. Oelschlaeger, Charlottenburg, Germany. App. filed April 6 1895. The combination of a source of alternating currents, two or more transformers having their primary coils connected in series and forming a part of the feeder circuit, through which a current of constant mean amperage is transmitted, and two translating devices or groups of translating devices adapted to operate at different potential, connected in parallel across the secondary circuits of the respective transformers.

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MEASURING HYSTERESIS.

Mr. Frank Holden in another column describes a simple hysteresis meter which has been in successful commercial use for several years, and has given results sufficiently accurate for practical purposes. Owing to the large variations in the hysteretic qualities of iron it is desirable in the construction of electrical machinery that this factor should be definitely determined for the particular iron used, not only in order to secure the least loss of energy, but also that the heating of the armature core may be kept down, since the hysteretic energy is transformed into heat. The data given seem to demonstrate that the hysteretic exponent is not so nearly constant as was supposed, and its average value not as great as 1.6; in the experiments referred to the value of the exponent varied between 1.4 and 1.7, the average being 1.5. The method of Mr. Holden in separating the effect of eddy currents from the hysteretic losses is an ingenious one, and, as shown by the results, proved to be sufficiently accurate for any practical purpose.

ELECTRICITY ON SHIPBOARD.

The description which we print elsewhere of the electrical installation on the new American liner, the *St. Louis*, will give a partial idea of the extent to which electricity is now employed on shipboard. While its application in the present case is not so complete as it might be made, yet the great care with which every part of the plant has been designed and executed to suit the actual conditions is unusual even in ship work. It would seem, however, that advantage might have been taken of the convenience of electric motors for the handling of the cargo, and it will probably not be long before other operations aboard ship will be performed by the same means, such as steering the vessel, handling the reversing gear of the main engines and turning the capstan. The rudder electric indicating apparatus on the *St. Louis* appears to be both simple and reliable, and the electric revolution indicator is simplicity itself. It remains to be proved, however, whether the latter will continue satisfactory in service; a method very similar for indicating revolutions was tried ten years or more ago in some of the European navies and discarded, but we are not aware of the nature of the objection found, which may be eliminated in the present case.

OUTPUT OF POLYPHASE GENERATORS AND ROTARY TRANSFORMERS

In another column we print a notable article by Mr. Ralph D. Mershon, in which the factors relating to the output of polyphase generators and rotary transformers are mathematically treated and comparative deductions made. While the mathematics employed is somewhat abstruse, this is necessarily so from the nature of the subject, and as the object of the article is to establish certain principles, it would not be desirable to make any sacrifice in the interest of simplicity. Polyphased machinery is often regarded as something complex and mysterious, but the second paragraph of the article shows that as far, at least, as the windings are concerned, this view is wrong. It will be seen that the armature of any closed coil direct current machine may be simply transformed into a polyphased armature, it being merely necessary to make three or more connections corresponding to the desired number of phases, from collecting rings to the same number of commutator bars at an equal angular distance from each other. We may here remark that in one of the largest manufactories of polyphased machinery in the world, the armature cores of some types of polyphased and direct current machines are made identical, and the windings on the cylindrical surface and back end are the same, the connections in the front end of the armature only differing. Some of the deductions of the author are rather striking, notably the one showing that by merely changing the connections of a three-phased generator and adding three additional rings the output of the machine may be increased 16 per cent. and that a similar change in the connections of a three-phased rotary transformer will produce an increase of 45 per cent. in its output. Similarly, the output of what are called "quarter-phase" generators and rotary transformers are increased 10 and 22 per cent., respectively, over corresponding three-phased machines. It very often happens, however, that the factor which fixes the output of an armature is the heating limit, and in the present instance it might occur that the calculated gain cannot therefore be practically realized, though, in any case, on account of the increased efficiency of the armature, it may be approached.

THE NIAGARA MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The general meeting of the American Institute of Electrical Engineers at Niagara the last week of the present month promises to be one of much interest, as indicated by the programme we print elsewhere. While the papers are less in number than at Philadelphia last year, they are, on the whole, more practical in character, and those relating to the Niagara plants will contain the first account of many of the electrical features of that enterprise. The selection of Niagara as the place of meeting would have been a happy one under any circumstances, and in the present instance is exceptionally appropriate on account of the date of meeting being coincident with the starting of the transmission plant which, we believe, is to be officially declared in commercial operation during the meeting of the Institute. That the attendance at Niagara will be unusually large seems probable, and perhaps the result may be to incline the opinion of members toward the choice of similar localities for future general meetings instead of holding them in large cities as in the past. A week off during June at a pleasant resort would present an attraction to many members who have never thought of attending meetings in cities, and the consequent absence of business engagements would tend to insure the undivided attention of all to the real objects of the meeting.

ARBITRARY THEORY

Mr. Townsend Wolcott in another column attacks in a lively manner the Rückerian philosophy of units, which he considers to be founded upon a wrong conception as to the nature of dimensional formulas. Leaving the defense of the theory attacked to others who have made it a close study, we may add that in the hands of others than adepts theories such as referred to are capable of creating much misunderstanding. It is but a few years ago that resistance was constantly referred to as a velocity for the reason that its dimensional formula was identical with that of velocity, and this singular assumption doubtless discouraged many students who endeavored to discover a physical *raison d'etre* for it. About the same time the henry was spoken of as a length, the result of which was probably to prejudice many against the introduction of a unit which, from this definition, could apparently serve no earthly use. In neither case, as far as we know, was any reason advanced for calling a resistance a velocity or an inductance a length, other than the identity of dimensional formulas. Viewed physically, the former naturally brought up the cognate idea of friction, and the latter that of electromotive force, and the student could not be blamed if he became discouraged in harmonizing these conceptions with velocity and length. The fault which we refer to is not, however, confined to the realm of theory, for in practice it is only too common to lose sight of the real nature of things and give extensions to principles not warranted by their nature. Characteristics, for example, at one time were given a most undue weight, it being shown that machines could not run in parallel that did not have identical curves, and all of the principles of dynamo action were illustrated by their arbitrary manipulation. Still later the counter electromotive force of motors was looked upon as sufficiently abstract in its nature to admit of many fanciful assumptions, and even Institute papers were read to glorify this mysterious attribute of motors, and ascribe to it singular properties. Abstractions as such may perhaps be safely handled by philosophers and savants, but it is rarely safe for others to wander too far away from the physical standpoint, or to accept ideas for which they can find no physical basis.

Steam Jackets.

Prof. Unwin, in a recent lecture stated that some time ago he ventured to say there was no trustworthy engine test which showed that the consumption of steam with a jacket is greater than without a jacket. He believes that is still true, but undoubtedly the economy due to the jacket varies in different cases from 30 per cent. to very nearly zero. Roughly, the jacket is more useful with small engines than with large; with slow engines than with fast engines; but all this amounts to little more than saying that the jacket is most useful in those cases where the initial condensation is largest. Just in proportion as the engine, whatever its type, is of the highest class and most scientific design, the jacket is less useful. No one probably designed better simple engines than Corliss, and Corliss did not use jackets. In an experiment by Delafond on a large Corliss engine at Creusot, the jacket effected an economy of only 2 per cent. The same rule holds with compound engines. Hirn found an economy of 25 per cent. due to the jackets in a Woolf engine tested in 1855, but since then the compound engine has been improved, and the advantage of the jacket is less. Prof. Witz made very accurate experiments with a large compound engine of about 600 ihp, provided with jackets both to cylinders and receiver. The trials were strictly comparable, the pressures, temperature ranges, and total power developed being nearly the same. The total condensation in the jackets was 12 per cent. of the steam used, so that the jackets were not inactive. Yet the absolute saving of steam due to the jackets was only 4 per cent., or allowing for heat saved by returning the jacket drainage to the boilers, 6.6 per cent. It is perhaps probable that as the temperature range in the cylinder is diminished by compounding, the temperature gradient from the jacket to the interior of the cylinder is diminished, and the rate of transmission of heat decreased. It appears, then, that as engines are better designed, the jacket is of less use, and it is not by means of the jacket that the waste due to cylinder condensation can be got rid of, or the highest economy of which the steam engine is capable reached.

Telephone Protective Association of America.

The officers of the Telephone Protective Association of America, which was organized at Chicago on May 27, are as follows:

President, J. E. Keelyn, Western Telephone Construction Company, Chicago; first vice-president, J. R. Johnson, Viaduct Manufacturing Company, Baltimore, Md.; second vice-president, S. J. Tunbridge, Utica Fire Alarm Telephone Company, Utica, N. Y.; secretary, Paul W. Bossart, Minneapolis, Minn. The office of treasurer was left vacant pending another meeting, the secretary being instructed to act in that capacity temporarily.

The members of the executive committee comprise the officers ex-officio and the following: H. T. Johnson, Manhattan Electric Supply Company, New York; P. C. Burns, American Electric Telephone Company, Kokomo, Ind.; H. C. Dodge, Standard Electric and Telephone Company, Madison, Wis.; M. O. Anthony, The Anthony Company, Cincinnati, O.; J. G. Ihmsen, Keystone Telephone Company, Pittsburg, Pa.

The next meeting of the Association will be held at Pittsburg, Pa., at an early date.

The Berliner Opinion.

It was expected that the United Circuit Court at Boston would hand down its opinion in the Berliner case on June 10, but up to noon of Tuesday of this week it had not been made public. It is thought, however, that the court will undoubtedly deliver the opinion during the present week.

Annual Meeting of the German Union of Electrical Engineers.

Electrical engineers who are going abroad this summer may be interested to know that the annual meeting of German electricians will be held at Munich, July 4 to 7.

The Triumphant Trolley.

A recent issue of a railway journal, after denouncing the proposed aerial wirerope railway over the Niagara Falls, gives vent to its feelings with the significant inquiry: "Are there to be no places on earth exempt from the invasion of the trolley?"

Niagara Falls Meeting of the American Institute of Electrical Engineers.

Following is the preliminary programme of the American Institute of Electrical Engineers for its Niagara Falls meeting, which will be held at the Cataract House, beginning on Tuesday, June 25, at 10 a. m., and continuing four days. The papers to be presented are as follows:

1. "The Substitution of Electricity for Steam in Railway Practice," inaugural address by the president, Dr. Louis Duncan, of Baltimore.
2. "Properties of Fuse Metals when Subjected to Short Circuits," by Walter E. Harrington, of Camden, N. J.
3. "Location of Grounds in Armatures, Fields, etc.," by Clarence E Gifford, of Jamestown, N. Y.
4. "Some Features of Alternating-Current Systems," by Chas. P. Steinmetz, of Schenectady, N. Y.
5. "General Theory of Alternating-Current Transformer," by Chas. P. Steinmetz, of Schenectady, N. Y.
6. "Compounding Dynamos by Armature Reaction," by Elihu Thomson, of Lynn, Mass.
7. "Existing Commercial Applications of Electrical Power from Niagara Falls," by W. L. R. Emmet, of Schenectady, N. Y.
8. "Alternating-Current Curves," by Dr. C. E. Emery, of New York.
9. "Electric Power in Factories," by Prof. Francis B. Crocker, Messrs. Benedict and Ormsbee, of New York.
10. "Some Observations on a Direct-Connected 300-kw Monocyclic Alternator," by Prof. Dugald C. Jackson and S. B. Fortenbaugh, of Madison, Wis.
11. "On Mechanical Models of the Electric Current," by Prof. Brown Ayres, of New Orleans, La.
12. "On the Cause of Death in Electric Shock," by Albert M. Bleile, M. D., of Columbus, O.
13. "Long-Distance Power Transmission at 10,000 Volts," (The Pomona Plant), by George Herbert Winslow, of Pittsburg.
14. "Notes on the Reconstruction of a Small Central Station Plant," by Franklin Leonard Pope, of Great Barrington, Mass.
15. "On Rating the Performance of Electric Power Plants and Transmission of Varying Loads," by Prof. Wm. S. Aldrich, of Morgantown, W. Va.
16. "Work of the Westinghouse Electric & Manufacturing Company for the Cataract Construction Company of New York," by L. B. Stillwell, of Pittsburg.

Among the objects of engineering interest which it is proposed to visit are the new works of the Niagara Falls Power Company, the Niagara Falls Park & River Railway on the Canadian side, the aluminum plant of the Pittsburg Reduction Company, the plant of the Carborundum Company, the central station of the Niagara Falls and Buffalo Electric Light & Power Company.

The date of the meeting has been fixed with a view to accommodating all who may wish to visit the Falls during the most desirable season. Members are requested to invite their friends, either ladies or gentlemen. Should a sufficient number of favorable responses be received, reduced railway rates may be secured. The hotel rate will be $3 per day and upward, according to room, at the Cataract House. Those who prefer will find the International convenient.

The convention rate of one and one-third fare for the trip has been granted by the Trunk Line Association, conditional upon an attendance of 100 members and guests. This covers the Grand Trunk (in part), N. Y. C. & H. R. R. R., West Shore, N. Y. O. & W., Erie, D. L. & W., L. V. R. R., C. R. R. of N. J., P. & R., B. & O., C. & O., Pennsylvania, and other minor lines. Similar concessions are expected from other lines, east, south and west, the above covering only the territory east of Niagara and north of Pittsburgh, except New England. In order that transportation arrangements may be made in good time, members should inform the secretary promptly of their intention to attend the meeting.

The Northwestern Electrical Association.

The summer meeting of the Northwestern Electrical Association will be held at Chicago on July 17, 18 and 19. The meeting is expected to be one of much interest, both professionally and socially, and all members of Western and Northwestern central stations and supply houses are invited to attend. The business sessions will be held in the forenoons, the afternoons and evenings to be devoted to pleasure and recreation.

On the Theory of Units.

BY TOWNSEND WOLCOTT.

In connection with the articles of Prof. Fessenden in your issues of May 4 and 18 I wish to make some suggestions.

To begin at the beginning, the most obvious purpose of dimensional formulæ is to determine the change of the magnitude of a derived unit, which results from changing the magnitude of one or more of the fundamental units. For instance, the dimensions of unit length area and volume are, respectively, L, L^2 and L^3. If we change our unit of length from say the foot to the yard, we have the new unit of length equal to 3 times the old, the new unit of area equal to 3^2 or 9 times the old, and the new unit of volume equal to 3^3 or 27 times the old. To convert the numerical expressions for given lengths, areas and volumes from the old to the new system, he must divide them by 3, 9 and 27, respectively.

This is so elementary that some may ask why attention should be called to it here at all. The answer is that simple as is this use, it and allied uses are the only legitimate ones to which dimensional formulæ can be put. There is, however, a school of philosophers who think quite otherwise. This school appears to have been founded by Prof. Rücker; at all events Prof. Rücker is its principal exponent, and has several worthy followers. According to the views of this school the principal use of dimensional formulæ is to discover the ultimate constitution of matter and to solve other like questions regarding the fundamental physical properties of things.

According to the Rückerian philosophy, because some derived units, such as those of area volume and velocity, have always the same dimensions, all other derived units, such as those of electric and magnetic quantities, must really have the same dimensions always, and if they appear not to, it is because of our defective knowledge of the subject.

This conclusion, however, is a non-sequitur. The reason that certain derived units have always the same dimensions is because they are always defined by the same properties, or relations to other things. For instance, velocity is always defined as length divided by time, and we are not even able to think of any other way of defining it, because we do not know of any relation between the physical quantities—length, time and velocity—independent of this one. So the dimensions of unit velocity are always given as $L T^{-1}$. So likewise there being no known relation between the relative magnitudes of lines and surfaces independent of the elementary theorem that the areas of similar surfaces are as the second powers of their homologous linear measurements, the dimensions of unit area are always L^2.

This is not the case, however, with all units. As Prof. Fessenden truly remarks, there are two independent properties of matter—gravity and inertia—and these give us two ways of defining force and energy. As kinetic energy is one half the product of a mass by its velocity we have, as in the ordinary system, the dimensions of energy $M L^2 T^{-2}$, and as potential energy is the line integral of force and by the conservation of energy the two kinds of energy are numerically equal, we have dimensions of unit force $M L T^{-2}$. Now we may make an independent start thus: let us define unit force as the force of gravity between two unit masses at unit distance. We thus obtain dimensions of unit force (from the known laws of gravitation) $M^2 L^{-2}$ which gives dimensions of unit energy $M^2 L^{-1}$.

We here have two different expressions for the dimensions of unit energy, which, according to the Rückerian philosophy (as expounded by Mr. Kennelly in former utterances and by Prof. Fessenden in the two communications under discussion), proves that we have made a mistake somewhere. But to those who place full confidence in the laws of algebra, this proves that the two ways of defining energy are really independent.

The dimensional symbols are perhaps not, strictly speaking, symbols of quantity, but it seems to be taken for granted by all (with the possible exception of the Rückerians), that they may be operated on according to the laws of ordinary algebra. If we have 1n simultaneous and independent equations of condition between $n+$ unknown quantities, we all know and no one disputes that it requires one arbitrary assumption in addition to make the system determinate.

The arbitrary condition assumed may be anything we like (that is, strictly arbitrary), but it cannot be two different things at once, or, in other words, any one of any number of arbitrary conditions may be true, but no two independent assumptions can be true at once. If, therefore, we make two assumptions at once not knowing whether they are independent or not, and find by trial that each gives a different set of values to the unknown quantities, we at once conclude that the assumptions are independent.

This is what we have just done with the unit energy. If we are convinced that it is impossible for energy to have more than one dimensional expression, we will equate the two expressions thus: $M^2 L^{-1} = M L^2 T^{-2}$, and then say that there is a mistake somewhere, but the only *algebraical* conclusion we can draw from this equation is that the three quantities M, L and T are not independent, but one is a function of the other two. If we eliminate M we have the astronomical system explained in Maxwell's and Prof. Everett's books.

In other words, after having defined energy by the kinetic method, its dimensions in terms of length, time and mass are determinate, and we are not at liberty to make another arbitrary condition. However, by making one of the so-called fundamental units a function of the other two we reduce the number of independent conditions, which allows us to make another arbitrary condition in the shape of a gravity definition of force.

As Prof. Fessenden quotes Prof. Rücker's remarks as found in Prof. Everett's book I will refer to the same. The quotation as found on pages 209 and 210 of Prof. Everett's book is "If electrical and magnetic actions are to be regarded as manifestations of ordinary laws of dynamics applied to motions which our present knowledge does not allow us to specify, then every electrical or magnetic quantity has definite dimensions in terms of mass, length and time, hence the expression $K^{\frac{1}{2}} \mu^{\frac{1}{2}} L T^{-1}$ must be of dimensions $M^0 L^0 T^0$, in other words $K^{\frac{1}{2}} \mu^{\frac{1}{2}}$ must be the reciprocal of a velocity."

If I understand the reasoning of this passage, it means that if we could find out the ultimate nature of things, and if it proved true that all electrical phenomena are due to more or less complex mechanical motions, then and only then will $K^{\frac{1}{2}} \mu^{\frac{1}{2}} = L^{-1} T$. This equation, however, is true in both the electrostatic and electromagnetic systems separately, in their present state, and does not depend on the truth of any particular theory of the ultimate nature of things, but upon the method of defining the units.

Now for Prof. Fessenden's equation (1) this would read, with an obvious typographical error corrected, $M^{\frac{1}{2}} L^{\frac{1}{2}} T^{-2} \mu^{\frac{1}{2}} = M^{\frac{1}{2}} L^{-\frac{1}{2}} T^{-\frac{1}{2}} T^{-\frac{1}{2}} \mu^{-\frac{1}{2}}$. Solving this for μ by the methods of ordinary algebra; that is, by collecting all the μ terms in one member, and all the other terms in the other members, and observing the law of indices, it becomes $\mu = L^{-1} T$, and combining this with equation (2) $K \mu = T^2 L^{-2}$, we have $L^{-1} T = T^2 L^{-2} K^{-1}$ which reduces to $K = T L^{-1}$. How Prof. Fessenden obtains his values in equations (A) and (B), I do not understand.

However, assuming for the nonce that Prof. Fessenden's values are correct, I cannot understand the logic of his interjecting them into the electrostatic and electromagnetic systems, and then saying that the resulting values are *the correct values in these systems*, and that the present values are incorrect. In the present electromagnetic system the dimensions of resistance are $L T^{-1}$. In the practical system the unit length is 10^9 centimetres and the unit time 1 second, from which we conclude that the ohm is equal to 10^9 C. G. S. units of resistance. Prof. Fessenden gives as the corrected dimensions of resistance $L^2 M T^{-2}$. This would give (the unit mass in the practical system being 10^{-11} grammes), 10^7 C. G. S. units equal to the ohm. Does Prof. Fessenden seriously maintain that there are, or even that there ought to be only 10^7 C. G. S. units in the ohm?

The starting point of the Rückerian philosophy seems to be in the dimensions, or, more correctly, in the lack of dimensions of magnetic permeability. The fact that permeability, although a physical property of bodies, has no dimensions in length, time and mass, seems to some very mysterious. The reason that permeability has no dimensions in length, time and mass in the electromagnetic system, is because it is so by hypothesis. As before stated, in order to form a connected system of units at all it is necessary to make a certain number of arbitrary assumptions, and the dimensionless permeability is one of the assumptions in the electromagnetic system. Not, to be sure, an explicit assumption, but implicitly contained in the definitions of those units where permeability is concerned.

The permeability of the air is unity both in the C. G. S. and practical systems. The permeability of any other substance, such as a piece of iron, has the same numerical value under the same conditions whatever be the magnitude of the units of length, time and mass. Therefore, as the magnitude of the unit permeability is in nowise related to the magnitudes of the fundamental units it cannot have any dimensions in the same.

The same reasoning applies to the unit of specific inductive capacity in the electrostatic system. The specific inductive capacity of any given substance is expressed by the same numerical value, whether the units of length, time and mass are the centimetre, gramme and second, or anything else we please.

The dimensions of the unit of any quantity have nothing to do with its ultimate physical nature, or even with its physical properties, if such it has, which are independent of those by which the unit is defined in the particular system.

If we equate the dimensional expressions for the unit of the same quantity in two systems, it requires in general the suppression of one of the arbitrary conditions before assumed. This we have already seen in the case of energy defined by two independent methods.

In like manner if we equate, as Prof. Fessenden has done, the dimensional expressions for two different quantities, we must suppress one condition, which existed before in order to allow the new condition expressed by the equation to be true. This new condition, according to my results, is for Prof. Fessenden's equation (1) $L = T$.

This does not mean that length and time are the same thing, nor even that any physical property of the two is the same, but simply that in order that the equation should hold true, we cannot change the unit length without changing the unit time in the same ratio, and *vice versa*.

The exponents of L and T being different in the two members any alteration of the magnitude of unit length or time separately would cause a different alteration in the two units which are respectively represented by the two members of the equation, thus destroying the equality. But the sum of the exponents being the same in both members, if length and time are never altered separately, but both together and in the same ratio the equality is preserved. Thus, as previously shown $\mu = L^{-1} T = K$ in consequence of the equation (1), but also $K\mu = L^{-2} T^2$ in both electrostatic and electromagnetic systems before equation (1) is assumed. Therefore after assuming equation (1) $T = L$.

In other words, if we make a system in which the unit length is 10^9 centimetres, as in the practical system, but instead of retaining the second as in the latter, adopt 10^9 seconds as unit time, then will the units of electric and magnetic force at a point in this system contain each the same number of respective C. G. S. units. This is the only result I have been able to deduce from equations (1) and (2), unless the fact that it applies equally to the electrostatic system be considered a different result.

In order to form a system of units fulfilling the condition $L = T$, we observe that in this system the dimensions of velocity are $M^0 L^0 T^0$. Take any velocity which is fixed, either absolutely, or within the limits of error of measurement, such as the velocity of light in interstellar space, and call it unit velocity. Now if we assume any unit of length such as the centimetre, the unit of time is also determined, as the time which light takes to travel one centimetre. If we take the earth's quadrant as unit length, we have 10^9 centimetres, but we also multiply the unit time by 10^9, and the velocity of light remains unity.

Profs. Rücker and Fessenden have written the foregoing equations in the interest of the search for the lost dimensions of one unit, and of course it is unkind to use them for the purpose of depriving still another unit of its dimensions, but if any one will show how (according to strict algebraic rules) the equation (1) can be satisfied without the condition $L = T$, I will gladly abandon my position on this point.

The dimensionless state of velocity in this case has no physical significance whatever. It does not prevent a velocity from being equal to a length divided by a time in the same sense as before. The *number of linear units* in a given distance divided by the *number of units of time* which a moving object requires to pass over the distance, gives the *number of units of velocity* in the motion of the body.

This case is entirely analogous to the case of permeability in the electromagnetic system. If $\mathfrak{H}$ and $\mathfrak{B}$ are so defined that their dimensions are the same, then of course the dimensions of $\frac{\mathfrak{B}}{\mathfrak{H}} = \mu$ disappear, but there is nothing mysterious in this, and it does not result from our ignorance, for the dimensions of a particular unit are to a great extent optional.

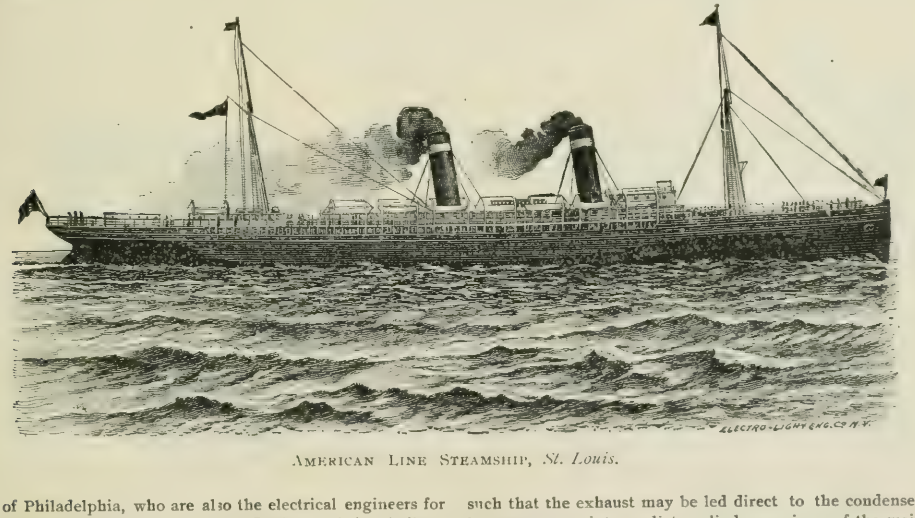
I do not understand, even according to the principles of Rückerian philosophy, how the equation $m/L^4 = m/L^3 \times {}^1/L$ shows that the ether has inertia depending first on its density, and second on curvature, but if it does prove this, there is practically no limit to the power of discovery, and as dimensional formulæ are largely optional we can to a great extent make the laws of Nature to suit ourselves.

Electricity on the St. Louis.

THE new American line ocean steamship, the *St. Louis*, which started on her maiden transatlantic voyage last Wednesday, is the largest vessel ever built in the United States, and one of the very few merchant vessels constructed in an American dock yard since the war, which can be considered truly creditable to a nation that for the quarter of a century previous to 1860 reigned supreme in the domain of naval architecture. Thanks to the experience gained by our ship-builders in the construction of the men-of-war of our new navy, we are now in a position to resume our former standing in this great art, and it is hoped that the *St. Louis* is but the forerunner of a merchant fleet that will carry the flag into every port of the world. As the object of this article is to deal only with the part that electricity plays on the new steamship, merely a brief resumé of its other details will be given.

The displacement of the *St. Louis* is 16,000 tons, and on her trial trip it is stated a speed of 22.75 knots was attained with 24,000 horse power. Her length is 555 feet, her beam 63 feet and the depth of hold 42 feet. The engines, of which there are two sets—one to each of the twin screws—are of the 6-cylinder quadruple expansion type. There are six double and four single boilers, 15 feet 7½ inches in diameter, the former each containing eight and the latter four furnaces; the double boilers are 20 feet long and the single boilers 11 feet, the steam pressure being 200 pounds. Forced draft on the Howden system is used, the air being heated before admittance to the furnaces. There are two elliptical smoke pipes, 11 feet 6 inches by 14 feet, and 100 feet high. The vessel has accommodations for 320 first-cabin, 200 second-cabin and 850 steerage passengers, and carries a crew of 400.

All of the electrical machinery required for the *St. Louis* except four ash-hoisting motors was manufactured by the Electro-Dynamic Company, of Philadelphia, who are also the electrical engineers for this vessel and for the sister ship, the *St. Paul*, now being built at Cramps' ship yard.


ELECTRO-LIGHT ENG. CO N.Y.

American Line Steamship, *St. Louis.*

The dynamo room of the vessel is located on the main deck, amidships, just forward of the main engine room, and is above the water line, thus insuring the continuance of lighting until the last moment in case of accident. Four generating sets are installed, each set consisting of a dynamo of 360 amperes capacity at 115 volts, direct-connected to a 9-inch × 5½-inch double vertical, Sturtevant engine of the marine type, running at a speed of 475 revolutions per minute at 100 pounds boiler pressure and 20 pounds back pressure. Each set rests upon a common bedplate made of I-beams riveted together, the entire frame being designed so as to combine lightness with strength and rigidity. The engine is connected to the dynamo by an insulated coupling.

The dynamos are of the Gramme ring, smooth-core, four-pole type, having but one layer of wire on the surface of the armature. The field frames are of re-annealed cast steel having a very high permeability, thus making the dynamos very light in weight—an important point in marine work. The magnetic density is just below the bend of the saturation curve, and the compounding is such that the voltage is maintained between 110 volts, the no-load reading, and 112½ volts, the half-load reading; the full-load reading is 112 volts, there being a reduction of speed of about 2 per cent. from no load to full load.

The brushes, of which there are 12 to each machine, are of leaf copper, carbon tipped, and require no adjustment from no load to full load. The carbon tip is small, and is supported on a flexible spring which allows the brush to follow the commutator in every vibration of the armature. The connections from the armature to the commutator are made with flexible cable, which prevents the frequent breaks that occur with solid wire connections. The main connections to the commutator are by means of copper tips and screws, the tips being soldered to the flexible cable.

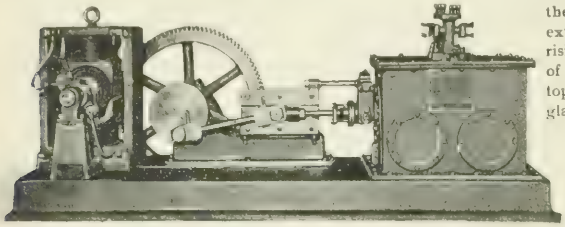
Each dynamo is provided with two self-aligning bearings, it being considered best to have the dynamo complete in itself. The bearings are self-oiling and have wick-feed oilers, by means of which the oil is filtered as used, thus allowing no grit to get into the bearings. Three wires connect each dynamo to the switchboard—two main conductors and an equalizing wire—so that two or more generators may be run in parallel, though the switching is such that any circuit may be placed on any dynamo. There is practically no stray field, all the external iron being in the form of a connecting yoke, the poles having very little area other than that facing the armature.

The engines of these generating sets were made by the B. F. Sturtevant Engine Company, of Boston, Mass., and are designed to develop 60 horse-power at a boiler pressure of 100 lbs. with a back pressure of 20 lbs.; the main boiler pressure of 200 lbs. is reduced by a valve inserted in the steam pipe leading to the dynamo room. The engines are of the pillow type, single valve, double acting, the cylinders being 9 inches × 5½ inches. The piping connections are such that the exhaust may be led direct to the condenser or to the low-pressure or intermediate cylinder receivers of the main engines.

The main switchboard, situated in the dynamo room, is 9 feet 3 inches long, and 5 feet 11 inches high, and made up of six slabs of marbleized slate secured to a frame built of angle iron. Upon the board are mounted four double-pole double-blade switches, used for running the dynamos in parallel. Also, 18 four way switches, one for each circuit of the ship, the circuits throughout the vessel being so arranged as to permit any circuit to be run from any one of the dynamos.

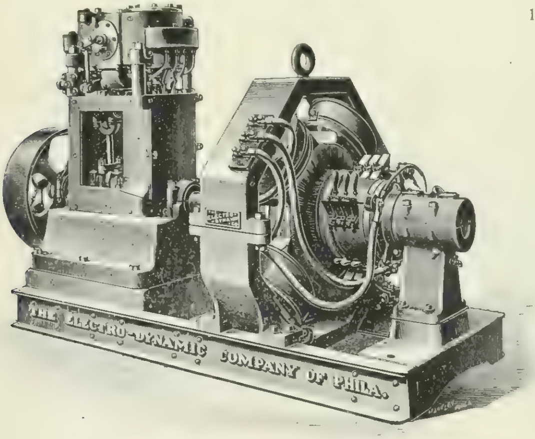
Upon the board are also placed four illuminated-dial Weston ammeters and one illuminated-dial Weston voltmeter and a ground detector, the latter being a duplicate of the voltmeter and so arranged that it can be used as a check on it. The bus bars at the back of the board are of flat copper. Adjoining the switchboard are placed 18 small double-pole knife switches, which are used for controlling the night lights scattered throughout the vessel.

One of the electrical features of the *St. Louis* is the large use made of motors for auxiliary purposes. For ventilation and heating there are four motors of 5 horse-power, two of 7 horse-power and two of 9 horse-power, each running a Sturtevant blower. By means of these blowers air for warming the staterooms and other parts of the ship is forced through nests of steam piping, and the vitiated air withdrawn through an exhaust system; the occupant of each stateroom can control the ventilation, being able to regulate the admittance or exhaustion of air. In warm weather cool air drawn from above deck is similarly distributed throughout the ship. For hoisting ashes from the fire-rooms there are four Storey motors; two motors of 10 horse-power furnish power for the refrigerating apparatus, and one of 7½ horse-power operates an elevator in the refrigerator room. There is also a small motor located in the casing of the main saloon dome to run the blower of the electric organ, being controlled from a small switch located on the keyboard of the organ.



Motor Driving Refrigerator.

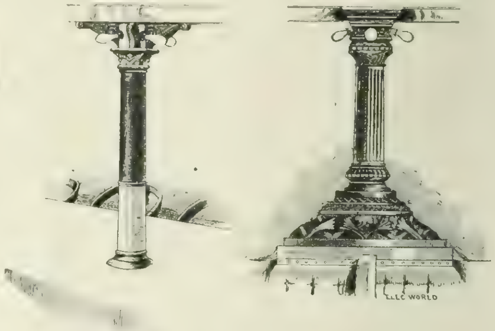
The ship is wired throughout with two circuits, one a general lighting circuit and the other a police circuit for standing lights. Over 18 miles of wire were required for the various lighting and motor circuits, all of which was supplied by the Safety Insulated Wire & Cable Company, New York, and tested by the engineer of the Electro-Dynamic Company before shipment. The wire is "navy standard," and has an insulation resistance of 1,000 megohms per nautical mile at 72 degrees F., and 25 megohms at 212 degrees F. Iron-armored conduit is exclusively employed, there being over one mile of it in the engine rooms alone.



One of the Generating Sets.

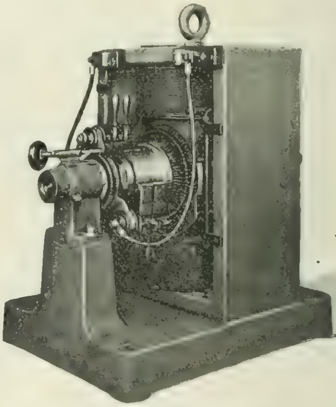
There are altogether 1,757 lights in the ship, of which about 200 are in the engineer's department. Distributing closets are located at appropriate intervals throughout the ship through which both circuits pass and in which are the fuses and switches controlling all the various circuits of the vessel. These distributing closets—47 in number, and especially designed for this installation—are water tight, and the switches are so applied that they may be operated without disturbing this feature. The fuses are thus centralized, there being no individual fuses on fixtures or groups of lamps. There is no wiring in the cold storage rooms, the lamps for use there having a flexible cord attachment to plugs located outside the rooms.

The electrical fixtures in the saloons and staterooms are neat, and in artistic harmony with their surroundings, no attempt having been made to produce purely electrical effects, if we may except the lighting of the main saloon. This magnificent apartment is 110 feet long by 50 feet wide and has sufficient sitting capacity for all the 320 cabin passengers. Above the central portion of the saloon extends a cylindrical glass dome, 32 feet long by 16 feet wide, and rising to a height of 25 feet amidships, the surface being composed of squares of handsome cathedral glass of light neutral tints. The top of the hatch into which the dome extends is covered with plain glass, and beneath this upper plane surface are distributed 84 lamps of 16 candle-power each, the light of which is transmitted through the cathedral glass of the dome into the saloon.



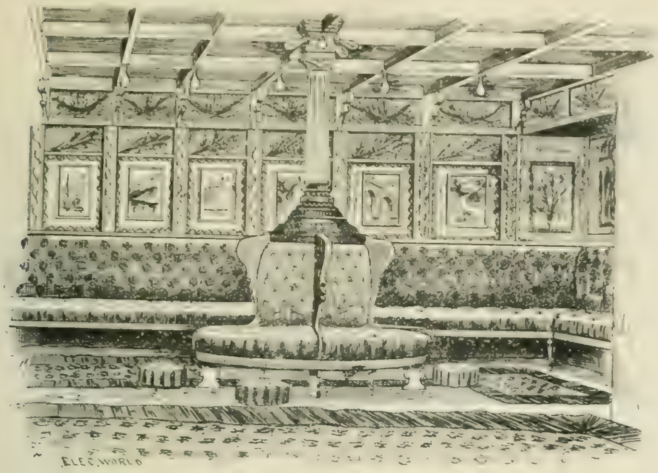
Columns with Incandescent Lamps.

In the other portions of the main saloon, in the main passages, the library, ladies' saloon and elsewhere, lamps are placed at the heads of columns, the accompanying sketches showing the neat and tasteful arrangement for this purpose; intermediate lamps are located overhead, as also shown. All of the fixtures were especially designed for the ship by the Kosenko & Hetherington Manufacturing Company, of Philadelphia.



One of the Blower Motors.

At the forward end of the saloon is a fine pipe organ, provided with an electro-pneumatic action which renders it practicable to elevate the organ about eight feet above the floor so as to allow free passage under it, as shown in the illustration of the main saloon. The keyboard is located below on the saloon deck, 30 feet forward of the organ. Each key has a circuit-closer attached which controls a very small magnet located within the organ case; this magnet actuates a valve to admit or exhaust compressed air to or from a little pneumatic bellows, which, in turn, controls the pallet or valve of the speaking pipe. The draw-stops, combination pedals and swell pedal are all equipped with electro pneumatic action constructed on the same general principle, but carried through several "relays" of pneumatic devices in order to obtain the greater power necessary to operate these several mechanisms. A small electric motor, as described above, operates the bellows. The organ is a single-manual instrument, with nine stops, three combination pedals and balanced swell, and was furnished by Messrs. Geo. Jardine & Son, of New York, the widely known organ builders.



A CORNER OF THE LIBRARY.

In the engine room the fixtures are steam-tight pendants, especially designed and manufactured by Page Bros. & Co., of Boston, who also furnished the cargo reflectors. The engine room is painted white, and the illumination is most effective, the light being diffused by reflection, while the lamps have been carefully distributed to give the strongest light where most necessary. Much credit is due to Mr. C. J. Dougherty, electrical engineer of the Cramps, for the very efficient manner in which a proper distribution of light here and elsewhere throughout the ship has been secured.

Large reflectors, 2½ feet in diameter, and each containing six lamps of 32 candle-power each, are used in the hold. These reflectors are portable, numerous plug connections being installed, to which electrical attachment can be made.

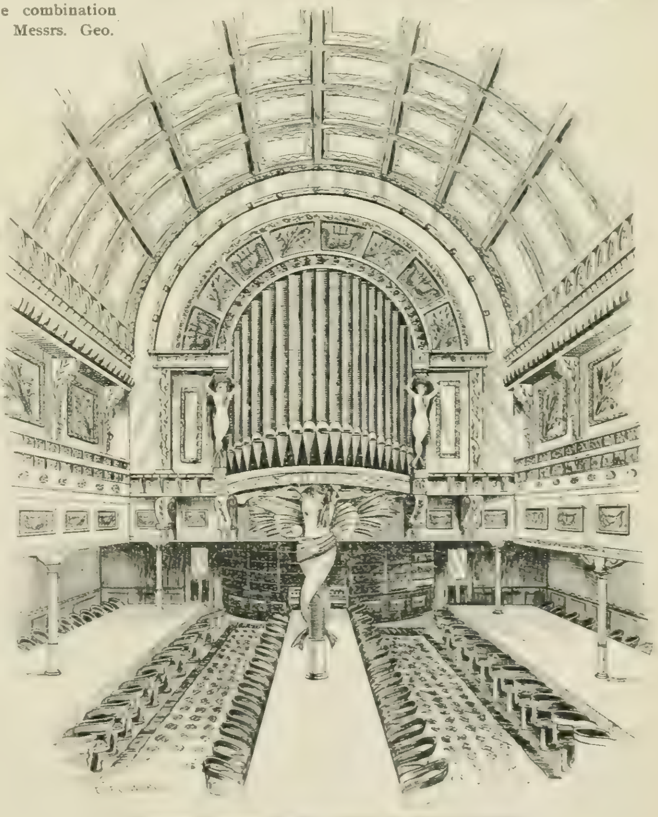
The ship is wired throughout for a complete system of electric call bells, the push buttons in all cases being fitted with a white thermostat button instead of the ordinary rubber button used in a push. Fusible alloy in these buttons is made to melt at a temperature of 168 degrees F., at which the spring in the bottom will be released and close the bell circuit, thus calling the attention of the steward or other attendant to the compartment, thus affording an efficient safeguard against fire. The bell circuits are operated by a small motor-generator driven from the main lighting circuits and with the additional safety device of a switch to throw the bell circuits into the main system through a resistance box in case of accident or damage to the motor-generator; provision is also made to connect in a few cells of storage batteries. The bell system was put in by Chas. H. Cory & Sons, New York.

There are two incandescent lamps in the lanterns of the four running lights—port and starboard, forward mast-head and stern—and are so connected to a tell-tale that should one of the lights in any lantern go out, or either be injured in any way, the tell-tale will give the alarm as well as show a signal to the man in the pilot house. This tell-tale device was especially designed for the purpose, none having been found on the market that was considered sufficiently reliable.

The ship is fitted with electric rudder and revolution indicators. The former consists of a rheostat of 220 ohms placed in the lighting circuit, and an arm on the tiller which travels along contact points connected with the resistance. A voltmeter is connected between the arm and central point of rheostat, and as the arm cuts in or out resistance the voltmeter indicates accordingly. The latter has an illuminated dial and is graduated in degrees corresponding to the angle of the rudder, the rheostat being so proportioned that the voltmeter divisions are proportional to this angle. Any number of voltmeters correspondingly graduated and located in any part of the ship can, of course, be connected.

The revolution indicator consists of two magneto generators belted, one to each shaft, and of illuminated voltmeters connected in each magneto circuit, the dials being graduated in revolutions. These indicators, which read both ahead and astern, are located, one in the wheel house and another in the chief engineer's room.

The entire electrical installation was done under the supervision of Mr. Mathias Pfatischer of the engineering department of the Electro-Dynamic Company, who also designed many of the novel features of the plant. The design of the plant as a whole is the work of Mr. L. T. Paul, engineer of the same company, who also had general supervision of its execution. The Electro-Dynamic Company is now placing a similar equipment on the *St. Paul*, a sister ship.



ELECTRIC ORGAN UNDER DOME OF MAIN SALOON.

The Output of Polyphase Generators and Rotary Transformers.

BY RALPH D. MERSHON

In consequence of the rapid development of polyphase power transmission the amount of available literature on the subject is comparatively small. For this reason there are many points of both theoretical and practical interest which, while they may be well understood by those actively engaged in the design and testing of polyphase machinery, are not known to engineers in general. The following paper, dealing with the output of polyphase apparatus of the closed-circuit type of winding, takes up a question of this kind, and is thought to be worthy of consideration, not only because the subject is an interesting one, but because in many cases the results arrived at have a direct commercial value.

If a direct-current dynamo, whose armature has the ordinary closed-circuit winding, have added to it two or more collector rings connected to the armature winding at suitable points, such a machine may be used as a direct-current generator, as an alternating-current generator, or as a rotary transformer for transforming from alternating to direct current or from direct to alternating current. In what follows a two-pole machine of the above description will be dealt with, though the statements made will all, with obvious changes in their wording, apply equally well to machines having a greater number of poles. The points of attachment of the collector rings to the armature winding are supposed to be so chosen that the length of the shorter path between any two adjacent points of connection is the same as that between any other two adjacent points. In this case, when all the collector rings bear the same effective ($\sqrt{\text{mean square}}$) current, the effective current in all parts of the armature is the same. Such a machine may be called a *symmetrical polyphase machine* and when the collector rings all bear the same effective current it may be said to be *symmetrically loaded.*

It is customary to speak of apparatus of the above type having two, three and four collector rings as "single-phase," "three-phase" and "two-phase" machines respectively. This method of designation recognizes only phase differences other than 180 degrees, and such machine might very properly be called *two-phase*, three-phase and *four-phase.* For there may be formed as many external circuits as there are leads from the armature (see Fig. 1) and no two of these circuits will bear currents of the same phase although pairs of circuits may bear currents 180 degrees apart, as is the case with a machine having an even number of leads. For the present purpose it is more convenient to adopt the latter mode of designation, and the number of phases will, therefore, be regarded as identical with the number of leads. It should be borne in mind that in the case of a machine having an even number of leads the result is precisely the same whether the number of external circuits be equal to or only half as great as the number of leads, providing that in both cases the leads bear the same effective currents.

Consider a symmetrical polyphase machine such as has been described. If when used in its several capacities of direct-current dynamo, rotary transformer, or alternating-current dynamo, it be run always with the same loss in the armature copper, its output as an alternating-current machine will, in general, differ from that as a direct-current machine and will depend upon the number of phases it receives or delivers being greater as the number of phases is greater. In what follows the endeavor is made to show how the output varies as the number of phases is varied. The output will in each case be expressed in terms of the output of the machine when used as a direct-current dynamo.

Let Fig. 1 represent the closed-coil armature of a two-pole generator giving a sine wave. A and B are two circuits each attached to the armature at points separated by the length of armature winding l, where l equals $\frac{1}{n}$ th of the total length of armature winding. The resistances of the circuits A and B are non-inductive, and are so adjusted that they have in them equal effective currents whose values at any instant are $c \sin \theta$ and $c \sin (\theta + a)$. θ is the angle between the line ab, corresponding to the diameter of commutation, and the middle point of the section of armature winding included in circuit A, the direction of rotation being counter clock-wise; $a = \frac{2\pi}{n}$ is the angular length of a section of armature winding l. The portions of armature winding included in circuits A and B, are supposed to have no electromagnetic interaction. This is permissible since the line of reasoning developed here will presently be applied to the case of an armature having its n circuits equally loaded, in which case, since the actions and reactions of a given portion of the winding are equal and opposite, each circuit may be regarded as though electromagnetically independent of the remaining circuits.

The inside arrows show the directions through the armature of the current of A, and the outside arrows, those of the current of B, when the circuits A and B are separately active. If the resistance obtained by cutting the armature winding and measuring the resistance between the terminals thus obtained be R, the resistance of the shortest armature path between any two adjacent leads is $\frac{R}{n}$ and that of the longest is $\frac{n-1}{n} R$. Therefore if the circuit B is opened and the current $c \sin \theta$ allowed to flow in A, the current in the short path of the armature will be $+ \frac{n-1}{n} c \sin \theta$ and that in the long path $- \frac{1}{n} c \sin \theta$.

The latter has the negative sign because, as can be seen from Fig. 1, it has a direction around the armature winding opposite to that of $\frac{n-1}{n} c \sin \theta$. Similarly, if the circuit A is opened and a current $c \sin (\theta + a)$ allowed to flow in B, the currents in the short and long armature paths will be $+ \frac{n-1}{n} \times c \sin (\theta + a)$ and $- \frac{1}{n} c \sin (\theta + a)$ respectively. If now the currents $c \sin \theta$, and $c \sin (\theta + a)$ be allowed to flow at the same time in their respective circuits A and B, the resultant current at any instant in any part of the armature winding may be determined by adding together with their proper signs the currents which at that instant would flow in that part of the armature winding if A and B were separately active. Therefore, the current in the short armature path corresponding to the circuit A is

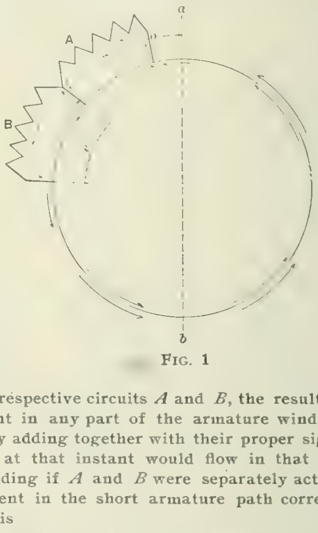


FIG. 1

$$\frac{n-1}{n} c \sin \theta - \frac{1}{n} c \sin \theta (\theta + a).$$

If, instead of two circuits as in Fig. 1, we have n circuits from which equal effective currents are drawn, the current in any part of the armature at any instant will be equal to the algebraic sum of all the currents which would exist there if each of the n external circuits were in turn to separately bear the current which flows in it at that instant. Let there be n leads brought off symmetrically from the armature and the n separate circuits equally loaded. Let the current in these circuits be

$$c \sin \theta,\ c \sin (\theta + a),\ c \sin (\theta + 2a),\ c \sin (\theta + 3a)$$
$$\ldots\ldots\ldots\ldots + c \sin (\theta + (n-1)\, a), \text{ where } a = \frac{2\pi}{n}.$$

Then it follows from what has been said above that the current in any short armature path, as that corresponding to the circuit whose current is $c \sin \theta$, will be

$$\frac{n-1}{n} c \sin \theta - \frac{1}{n} c \sin (\theta + a) - \frac{1}{n} c \sin (\theta + 2a), \text{ etc.}$$

$$\text{or } \frac{n-1}{n}\, c \sin\theta = \frac{1}{n} \times \Big[\sin(\theta + a) + \sin(\theta + 2a) \ldots\ldots + \sin(\theta + (n-1)a) \Big]$$

The term in the bracket equals

$$(\sin\theta \cos a + \cos\theta \sin a) + (\sin\theta \cos 2a + \cos\theta \sin 2a)$$
$$\ldots\ldots\ldots + (\sin\theta \cos(n-1)a + \cos\theta \sin(n-1)a)$$
$$= \sin\theta(\cos a + \cos 2a + \cos 3a \ldots + \cos(n-1)a)$$
$$+ \cos\theta(\sin a + \sin 2a + \sin 3a \ldots + \sin(n-1)a).$$

Since $a = \frac{2\pi}{n}$ where n is an integer, the sum of the sines is zero and that of the cosines is -1. Therefore we have for the current in the short path corresponding to the external circuit bearing the current $c \sin\theta$.

$$\frac{n-1}{n} c \sin\theta - \frac{1}{n} c \sin\theta(-1) = c \sin\theta.$$

Therefore, in any symmetrically loaded closed-coil alternator the current in that section of the armature winding which is included between the points of attachment of any two adjacent leads, is at every instant equal to the current in the shortest external circuit connecting these leads. (By a symmetrically loaded machine is meant, of course, one from which leads are brought off symmetrically and whose external circuits bear equal effective currents.) It follows, then, that the effective currents in the two cases are equal.

If E be the E. M. F. and C_{dc} the current when the machine is carrying full load as a direct-current dynamo, the output is $EC = W_{dc}$. The effective E. M. F. of a circuit whose leads are attached to the ends of a diameter is $\frac{E}{\sqrt{2}}$ since E will be the maximum E. M. F. of the circuit. Then, as has been shown in a preceding paper*, the effective E. M. F. of each of the n alternating-current circuits led off from this armature will be $\frac{E}{\sqrt{2}} \sin\frac{\pi}{n}$. If the effective current in each of the n external circuits be C_{ac}, the output of the machine as an alternating-current generator is $n\frac{C_{ac}E}{\sqrt{2}} \sin\frac{\pi}{n} = W_{ac}$. C_{ac} and C_{dc} bear a definite relation given by the equation

$$\frac{C^2_{dc} R}{4} = n\, C^2_{ac} \frac{R}{n}$$

since the copper losses in the two cases are to be equal.

$$\therefore C^2_{ac} = \frac{C^2_{dc}}{4} \text{ or } C_{ac} = \frac{C_{dc}}{2}$$

$$\therefore W_{ac} = \frac{n\, C_{dc}}{2\sqrt{2}}\, E \sin\frac{\pi}{n}$$

$$\therefore \frac{W_{ac}}{W_{dc}} = W_r = \frac{n \frac{C_{dc}}{2\sqrt{2}} . E \sin\frac{\pi}{n}}{E\, C_{dc}} = \frac{n \sin\frac{\pi}{n}}{2\sqrt{2}} \qquad (1)$$

which is the expression for the output of a generator of n phases in terms of its output when used for direct current. If the total loss with direct current is p per cent., the loss with alternating current is $\frac{2\sqrt{2} \times p}{n \sin\frac{\pi}{n}}$ per cent., and the efficiency is $100 - \frac{2\sqrt{2} \times p}{n \sin\frac{\pi}{n}}$

The value of equation (1) has been calculated for several values of n, and the results plotted in Fig. 3. The curve A has been run through these points, though strictly no such curve exists, since the output is physically a discontinuous function of the number of armature leads.

The case of the rotary transformer is somewhat more complicated. Let Fig. 2 represent the armature of the machine into which direct current is put and from which alternating current is taken, or the reverse. Though it is immaterial as far as the result is concerned which way the transformation takes place, it is assumed that the transformation is from direct to alternating current. D. C.,—D. C are the direct current brushes and the inside arrows indicate the course which the direct current would take if it alone flowed through the armature. The outside arrows where drawn indicate the direction of alternating current under similar conditions. All the n alternating circuits are supposed to have in them the same effective currents and the instantaneous values of them are as before $c \sin\theta$, $c \sin(\theta + a)$, etc. Then, as before the instantaneous values of the alternating currents which would be in each short section of the armature winding if alternating currents only were flowing are the same as those of the currents which flow in the circuits corresponding to these sections; they are, $c \sin\theta$, $c \sin(\theta + a)$, $c \sin(\theta + 2a)$, etc.

It is desired to find the mean loss in each section when both direct and alternating currents are flowing. This can be accomplished by summing up the losses which take place in a given section while rotating through an angle π and dividing the result by π. Consider any particular one of the n sections as that corresponding to the current $c \sin\theta$. As long as it is wholly on one side or the other of the diameter of commutation, the numerical value of the current in it is, as is evident from Fig. 2, $\frac{C_{dc}}{2} - c \sin\theta$ where C_{dc} is the total direct current flowing through the direct current brushes. When, however, this section is passing from one side to the other of the diameter of commutation as shown at b, Fig. 2, the above expression does not give the value of the current. It will be convenient, therefore, to sum up separately the losses in the section under consideration when it is wholly on one side of the diameter of commutation and when it is passing from one side to the other. Suppose the rotation of the armature in Fig. 2 to be counter clock-wise. Then remembering that θ, $\theta + a$, $\theta + 2a$, are the angular distances between the middle points of their respective sections of the armature winding and the upper D. C. brush, and that $a = \frac{2\pi}{n}$ is the angular length of one section, the loss in the section corresponding to $c \sin\theta$, may be most conveniently found for the half revolution extending from the angle $\theta = -\frac{a}{2}$ to the angle $\theta = (\pi - \frac{a}{2})$. The two parts of this which must be determined separately extend from $\theta = -\frac{a}{2}$ to $\theta = +\frac{a}{2}$ and from $\theta = +\frac{a}{2}$ to $\theta = \pi - \frac{a}{2}$. The loss over the part of the half revolution extending from $+\frac{a}{2}$ to $\pi - \frac{a}{2}$ is

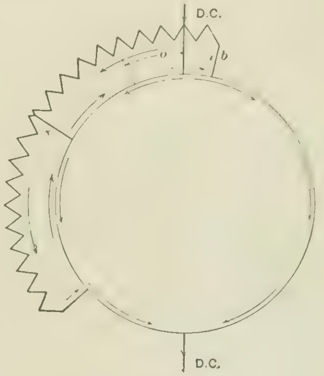


FIG. 2.

$$\int_{\frac{a}{3}}^{\pi - \frac{a}{2}} \frac{R}{n}\left(\frac{C_{dc}}{2} - c \sin\theta\right)^2 d\theta \qquad (2)$$

the loss as the section passes over the angle from $-\frac{a}{2}$ to $+\frac{a}{2}$ can be divided into two exactly similar and equal parts, namely, the loss taking place during the movement from $-\frac{a}{2}$ to 0 and that during the movement from 0 to $+\frac{a}{2}$. It is most convenient to determine the loss during the movement over the latter angle and the section at one instant of this movement is shown at *b*, Fig. 2. From this diagram it is evident that the current in that part of the section which has passed the D. C. brush is $\frac{C_{dc}}{2} - c \sin \theta$, while that in the other part of the section is $\frac{C_{dc}}{2} + c \sin \theta$ and the resistances through which these currents flow are $\frac{R}{2\pi}\left(\frac{a}{2} + \theta\right)$ and $\frac{R}{2\pi}\left(\frac{a}{2} - \theta\right)$ respectively. Therefore, the rate of loss at any instant in the two parts of the section are

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* ELECTRICAL WORLD, Dec. 15, 1894, "Some Notes on Multiphase Power Transmission."

$$\left(\frac{C_{dc}}{2} - c \sin \theta\right)^2 \frac{R}{2\pi}\left(\frac{a}{2} + \theta\right) \text{ and } \left(\frac{C_{dc}}{2} + c \sin \theta\right)^2 \frac{R}{2\pi}\left(\frac{a}{2} - \theta\right)$$

Therefore the loss during the movement of the section from $\theta = -\frac{a}{2}$ to $\theta = +\frac{a}{2}$ is,

$$2\int_0^{\frac{a}{2}} \left(\frac{C_{dc}}{2} - c \sin \theta\right)^2 \frac{R}{2\pi}\left(\frac{a}{2} + \theta\right) d\theta +$$

$$2\int_0^{\frac{a}{2}} \left(\frac{C_{dc}}{2} + c \sin \theta\right)^2 \frac{R}{2\pi}\left(\frac{a}{2} - \theta\right) d\theta \qquad (3)$$

adding (2) and (3) and dividing the sum by π gives the mean loss in the section.

$$\therefore L = \frac{R}{\pi}\int_0^{\frac{a}{2}} \left[\left(\frac{C_{dc}}{2} - c \sin \theta\right)^2 \left(\frac{a}{2} + \theta\right) + \left(\frac{C_{dc}}{2} + c \sin \theta\right)^2 \left(\frac{a}{2} - \theta\right)\right] d\theta + \frac{R}{n}\int_{\frac{a}{2}}^{\pi - \frac{a}{2}} \left(\frac{C_{dc}}{2} - c \sin \theta\right)^2 d\theta$$
$$\overline{\qquad\qquad\pi\qquad\qquad}$$

Since there are *n* sections the mean loss in the armature will be *n* times this; hence multiplying by *n* and reducing

$$n\,L = \frac{n\,R}{\pi^2}\int_0^{\frac{a}{2}} \left(\frac{a\,C_{dc}^2}{4} + a\,c^2 \sin^2 \theta - 2\,C_{dc}\,c \sin \theta\right) d\theta$$
$$+ \frac{R}{\pi}\int_{\frac{a}{2}}^{\pi - \frac{a}{2}} \left(\frac{C^2_{dc}}{4} - C_{dc}\,c \sin \theta + C^2 \sin^2 \theta\right) d\theta.$$

The integral of this expression is, since $\int \sin^2 x\,d\,x = \frac{x}{2} - \frac{\sin x \cos x}{2}$ and $\int x \sin x\,d\,x = \sin x - x \cos x$,

$$\frac{n\,R}{\pi^2}\left[\frac{a\,C^2_{dc}\,\theta}{4} + a\,c^2\left(\frac{\theta}{2} - \frac{\sin \theta \cos \theta}{2}\right) - 2\,C_{dc}\,c\left(\sin \theta - \theta \cos \theta\right)\right]_0^{\frac{a}{2}} + \frac{R}{\pi}\left[\frac{C^2_{dc}\,\theta}{4} + C_{dc}\,c \cos \theta + c^2\left(\frac{\theta}{2} - \frac{\sin \theta \cos \theta}{2}\right)\right]_{\frac{a}{2}}^{\pi - \frac{a}{2}}$$

Evaluating and substituting the values

$$a = \frac{2\pi}{n} \text{ and } \pi - a = \pi - \frac{2\pi}{n} = \left(\frac{n-2}{n}\right)\pi$$

$$n\,L = \frac{C_{dc}^2\,R}{4} - \frac{2\,C_{dc}\,c\,n\,R \sin \frac{\pi}{n}}{\pi^2} + \frac{c^2\,R}{2} = K_1 \qquad (4)$$

where K_1 is the full load loss in the armature copper when the machine is run as a direct current generator. Let E be the D. C. E. M. F. generated in the machine. E is the E. M. F. on the D. C. brushes, if alternate current is put into the machine or the E. M. F. on the D. C. brushes less the copper drop in the armature if D. C. is put into the machine. As the latter case is that under consideration, E is the E. M. F. at the D. C. brushes less the copper in the drop armature. The result is the same, of course, in either case. The effective E. M. F. on each of the *n* A. C. circuits is $\frac{E \sin \frac{\pi}{n}}{\sqrt{2}}$. E is also the E. M. F. at which the machine would be run when used as a direct current dynamo, and since the copper loss of the armature is K_1 and the resistance of the armature $\frac{R}{4}$, the current when run as a direct current dynamo is $\sqrt{\frac{4\,K_1}{R}}$. The output as a direct current dynamo is therefore $E\sqrt{\frac{4\,K_1}{R}}$. If K_2 be the per cent. which the friction loss and the iron loss of the armature is of this output, the friction and armature iron losses are $K_2\,E\sqrt{\frac{4\,K_1}{R}}$. Therefore if C be the effective current in each A. C. circuit, the output when used as a transformer is

$$W_{ac} = E\,C_{dc} - K_2\,E\sqrt{\frac{4\,K_1}{R}} = \frac{n\,E \sin \frac{\pi}{n} c}{2} \qquad (5)$$

For, since E is the counter E. M. F., $E\,C_{dc}$ represents the total power delivered to the armature less the copper loss, and this diminished by the iron and friction losses must equal the power delivered to the external *A. C.* circuits.

If W_r be the output as a rotary transformer in terms of the output as a direct current dynamo,

$$W_r = \frac{W_{ac}}{W_{dc}} = \frac{n\,E \sin \frac{\pi}{n} c}{2} \cdot \frac{1}{E\sqrt{\frac{4\,K_1}{R}}} = \frac{n \sin \frac{\pi}{n} c}{2\sqrt{\frac{4\,K_1}{R}}} \qquad (6)$$

From (5),

$$C_{dc} = \frac{n \sin \frac{\pi}{n} c}{2} + K_2\sqrt{\frac{4\,K_1}{R}}$$

Substituting this value of C_{dc} in (4) and solving, the value of c is obtained. Substituting this value in (6), there results,

$$W_r = \frac{-(\pi^2 - 8)\,K_2\,n^2 \sin^2 \frac{\pi}{n} + n \sin \frac{\pi}{n}\left[(\pi^2 - 8)^2\,K_2^2\,n^2 \sin^2 \frac{\pi}{n} + 4\,\pi^2\,(1 - K_2^2)\left(\left(\frac{\pi^2}{4} - 4\right)n^2 \sin^2 \frac{\pi}{n} + 2\,\pi^2\right)\right]^{\frac{1}{2}}}{4\left[\left(\frac{\pi^2}{4} - 4\right)n^2 \sin^2 \frac{\pi}{n} + 2\,\pi^2\right]} \qquad (7)$$

When the iron and friction losses are so small that they may be neglected (7) becomes,

$$W_r = \frac{n \sin \frac{\pi}{n}}{2\left[\left(\frac{\pi^2}{4} - 4\right)n^2 \sin^2 \frac{\pi}{n} + 2\,\pi^2\right]^{\frac{1}{2}}} \qquad (8)$$

If the total loss as a direct current dynamo is p per cent, the efficiency as a rotary transformer is,

$$\text{Efficiency} = 100 - \frac{p}{W_r} \qquad (9)$$

Values of (7) have been calculated for different values of n when $K_2 = .02$; that is, when the iron and friction losses are 2 per cent. of the output as a direct current dynamo. These values have been plotted in Fig. 3 and the curve B run through them.

Fig. 3 shows that in a three phase system, if each of the converters receiving energy from the generator have its terminals connected to the generator armature at points 180 degrees apart instead of 120 degrees, so that there are six leads from the armature instead of three, the output of the generator will be increased about 16 per cent.; while for the same change in a three-phase rotary transformer the output is increased about 45 per cent. This gain is made at the expense only of three additional collector rings for the machine.

Fig. 3 also shows that the output as "quarter-phase" generator is about 10 per cent. greater than that as a three-phase generator, and that the output as a "quarter-phase" rotary transformer is about 22 per cent. greater than that as a three-phase rotary transformer.

Finally, Fig. 3 shows that in any polyphase system the output of all the apparatus of the closed-coil type, whether generators, rotary transformers or motors, may be increased by increasing the number of phases supplied to or taken off from it. This applies also to the short-circuited secondary of an induction motor of the rotary field type, the output of the motor being increased by an increase in the number of points at which the secondary winding is short-circuited. It is obvious that along with such increase in the output of the apparatus there is an increase in efficiency.

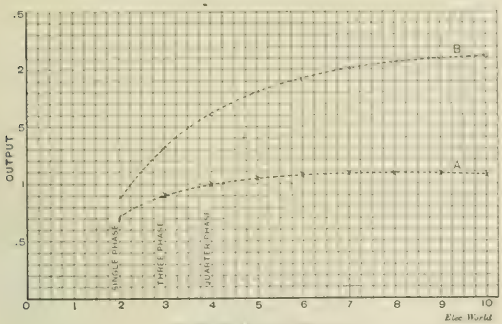


FIG. 3.

There are two small errors in the above analysis of the rotary transformer. One of them is in the assumption that the iron losses and field copper losses are the same in the machine whether it be used as a rotary transformer or as a direct-current dynamo. They are not the same, both being somewhat greater in the case of the dynamo because of its greater armature reaction. The other error is in the assumption that when direct current is fed into a machine which inherently generates a sine wave, the alternating E. M. Fs. and currents taken from that machine will be sine waves. This is not true because of the redistribution of current in any given section as it passes under the direct-current brush, and the consequent departure, during this time, of the wave representing the energy lost in that section from the form which it has when the section is not under the brush. Both these errors are small, however, and the results obtained above are, as experience has shown, well within the accuracy of commercial measurements.

Progress in Gas Journalism.

A contemporary whose pages are devoted almost exclusively to the interest of gas, gives a brief analysis of the recent report for Massachusetts, saying that that State "lives up to her reputation as a leader in modern progress," which remark is followed by a statement showing that there are more companies supplying electric current than there are supplying gas, and that during the year 1894 the total gross receipts of all the gas companies fell 17.75 per cent., the total net profits 24.75 per cent., the entire operations showing a deficit of over $108,000, while with the electric light companies there was an increase in receipts, expenditures and profits, the deficit for 1893 having been replaced by a surplus. Such a frank admission by a gas journal is in itself an indication of progress.

Platinum Mines in Human Skulls.

Some time ago it was stated in these columns that in America about three tons of platinum was used annually for incandescent lamps, and one ton for artificial teeth. *L'Eclairage Electrique* in this connection suggests that for future generations the American cemeteries will become platinum mines. The editor of that journal is apparently not aware of the tricks of American undertakers.

Analogies.

Prof. Forbes in a recent lecture likens the reverse curbing current in submarine cables to the pullback when a whip is cracked, the sharp jerk causing a better defined and more vigorous effect than if the whip were merely thrown forward.

Some Work on Magnetic Hysteresis.

BY FRANK HOLDEN.

Having read the description of Prof. Ewing's latest apparatus for determining the hysteresis loss in sheet iron, it seemed that an account of work done some time ago in very much the same direction would be of interest.

During the last few weeks of the year 1892 there was built at the works of the General Electric Company, in Lynn, Mass., under the writer's direction, an instrument, shown in Fig. 1, by which the losses in sheet iron were determined by measuring the torque produced on the iron, which was punched in rings, when placed between the poles of a rotating electromagnet. The rings were held by a fibre frame so as to be concentric with a vertical shaft which worked freely on a pivot bearing at its lower end. They had a width of 1 cm, an outside diameter of 8.9 cm, and enough were used to make a cylinder about 1.8 cm high. The top part of this instrument, which rested on a thin brass cylinder surrounding the rings, was movable. On the upper surface was marked a degree scale, over which passed a pointer, with which the upper end of a helical spring rotated. It was so constructed that when the vertical shaft with the rings and the upper part of the instrument with the spring was put in place, the lower end of the spring engaged with the shaft, and, consequently, rotated with the rings. A pointer moving with the lower end of the spring reached to the zero of the degree scale when the apparatus was ready for use. By this arrangement it was found what distortion it was necessary to give the spring in order to balance the effect of the rotating magnet, and the spring having been calibrated the ergs spent on the rings per cycle were determined by multiplying the degrees distortion by a constant.

A coil, so arranged that it surrounded but did not touch the rings, made contact at its ends with two fixed brushes that rested in diametrically opposite positions on a two-part commutator, which revolved with the magnet. The segments were connected each to a collector ring against which rubbed a brush, the latter two brushes being joined through a sensitive Weston voltmeter. If this were so arranged that the coil was at right angles to the induction, when the brushes changed contact from one segment to the other, it is evident, the self-induction of the circuit being negligible, that the mean value of the current in the circuit was proportional to the total flux through the coil. Knowing the constant of the voltmeter the deflection was easily calculated from the speed of the magnet, the number of turns in the coil, cross-section of the rings and the

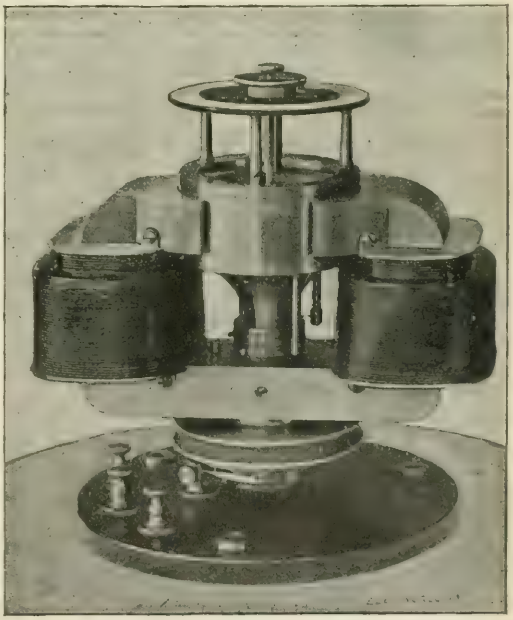


FIG. 1.—HYSTERESIS METER.

resistance of the circuit. From an induction of 2,000 gausses to at least 10,000 gausses, the leakage across the interior space of the rings was negligible.

Carried on the shaft below the magnet was a pulley around which passed a flat belt driven with a pulley of the same size on an electric motor, so that the speed of the magnet could be found by observing that of the motor. In operating, the deflections to be produced on the voltmeter at a certain speed, with the desired induction in the rings, were first calculated. Five hundred revolutions per minute was generally adopted as the speed in this case. The motor being run at the desired speed, the magnetizing current was adjusted until the calculated deflection was produced on the voltmeter. Keeping the magnetizing current constant the speed was changed successively in value to certain values, and the corresponding distortions of the spring necessary to balance the effect of the magnet noted. When this process was carried out at different induction values and the ergs expended per cycle on the rings plotted as a function of the speed, a series of lines were produced, as shown in Figs. 2 and 3. It was found that the slope of the lines decreased very rapidly with the decrease in thickness of the iron sheet used so as to indicate that had it been thin enough the slope would have been zero between 100 and 800 revolutions per minute, which was about the highest speed permissible. From this it would seem that, in these tests, the total loss per cycle had two components; one remaining constant, due to hysteresis, and the other varying as the speed of the magnets, due to currents induced in the iron.

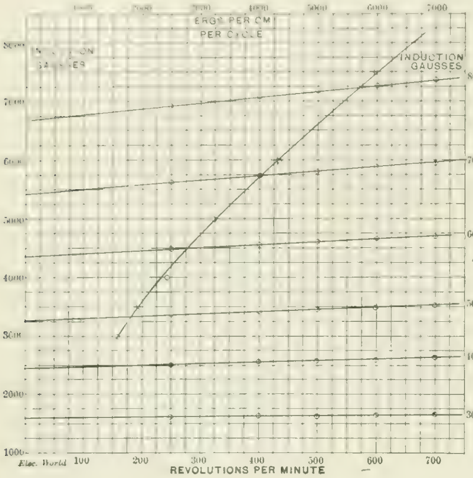


FIG. 2.

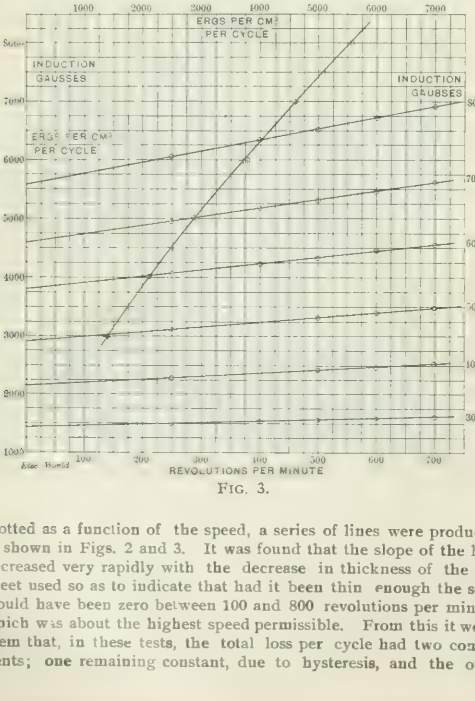


FIG. 3.

Fig. 6 gives observations of eddy current loss and thickness of iron sheet on this assumption. The line drawn is a parabola, so that it would appear that with the range of observations made the loss varied about as the square of the thickness of the sheets.

Fig. 2 gives lines from iron .04 cm thick. Speed readings were not taken lower than 250 revolutions per minute, as it had been found that the lines were always straight, and speeds below this value could not be read with the tachometer available for this particular test. Plotting the hysteresis as a function of the induction, in this case the points are all quite close to a curve whose equation is, Ergs $= K\,\mathfrak{B}^{1.47}$, three points in the latter calculated curve being shown by the crosses. The iron, a test on which is shown in Fig. 3, was .1 cm thick, and shows a greater eddy current loss. The equation for the hysteresis curve for this sample is, Ergs $= K\,\mathfrak{B}^{1.4}$, some points in the latter curve being shown by crosses, as before.

The eddy current losses for these two samples are plotted as functions of the induction in Fig. 5. The curves drawn are parabolas, showing that in these cases the eddy current loss varied approximately as the square of the induction, although there were often greater variations from that law than these two samples show. The average exponent for the hysteresis curves was a little over 1.5, although it varied from 1.4 to 1.7. Rings tested in this manner were wound and tested with a ballistic galvanometer, using the step-by-step method. There were discrepancies of as much as 4 per cent. between the two results, but an average of ten tests showed the ballistic galvanometer method gave results 2.5 per cent. lower than the other. This difference is easily attributable to experimental errors.

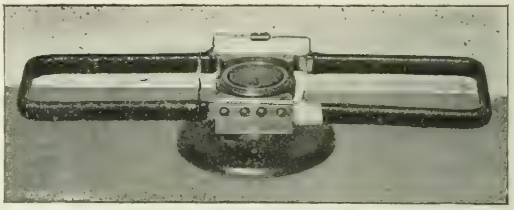


FIG. 4.—MODIFIED HYSTERESIS METER.

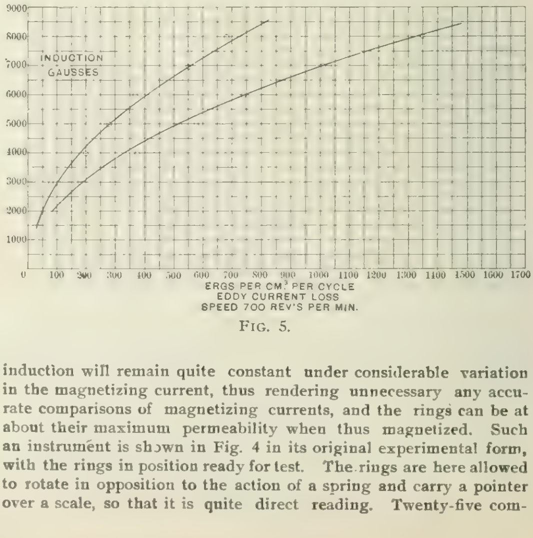


FIG. 5.

It being noticed that, for a given induction in the rings, the magnetizing currents for different samples did not vary much, it was planned shortly after completing the above apparatus to construct a modified instrument which would use electromagnets of such high reluctance that the variations of the rings would be negligible, and induction be dependent only on the current. By making the electromagnets of suitable iron and of about one third the cross-section of the rings used, the iron may be so highly saturated that the induction will remain quite constant under considerable variation in the magnetizing current, thus rendering unnecessary any accurate comparisons of magnetizing currents, and the rings can be at about their maximum permeability when thus magnetized. Such an instrument is shown in Fig. 4 in its original experimental form, with the rings in position ready for test. The rings are here allowed to rotate in opposition to the action of a spring and carry a pointer over a scale, so that it is quite direct reading. Twenty-five comparisons of this instrument with the original one gave results that agreed within 6 per cent. in all cases, and more than half were within 2 per cent. of agreement. Permanent magnets had been previously tried, but the attempt seemed to show that the instrument would not, in that case, compare samples of iron widely different in character, and the writer not being able to give any attention to the matter no further investigations in that direction were conducted.

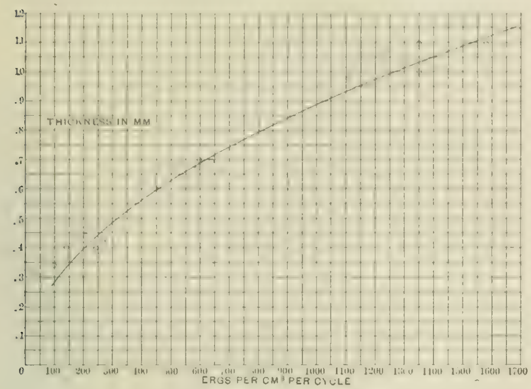


FIG. 6.

The instrument first described has been in use continuously since its completion at the works of the General Electric Company, in Schenectady.

The Direct Production of Electricity from Hydrogen.

BY C. J. REED.

Under the above title Mr. H. H. Dow describes in THE ELECTRICAL WORLD of June 8, 1895, another new battery for the "direct production of electricity from fuel." The importance of this battery will be appreciated when it is understood that the "fuel" employed in it is metallic zinc. This is a very convenient and a very efficient fuel for the purpose, as has been shown by many others who have worked in the same line.

Mr. Dow calculates that he has obtained an efficiency of 57 per cent. of the original energy of this fuel. The fact that others have by a similar calculating process obtained as high as 97 or 99 per cent. efficiency is not of very great importance.

If Mr. Dow will study the reactions of the Grove, bi-chromate or any other zinc battery, in which an oxidizing agent is kept in contact with the electronegative plate to prevent the reduction and escape of hydrogen gas, he will learn that the energy all comes from the oxidation of the zinc. If hydrogen is evolved in any zinc battery, it means that the energy of the zinc is not all being used to produce electrical energy, but that a portion of it is being used to reduce hydrogen gas from combination. This energy is, of course, wasted when the hydrogen escapes. Whenever this is allowed to occur, the reaction, instead of producing electricity directly from hydrogen, is producing hydrogen, *i. e.*, reducing it, directly from the energy of the zinc. In the Grove, Bunsen and bi-chromate batteries and in all batteries using a powerful oxidizing agent which effectually prevents the reduction of hydrogen, we have the most highly efficient transformation of the energy of the zinc into electrical energy. Such batteries have an electromotive force approaching closely to the theoretical electromotive force of the chemical reaction in the battery.

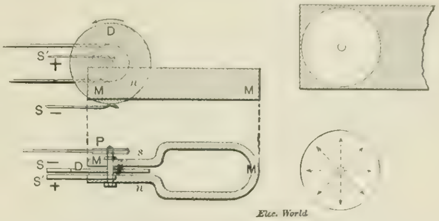
According to Mr. Dow's statement, his battery gives only 1.32 volts, which shows that the efficiency is very low, like that of the Smee battery, and the reasons are very apparent. To be a little more specific, we may say one gramme of zinc in Mr. Dow's battery will furnish 0.83 ampere-hour of electric current at 1.32 volts (assuming his figures to be correct); while one gramme of zinc in a bi-chromate cell will furnish 0.83 ampere-hour at about 2.1 volts. The difference between 1.32 and 2.1 or 0.78 volt represents the loss of electromotive force in the Dow battery due to the escape of energy in hydrogen gas and other unavailable by-products, which is saved in the bi-chromate battery. While the Dow battery would have a low efficiency and use more zinc, it would, like the Smee battery, require no oxidizing agent which is a source of expense. But to speak of this or any other zinc battery as one in which electrical energy is produced directly or indirectly from hydrogen gas, is nonsense pure and simple.

Electrodynamic Machinery.—XXXVIII.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

253. Commutatorless, continuous-current dynamos are sometimes called unipolar dynamos, although very erroneously. It is impossible to produce a single magnetic pole in a magnet, since all magnetic flux is necessarily circuital, and must produce poles, both where it enters and where it leaves a magnet. The fact that these machines are capable of furnishing a continuous current without the aid of a commutator, at one time caused considerable study to be given to them in the hope of rendering them commercially practicable. The maximum E. M. F. which they have been constructed to produce, appears, however, to have been about six volts, and, consequently, they have practically fallen out of use, although they have been commercially employed for electroplating.

254. Fig. 178 represents what is known as a Faraday disc. This was, in fact, the earliest dynamo ever produced and was of the so-called unipolar type; for here, a copper disc *D*, rotated by mechanical force, about an axis parallel to the direction of the magnetic flux, supplied by a permanent horseshoe magnet *MM*, continuously cuts magnetic flux in the same direction, and, consequently, furnishes a continuous E. M. F. between the terminals *S*, *S'* without the use of a commutator.



Elec. World

FIGS. 178 AND 179.—FARADAY DISCS.

255. The portion of the disc lying between the poles is caused to rotate in a nearly uniform magnetic flux and with a velocity which depends upon the radius of the disc at the point considered, as well as on the speed of rotation. The direction of the E. M. F. induced will be radially downward from the axis to the periphery, and if connection be secured between the axis as one terminal, and the rotating contact or brush as the other terminal, an E. M. F. will be continuously produced in that portion of the disc which lies beneath the poles; or, more strictly, in that portion of the disc which passes through the flux between them and around their edges. If, however, as in Fig. 179, the disc be completely covered by the pole faces, a radial system of E. M. Fs. will be induced outward in the direction indicated by the arrows, or, upwards, if the direction of rotation be reversed. If no contacts are applied to the disc, these E. M. Fs. will supply no current and will do no work. If brushes are applied at the axis, and at any or all parts of the periphery, the E M. F. can be led off to the external circuit.

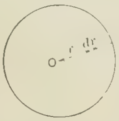


FIG. 180.

256. The value of the E. M. F. will depend upon the speed of rotation, the intensity of the magnetic flux, and the radius of the disc. The intensity of the magnetic flux can usually be made much greater by the use of a soft-iron disc instead of a copper disc, thereby practically reducing the reluctance of the magnetic circuit between the poles to that of two clearance films of air, since the reluctance of the iron disc will be negligibly small.

257. If we consider any small length of radius dr, Fig. 180, situated at a distance r, from the axis of the disc, the E. M. F. generated in this element of the disc will be the product of the intensity, the length of the element, and its velocity across the flux. The element will be moving across the magnetic flux of uniform intensity at $\mathcal{B}$, a velocity $r\,\omega$ centimetres-per-second, where ω, is the angular velocity of the disc in radians per second. Consequently, the E. M. F. in this element will be:

$$de = r\,\omega\,.\,dr\,.\,\mathcal{B}\,.\ \text{C. G. S. units of E. M. F.}$$

The total E. M. F. will be the sum of the elementary E. M. Fs.

[illegible] on the radius taken from $r = o$ to $r = R$, the radius of the disc, or the integral of de, in the above equation between the limits $r = o$, and $r = R$. This integral is $\frac{R^2}{2} \omega \mathcal{B} = e$. The E. M. F. from such a disc, therefore, increases as the square of the radius of the disc, directly as the speed, and directly as the uniform intensity of the magnetic flux. The same result can be obtained in a slightly different expression, since $\omega = 2 \pi n$, where n, is the number of revolutions of the disc in a second, $e = \frac{R^2}{2} \cdot 2 \pi n \mathcal{B} = \pi R^2 n \mathcal{B} = S n \mathcal{B}$ where S, is the active surface of the disc. This will also be true if the surface S, instead of extending over the entire face of the disc, extended only from the periphery to some intermediate radius. From this point of view the E. M. F. of the disc is equal to the product of the intensity in which it runs, the number of revolutions it makes per second, and its active surface in square centimetres. To reduce this E. M. F. to volts we have to divide by one hundred million.

258. There are two recognized types of commutatorless continuous-current dynamos; namely, the *disc type* and the *cylinder type*. The outlines of a particular form of the disc type are represented in Fig. 181. Here the shaft *SS*, usually horizontal, carries a concentric, perpendicular disc of copper or iron, rotating in a vertical plane, in the ring-shaped magnetic frame, and through the flux produced by two coils of wire in a circular groove. The general direction of the magnetic flux, through the field frame and disc, is represented by the curved arrows. It will be observed that the magnetic flux will be uniformly distributed so as to pass through the rotating disc at right angles. Brushes rest on the periphery, and on the shaft, of the disc. Inasmuch as the E. M. F. in the disc is radially directed at all points, the brushes for carrying off the current may be as numerous as is desired. These brushes are marked b, b, in the figure. A, and B, are the main terminals of the machine, and f, f', the field terminals.

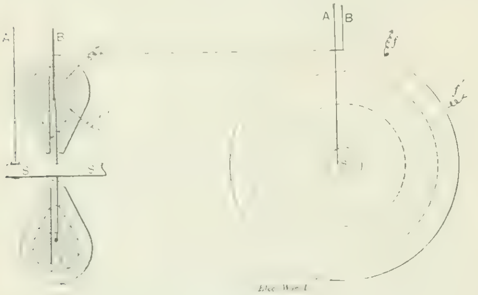


Fig. 181.—Disc Type of Commutatorless Direct-Current Generator.

259. If we suppose that the intensity $\mathcal{B}$ is 12,000 gausses, that the radius of the disc is 1 foot or 30.48 centimetres, that the active surface on each side of the disc is 2,500 square centimetres, and that the speed of rotation is 2,400 revolutions per minute, or 40 revolutions per second, then the E. M. F. obtainable from the machine will be:

$$\frac{2{,}500 \times 40 \times 12{,}000}{100{,}000{,}000} = 12.0 \text{ volts.}$$

In order to produce an E. M. F. of say 140 volts, such as would be required for continuous-current central-station generators, it would be necessary to connect a number of such machines in series, to increase the diameter of the disc, or to increase its speed of rotation. It would, probably, be unsafe to run the disc at a peripheral speed exceeding 200 miles per hour, owing to the dangerously powerful mechanical stresses that would be developed in it by centrifugal force. This important mechanical consideration imposes a limit of speed of rotation and diameter of the disc, taken conjointly. By increasing, however, the active surface of the disc, and, at the same time, working at a safe peripheral velocity, it would be possible to construct large disc generators of this type for an E. M. F. of 100 or 150 volts.

260. It should be borne in mind that although such machines would be capable of producing continuous currents without the use of a commutator, yet the necessity of maintaining efficient rubbing contacts on the periphery of the rapidly-revolving disc, introduces a difficulty and waste of power which has, hitherto, prevented the development of this system, and probably accounts for the fact that large machines of this type do not exist.

261. Irregularities in the distribution of magnetic flux over the surface of the disc may give rise to strong eddy currents and waste of power in the same. If the flux be variable along any radius of the disc $O B$, as represented in Fig. 182, so that the intensity $\mathcal{B}$, is not uniform along these lines, this irregularity will not produce eddy currents in the disc unless the distribution is different along different radii. In other words, if the distribution of magnetic flux and intensity are symmetrical about the axis of rotation of the disc, the irregularities which exist will only alter the intensity of E. M. F. in different elements of a radius. In Fig. 182 the intensity, instead of being uniform from centre to edge, as indicated by the straight line d, a, c, toward the edge, following the line o, a, b. The formula for determining the E. M. F. of the disc is in such case rendered somewhat more complex.

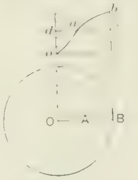


Fig. 182. — Diagram Showing Flux Density Through Disc Along a Radius.

262. If, however, the curve C, D, of flux intensity along different radii is different, so that the distribution of magnetic intensity is not symmetrical about the axis of rotation, then eddy currents will tend to form, the amount of power so wasted depending upon the amount of irregularities, the resistivity of the material in the disc, and the load on the machine.

263. Fig. 183 represents the outlines of a particular form of the second, or cylindrical type of commutatorless continuous-current generator. Here a metallic conducting cylinder *cccc*, revolves concentrically upon the shaft *SS*, through the uniform magnetic flux, produced by the field frame surrounding it. Here, however, two sets of brushes bb, $b'b'$, have to be applied to the edges of the cylinder in order to supply the main terminals A and B. The terminals of the four circular coils constituting the field winding are shown at f, f'.

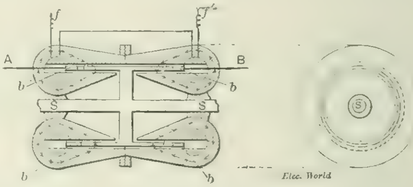


Fig. 183.—Cylinder Type of Commutatorless Direct-Current Generator.

264. If the magnetic intensity produced by the field is uniform the E. M. F. will be generated in lines along the surface of the cylinder parallel to its axis, as represented in Fig. 184. If v, be the peripheral velocity of the cylinder in centimetres per second, l, the length of the cylinder in centimetres, and the uniform intensity, the E. M. F. generated by the machine will be:

$$e = \frac{v\, l\, \mathcal{B}}{100{,}000{,}000} \text{ volts.}$$

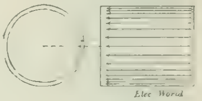


Fig. 184. — Indicating Direction of E. M. F. Induced in Revolving Cylinder.

Machines of the cylindrical type have been constructed and used for electrolytic apparatus, and give very powerful currents, as compared with ordinary generators of the same dimensions employing commutators. Unsatisfactory as these unipolar machines have so far proved, except in special cases, they are, nevertheless, the only dynamos which have yet been successfully constructed for furnishing continuous currents without the use of a commutator.

(To be continued.)

Laboratory of Houston and Kennelly, Philadelphia.

New Use of Old Insulators.

The Belgian telephone and telegraph department announces that it desires to sell a lot of old insulators, and by way of a suggestion to purchasers it states that they may be used to advantage for making borders in parks and gardens!

Rope Driving.—XX.

BY J. J. FLATHER.

Guide pulleys or idlers should be made with a semi-circular groove so that the rope runs upon the bottom instead of being wedged between the sides as in grip pulleys. Some engineers maintain that the wedge groove should be used in all cases, and many plants are in operation having V-shaped grooves in the idlers, but we believe the most satisfactory results will be obtained by using a groove in which the rope runs on the bottom. Of these there are two general forms—the one in which the rope has considerable play in the groove, and the other of such form that the rope is embraced by a portion of the surface of the groove. The first is used more particularly for single ropes, while the latter is adapted to any number of wraps.

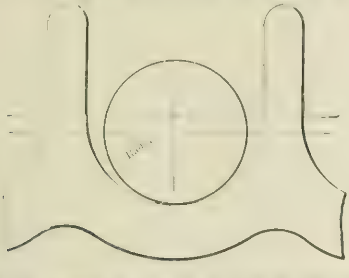


FIG. 57.—FORM OF GROOVE FOR GUIDE PULLEYS.

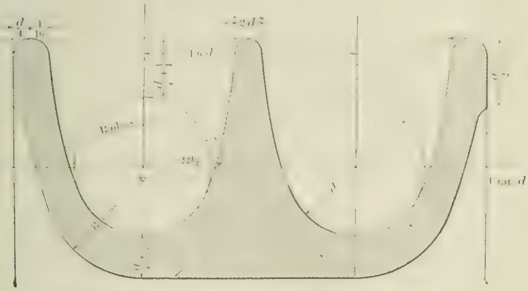


FIG. 58. FORM OF GROOVE FOR GUIDE PULLEYS

A modification of the first form is frequently used for a number of ropes, as shown in Fig. 57.

The proportions shown in Fig. 58 will be found very satisfactory for single or multiple groove guide pulleys, in which the pitch is equal to that used with the grip pulleys represented in Fig. 56. The general design conforms closely to the latter, but the pulley is somewhat lighter.

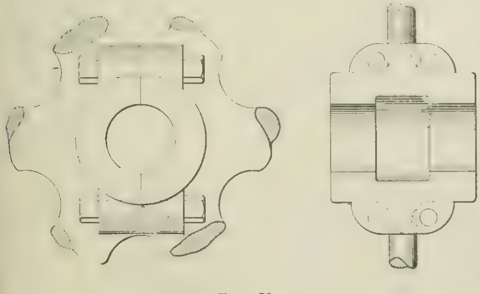


FIG. 59.

For shaft pulleys and the smaller sizes of fly-wheels not exceeding about 9 feet in diameter, the casting is usually made in one piece unless a "split" pulley is required. In order to relieve the wheel in cooling, the arms were formerly given a curved, or S shape, as this form yields more readily and is supposed to conform to the unequal contraction of the rim and hub of the pulley in cooling.

With properly proportioned wheels, however, and with due care in the foundry, straight-armed pulleys may be cast as readily as those of curved outline, and as the former are lighter, neater, and cheaper than the latter, they are now almost universally employed.

In the larger single casting pulleys the hubs are frequently split in order to favor the arms in cooling; when split by a diametral plane, the two portions at the hub are generally secured by bolts and nuts, as in Fig. 59, or less frequently by pins and cotters; when split in three, wrought iron or steel rings are shrunk into the ends of the hub which is turned to receive them, as represented in Fig. 60.

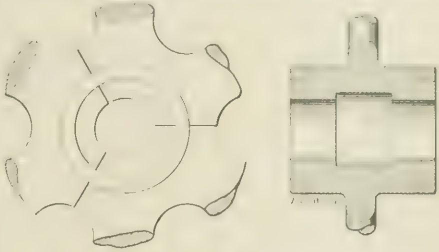


FIG. 60.

Occasionally rings are shrunk on and bolts used as well, but this precaution is not common practice.

There is no general rule by which the number of arms may be determined. For small rope pulleys the number is usually six, while for the larger sizes, six or eight arms are used for pulleys cast in one or two parts, but these in some cases have two sets of arms, as shown in Fig. 61, which represents a 78-inch pulley made by The Robert Poole & Son Company, for the Providence Cable Tramway Company.

The usual run of wheels from 9 feet to 15 feet in diameter are cast in halves, six or eight arms being employed.

Occasionally, however, narrow rope fly-wheels, of diameter up to 18 feet, are made in two pieces only, with eight arms. Moderate-sized wheels are frequently cast in one, but arranged so as to be readily split in two afterward.

Pulleys cast in halves having light rims should have double arms along the line of separation, as shown in Fig. 62, which represents a form of split pulley made by Fairbanks, Morse & Co. This prevents undue bending action, and is otherwise the better able to resist the effect of centrifugal force due to the added weight at the point of connection.

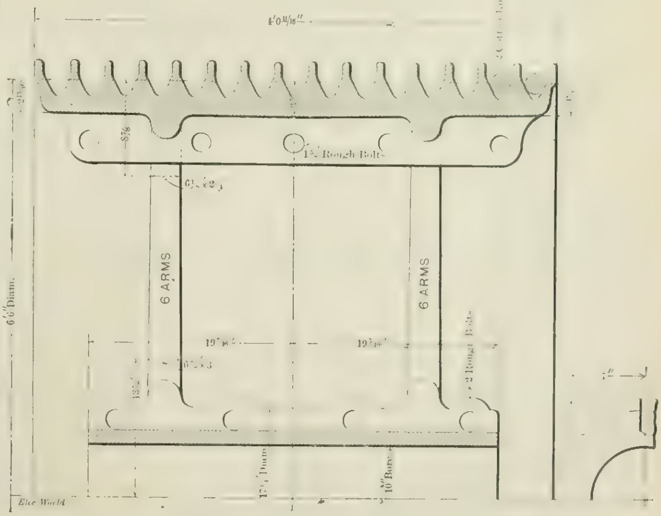


FIG 61.—78-INCH ROPE PULLEY WITH TWO SETS OF ARMS.

For diameters ranging from 15 feet to 20 feet the usual practice is to make the pulley in six or eight segments with as many arms, although some makers prefer ten segments; from 20 to 26 feet ten segments are usually adopted. For wheels from about 26 to 32 feet, 12 segments and as many arms are generally used, while larger-sized wheels are built up of 14, 16 and even more segments—sometimes as many as 24 being employed.*

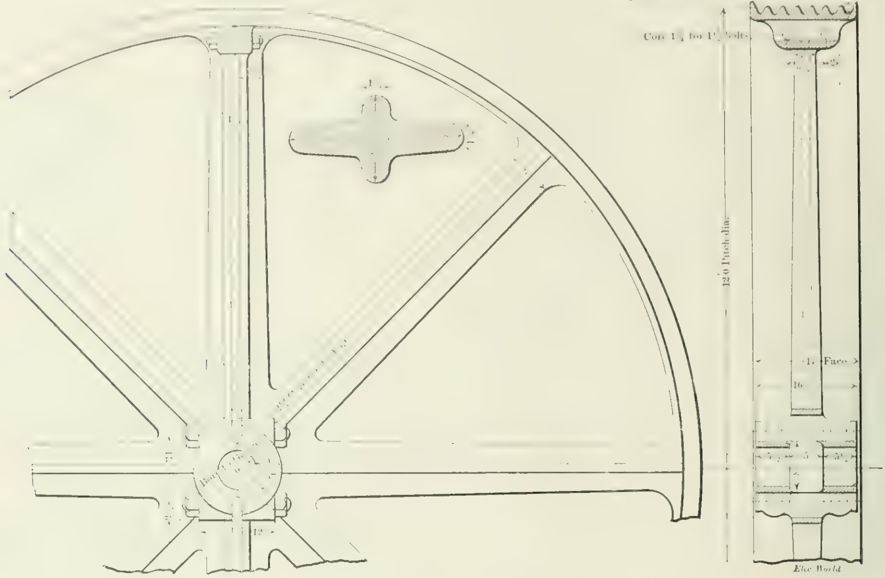


FIG. 62.—12-FOOT SPLIT PULLEY WITH DOUBLE ARM AT JOINT.

When rope pulleys are made in halves or are built up it is important that the connecting bolts and flanges in the rim should be strong enough to resist the maximum stresses that may occur in the joint.

Ordinarily in rope pulleys the net section of bolt area is about 12 per cent. of the section at the joint, but this ranges from 25 per cent. to about 6 per cent. in different cases. Various shop rules are used by designers for obtaining the bolt section, many of which give the bolt area directly in terms of the cross-section of the rim. While such formulas may give satisfactory results for an assumed average rim speed, it is better to design the joint in large wheels from a consideration of the particular conditions in each case.

In very slow-moving, heavy wheels the principal stress may be that due to the weight of the wheel itself, but in rope pulleys and fly-wheels the rim has usually a high velocity and the strain due to centrifugal force in the rim is the principal factor in determining the bolt section; it is obvious, however, that in high-speed heavy wheels both influences should be taken into consideration.

The tension in the rim produced by centrifugal force is equal to one half the centrifugal force due to the weight and velocity of the rim multiplied by the ratio of diameter to semi-circumference or equal to

$$\frac{F_0}{2} \times \frac{2r}{\pi r} = \frac{F_0}{\pi};$$

as this force is resisted at each end of a diameter, the strain T_h, or hoop tension acting at either end, will be one half the above, hence

$$T_h = \frac{1}{2}\,\frac{F_0}{\pi}$$

in which F_0 has the usual value $0.00034\,W R N^2$,

where W = entire weight of rim,
R = effective radius of rim in feet.
N = revolutions of wheel per minute.

The tension at each end of a diameter due to the weight of the rim is evidently equal to $\frac{1}{2}\left(\frac{W}{2}\right)$ therefore the stress in the rim due to F_0 and W will be:

$$S = \tfrac{1}{2}\left(\frac{F_0}{\pi}\right) + \tfrac{1}{2}\left(\frac{W}{2}\right) = \tfrac{1}{2}\left(\frac{F_0}{\pi} + \frac{W}{2}\right).$$

If the bolts could be placed at the point of application of this force, their effective section A would be $\frac{S}{f}$, where f is the allowable stress in the bolts.

(To be continued.)

Maxwell and Joubert.

To the Editor of The Electrical World:

SIR:—The letter of Dr. Pupin in THE ELECTRICAL WORLD of May 11, in which he criticises the passage in the biography of Prof. Joubert where I attribute to the latter the discovery of the law of alternating currents, seems to me to be due to a misapprehension and one easy to dissipate.

Every one knows, of course, that the study of induced currents had been theoretically made long ago by Maxwell, whom, besides, I cited. Kohlrausch had invented his sine-inductor as early, I believe, as 1869, and a search through the memoirs of Weber would probably bring to light still earlier references. But I do not think that the merit of Prof. Joubert is thereby diminished, which merit consists (as I have said in a phrase which Dr. Pupin probably did not read), in having *discovered this law experimentally* at a period when no one thought of applying it to practical industrial currents. It is a fact which, I believe, Dr. Pupin does not contest, that in 1881, no one, even in America, knew what formulas applied to alternators, and that after the work of Prof. Joubert everything relating to this became very clear; this is what to me seems to constitute a discovery. Perhaps it would not be considered as such in the Patent Office, but from this standpoint the polyphased motor of Bailey might be a sufficient anticipation to invoke against Ferraris or Tesla in order to declare their work without value. If Dr. Pupin accepts this consequence of his method of appreciating discoveries, I can only bow to his opinion. But, in the contrary case, I believe I can claim, without "bolstering up" the glory of Prof. Joubert, that the law of alternating currents was sufficiently invented or re-invented by him to justify giving his name to it, and this without lacking a jot in the great respect inspired in all of us by the name of Maxwell.

A. BLONDEL.

PARIS, FRANCE.

The Efficiency of the Sun's Radiations.

According to Prof. Langley's researches on Mt. Whitney the amount of energy received on the surface of the earth from the sun when it is overhead is 1.6 kilowatt per square meter; the portion of this which represents light is only 35 per cent., that is, 0.56 kilowatt.

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* *American Machinist*, Feb. 16, 1895.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

BY CARL HERING.

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors, or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 927 Chestnut Street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English French, or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Calculation and Construction of Dynamos.—In a continuation of Mr. Picou's article in "L'Eclairage Elec.," May 11, he discusses commutators, brushes, sparking and field magnets; it appears to be somewhat elementary in character.

Brush for Low Voltage Machines.—The "Elec. Eng.," May 29, describes and illustrates Prof. Elihu Thomson's brush which is made of a number of small rods of carbon, plated with a thin film of copper, assembled in the form required and then united by soldering them together; the copper is so thin that the moment it touches the commutator the current through it disintegrates it at once, thus eating away the metal for a short distance as rapidly as the carbon wears away; the conductivity of the brush may be varied to suit the current to be taken, by increasing the thickness of the copper deposit.

Practical Hints in Dynamo Design.—The "West. Elec.," June 1, reprints from the "Bul. Univ. of Wisconsin" for May, 1894, a lecture by Mr. Wilkes; it is practical in its nature and is limited to continuous-current machines for general purposes.

Rotary Current and Alternating Dynamos.—A paper of Mr. Dobrowolsky, abstracted in the Digest, March 9 (see also April 20), is reprinted from the Lond. "Elec.," May 17, with illustrations in the "Elec. Eng.," June 5.

LIGHTS AND LIGHTING.

Train Lighting.—In the continuation of Mr. Weeks' article in the Lond. "Elec. Eng., May 24, he gives a short historical summary and begins the detailed description of the system used in England; in the present number he gives a well-illustrated description of the one used on the London, Brighton & South Coast Railway in which the dynamo is placed on the baggage car and the accumulators are either distributed on the whole train or all together in the baggage car; the dynamo is driven by means of a belt over the axle of the car; an automatic switch connects or disconnects the dynamo at the proper speeds; the E. P. S. accumulators are used and are said to last about 2¾ years but must be dismantled every 16 months and thoroughly cleaned; the E. M. F. of the dynamo rises very little with increase of speed, and no regulator is used in the exciting circuit, the dynamo being an open-coil Brush machine having a great armature reaction. The costs are given as follows: each train costs about $2,000 to equip and the working costs for maintenance and renewals for a year are $270 per train; there are now in use 36 trains of 10 and 12 coaches each and 4 main line fast trains, making a total of 410 coaches; experience has shown that these trains are more serviceable than gas lighted trains, being always ready to run and to run continuously; it is estimated that the company gets about 15 per cent. more work out of them than from gas lighted trains, thus 85 electrically lighted trains would do the work of 100 gas lighted trains.

The following data from a report of Mr. Staberow concerning the system used on the line from Dortmund, is published in the "Elek. Zeit.," May 23. The plant was installed a year ago; Tudor accumulators are used; seven cars are equipped with a total of 85 lamps; the results were satisfactory from both an engineering and a commercial standpoint; the total cost of the whole installation and equipment was about $9,000; the cost of operation per 10-cp lamp-hour was 0.68 cts. or with the addition of 4 per cent. for interest and 3 per cent. for amortization it was 1.58 cts.; with a larger installation the cost would be lower; on the Jura-Simplon railway it was only 1.03 and on the Danish railway 1.54 cts.

Employment of Electric Light on Railway Purposes.—The recent Institution paper of Mr. Langdon is published in full, with the illustration and discussion, in the "Jour. Inst. Elec. Eng." for May.

Products of Combustion of the Arc.—An abstract of the article of Mr. Grehant describing the apparatus and tests (see Digest, May 25), is given in the Lond. "Elec. Eng.," May 24.

Non-Magnetic Arc Lamp.—In the "West. Elec.," June 1, Mr. Irish describes a lamp which is governed by a thermo wire and has a screw feed.

POWER AND HEAT.

Hydro-Electric System.—According to the Lond. "Elec.," May 24, the company operating the Van Rysselberghe combined hydraulic and electric system in Antwerp, has issued its first report from which it appears that the system has not been as successful as was anticipated; there is a deficit of about $9,000; the management admits that the system cannot compete with other electrical systems. This system, in which the power is transmitted hydraulically and converted into electric energy at the local stations, was described in the Digest, Oct. 7, 1893; Feb. 24, and April 14, 1894.

Portable Electric Drill.—An illustrated description of the Kodolitsch drill is given in the Lond. "Engineering," May 24.

Regulation of Turbines.—In reply to the recent statement of Mr. Egger (see Digest, May 18), that a mechanical regulation of a turbine is an impossibility, Mr. Voith, in the "Elek. Zeit.," May 23, states that he has installed several such regulators which are very satisfactory; he describes one of these installations.

Possibilities of Electrical Pumping Machinery.—In a recent paper by Mr. Hague, abstracted in "Eng. News," May 30, he shows the advantages and economy of utilizing electrically driven pumps for supplying water to portions of a city where a high-pressure service is required over a limited area and for a comparatively small percentage of the total water supply of the city; as an illustration for a large city, he shows that about 500 hp would be required if the whole city were supplied with a high-pressure system, while if the divided system were used, one tenth of the supply being required for the high-pressure district, the economy of power would be 210 hp. The main pumping plant would be used to generate the current and the electric pump would be placed locally where the high pressure is required; power could also be obtained from existing street railway or lighting plants; the current might readily be switched on and off automatically.

Electric Motors in Sugar Refineries.—The "West. Elec.," June 1, abstracts briefly from a German journal an article by Mr. Kohler showing the economy in the introduction of electric motors in a sugar refinery; an elevator formerly run by steam required 32.5 hp-hours per day while run by electric motors it required but 17.6.

Slavianoff Welding System.—The "West. Elec.," June 8, publishes a number of illustrations of repairs of large pieces of machinery made by this system; among them is a large bell, a shaft, some large wheels and a large roller for a rolling mill; the system was described in the Digest, April 6.

Electric Heater.—A novel form of heater devised by Mr. Reed is described and illustrated in the "Elec. Eng.," June 5; it consists of a glass or porcelain tube on the interior of which is a thin film of silver deposited in the same way as in the silvering of mirrors; on account of its extreme thinness its resistance is high; the conductor is thoroughly protected, is not exposed to the air and has a very large heating surface.

TRACTION.

Side Trolley Wire System.—In a communication in the Lond. "Elec. Eng.," May 24, Mr. Owen gives briefly some of the advantages of the system used in South Staffordshire in which the trolley wire is over the side of the street.

Car Wire and Equipment.—In Mr. Dawson's serial in Lond. "Engineering," May 24, he describes and gives good illustrations of the car wiring and equipment.

Electricity for Marine Propulsion.—"Cassier's Mag." for June, contains an interesting article by Prof. Durand in which he compares, in detail, electricity with steam for marine propulsion, with reference to the weight, volume and cost. In considering electrical propulsion he assumed that it would take 100 pounds of accumulators to generate

1 hp or 128 pounds for 1 hp at the shaft; this occupies one cubic foot of space; he finds that for equal amounts of energy embodied, storage batteries weigh about 550 times as much as coal and occupy about 220 times as much space; for equal amounts of work on the shaft, batteries weigh about 40 times as much as coal and occupy about 16 times as much space; for the same power developed electric motors weigh considerably less than steam engines while the space occupied is so small that it is practically negligible when compared with boilers, engines and auxiliaries; for equal amounts of energy embodied the cost of charging batteries is about 100 times the cost of coal; for equal amounts of work on the shaft the cost of charging the batteries is about seven times that of coal; for equal amounts of work on the shaft, electric propulsion would require an initial consumption of twice as much coal as with steam propulsion; for equal power on the shaft electric motors will cost nearly as much as the total steam machinery (?); he discusses the elements of weight algebraically and shows the limitations; the most favorable comparison for electrical machinery he shows to be on a basis of about 8 hours service and in such cases the electrical machinery would weigh about 5 times as much as the equivalent steam machinery and coal; in first cost electrical machinery will be much more expensive. In conclusion he points out the well-known advantages of electrical propulsion which under certain circumstances far outweigh its disadvantages; electrical propulsion cannot compete with steam for either high speed or long runs; for a transatlantic steamship of 15,000 tons displacement, 20,000 shaft-hp and 7 days supply, the weight for the steam machinery would be about 4,400 tons and for electric machinery 150,000 tons or about 10 times the total displacement of the vessel.

Electric Launch.—An illustrated description of the Hickley double-screw launch is published in the "Elec. Eng.," June 5.

Interurban Electric Railway.—The "Elec. Eng.," May 29, reprints in abstract a recent paper by Prof. Short read at the Cleveland Electric Club; he discusses the various points developed in this new branch of travel from the standpoint of a practical engineer; several tables are reproduced, of the performance of 50 and 100-hp motors; the advantages of continuous-current rotary transformers are discussed and a good illustration of a Walker interurban train is given.

Method of Locating Faults in Electric Railways.—Mr. Henry's system is briefly described in the "Elec. Eng.," June 5; a supplemental overhead, insulated, return conductor, run along the tops of the poles is divided into sections each of which is connected to the track and so arranged that an ammeter may be inserted between the sections or in the connection to the track, in order to measure the current in that wire; it has a comparatively high resistance but on the occurrence of a fault in the track an increased current will pass through this supplemental wire around the fault; the readings of a portable ammeter conveniently arranged for insertion in this circuit will then locate the fault.

Limit of Passenger Capacity of a Suburban Track.—A discussion by Mr. Von Emperger is reprinted in the "Elec. Rev.," June 5, from the "Railroad Gazette." He shows that the highest permissible capacity of the whole proposed rapid transit road in New York City below Fourteenth Street, consisting of two tracks, would be 28,000 passengers of which 10,000 would have no seats; as the Rapid Transit Commission claim that 60,000 can be carried an hour by one track, its claim should not go unchallenged.

Electric Car Heating.—The "Eng. Mag." for June states that according to the "R. R. Gaz.," March 22, steam heating costs per car-hour 3.75 cts. with coal at $4.50 per ton, while heating by electricity costs 10.7 cts. or a little more than three times as much; the estimate is said to have been made with perfect fairness to electrical heating and all details are said to have been carefully considered.

Legislation on Steam and Electric Roads.—An abstract of a paper by Mr. Woodruff, read at the Washington convention of railroad commissioners, is published in the "Elec Eng.," May 29.

Boston Subway.—A long, well-illustrated description referring almost entirely to the civil engineering features, is published in the "Eng. News," May 30.

Street Railway Mail Car.—A brief, illustrated description of the one used in Chicago, is published in the "West. Elec.," June 1.

Columbus.—The water power plant for the Columbus, Ga., electric railway is briefly described and illustrated in the "Elec. Eng.," May 29.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Accumulators in Central Stations.—A recent paper by Mr. Howell on "Uses of Accumulators" is reprinted in full with the exception of the illustrations, in the Lond. "Elec. Eng.," May 24, and is begun in the Lond. "Elec. Rev."; he limits himself to showing the advantages of using accumulators in central stations; the first portion gives a history of the use of accumulators. He gives a table of the efficiencies of a steam-driven dynamo at various loads, showing that the quantity of water evaporated per unit when the engine is working at 20 per cent. of its full load is more than twice as much as when it is fully loaded; in another table he gives the results of some tests of Prof. Kennedy showing the coal consumption at various loads and among other things showing that there was less coal burned during the period of lighter load and that 63 per cent. of the total amount of fuel consumed was used to provide 33 per cent. of the output; from this it is seen that if there had been a means of storage which would have allowed the engines to run at a fair rate of economy there would have been a saving of coal. To show the advantages in the use of accumulators he takes as an illustration a large American station having a maximum output of 18,800 amperes which is at present running without accumulators, and points, out what the gain would be if accumulators were added (in this connection he refers to diagrams and curves which are not given but which will probably be published in the next number of the "Elec. Rev."); from the minimum demand and the time during which it lasts he determines the capacity of the accumulators which he finds must be 14,000 ampere-hours; the accumulators will cost $35,000 delivered and erected; whenever an engine is started it can then be run at full load from the minute it starts to the moment it ceases running, thus bringing the efficiency of the station to 100 per cent. engine load factor; the hours of running will be shortened from 24 to 18; three large sets would be started with full load at 7 a.m. and run steadily throughout the day; the peak of the load line would be supplied by the battery. He states that the regulation of the charging current is an exceedingly simple matter; one of the steam dynamos would be expressly made to give just the current rate necessary for properly charging the battery and no more; the loss in the accumulators is very slight as it is felt only by one unit of the plant, and on the load diagram under discussion it would be only 1 per cent. of the total load delivered to the circuit, the accumulators supplying about 8 per cent. of the total output. He then shows what has been gained by the introduction of accumulators; the station work will be immensely simplified; the labor bill will be considerably reduced; he gives the latter in detail showing a saving of almost $9 per day; the coal will be reduced from 80 to 67 tons per day and the bill for oil and petty stores in about the same proportion; three engines that are required now can then be abandoned altogether; the total saving is $75 per day; against this there is $10 a day for depreciation of accumulators and $5 for interest, thus reducing the net saving to $60 per day, which is sufficient to cancel the cost of the accumulators in two years; he has taken for this illustration a very large station showing that the statement that the use of accumulators is limited to small stations, is incorrect; the economy is sufficiently marked at any value of coal, to warrant the adoption of accumulators; he concludes that wherever there exists an intermittent demand for a supply of electricity a storage system is a necessity unless the cost of initial power is abnormally low, which sometimes occurs when there is an abundant supply of water power; to obtain the utmost economy, accumulators are absolutely necessary; he also believes that they will surely be used in the near future in mining work, the batteries being installed in the mines.

Electric Lighting in Small Towns.—In its leading editorial the Lond. "Elec. Rev.," May 24, suggests a plan for supplying small towns and villages with light and power, which it believes can be carried out successfully. In such towns central stations will never succeed as long as each is a distinct concern, and it therefore suggests that the owners of the installation in a large central town install independent plants in the smaller towns in the neighborhood, which plants are controlled by them from the large town as centre; two or more units would be installed in each town and one or more banks of accumulators for supplying the day load; one man and a boy would be sufficient to take charge of each station and the engineer of the central town station would have control of all the small plants; a portion of the officers' salaries and other incidental expenses would be charged to each of the small stations, thus relieving them of the heavy management expenses. It gives the operating expenses of a small plant showing a revenue of 7.5 per cent. on the capital outlay; continuous current is used in connection with storage batteries; regarding the use of alternating currents for this purpose it believes that the risks to which the town would be exposed, due to some failure of the lines, would be too great.

Variations of Electric Pressure in London.—The Lond. "Elec.," May 24. published a set of diagrams prepared by Mr. Swinton, giving the voltage during the period of one whole day, of each of the stations in London; the records were made with a Holden form of hot-wire recording voltmeter which is exceedingly sensitive and very dead beat; the records were taken at the consumers' end of the system. In many cases the variation from the correct voltage is considerable; as far as the fluctuations from the average are concerned, there is not much to choose between the alternating and the continuous current systems; in the latter there is a tendency for the average volts to be below the correct value, while with the former it is the other way, the average being very considerably higher than it should be; where the supply is from accumulators during some portions of the day it is well indicated by the smoothness of the curve.

Electric Heating and the Day Load.—Mr. Jenkinson, in a correspondence to the Lond. "Elec. Rev.," May 24, calls attention to the use of separate meters, if the day load is to be charged for at a different rate, and states that Mr. Wright's system at Brighton avoids this, the current all passing through one meter, the reduction to six cts. per unit for all purposes taking place after the maximum current has passed for one hour per day; he believes this to be as nearly perfect a system as any that he has seen.

Association for Controlling Electric Installations.—The Lond. "Elec.," May 24, published a translation of the objects, rules and regulations of the "Bureau de Controle des Installations Electriques." This association, which was started in Paris about two years ago by the electric supply companies, is free from any commercial connections and has for its object the inspection of electric lighting installations, and the testing of meters belonging to companies and private concerns, and provides to its customers all the desired information concerning the safe operation of their installations. Of the 101 installations inspected during the first year 62 were reported as being defective and of the 168 inspected in the second year 148 were defective; about one third of the meters tested were defective. The organization of such a society in England is discussed editorially; a description of the method used for testing the meters and the insulation of installations, is promised in a future article.

Rules and Regulations for Installations.—The "Elek. Zeit.," May 23, publishes in full the proposed set of rules for installations in Germany, which were prepared by a joint commission of the Union of German Electricians and the German Electrical Society; a brief abstract giving some of the most important points is published in the Lond. "Elec.," May 24. (As these rules are to be acted upon at the annual meeting of one of the societies in July, our abstract will be postponed until after they have been finally adopted.)

Budapest.—The long report on this station by Prof. Kittler is concluded in the "Elek. Zeit.," May 23; it gives in detail the results of a very elaborate test.

Hong-Kong.—An illustrated description of this alternating-current station, which has been running for over five years, is published in the Lond. "Elec. Eng.," May 24.

Polycyclic System.—A brief description of this system devised by Mr. Steinmetz, is published in the "Elec. Eng.," May 29; it is specially designed to avoid unbalancing of the system when motors and lights are both supplied from the same circuits; the lights are all on one of the three branches and the energy is transferred "between this branch and the other branches through one of the motor coils"; the motors receive power currents of two phases between the other branches of the system; there will be "substantially a balance between the counter E. M. F. generated in the circuit of the motor coil (which corresponds to the branch containing the lights) and the impressed E. M. F. in the lighting circuit. Whenever this relation becomes distributed, as for example by changing the lamp load and so changing the voltage in the lighting circuit, the balance is restored by current flowing through that coil of the motor and which may help out either the lamps or motors as conditions require."

Power, Light and Heat in City Blocks.—In a short article by Mr. Talbot, in the "Eng. Mag." for June, he points out the advantages and economy of supplying power, light and heat to a city block or "square" from a small central station erected in one of the large buildings; as such a building would probably install a plant of its own it would require only an enlargement of it to supply the whole block.

Central Station Practice.—A lecture by Mr. Greene on "Some Suggestions on Central Station Practice with Special Reference to Developments During the Past Year" is published in "Sibley Jour." for May; he discusses first the original investments and secondly the operating expenses of the plant.

Methods of Storage Battery Installation.—The "Elec. Eng.," June 5, reprints from a new catalogue of the Electric Storage Battery Company (makers of "chloride" accumulators) several diagrams showing various methods of connecting batteries with the necessary apparatus to form a complete plant.

Pennock Electric System.—The article of Mr. Swann, abstracted in the Digest, June 8, is reprinted in "El'ty," June 5.

Belfast.—Some of the illustrations of the article published in The Electrical World, May 18, of this gas engine and accumulator station are reprinted in the "West. Elec.," June 1.

Private Plants.—The Siemens & Halske plant in the Boston new public library is described and illustrated in the "Elec. Eng.," June 5.

ELECTRO-PHYSICS AND MAGNETISM.

Conductivity.—An article by Prof. Strecker from the "Wied. Ann.," 1895, p. 434, is abstracted briefly in the "Zeit. f. Electrochem.," May 20. He finds a contradiction in the modern views concerning conductivity; in a metallic conductor it is said to be the property to receive electric energy from the ether and convert it into molecular energy; in electrolytes, on the other hand, electricity is said to be something which is connected with the smallest particles of matter and travels through the liquid by being transferred from particle to particle; he thinks that the same explanation should apply to both cases and he, therefore, suggests that the first one, regarding metallic conductivity, be applied also to electrolytic conductivity and that it is the ions and not the molecules which should be considered; by the movement of the ions caused by the current there is an action between the ion particles and the ether at the moment when the energy passes from one to the other.

Influence of Electric Waves on the [illegible] Conductors.—A paper by Mr. Aschkinass from the German is abstracted in "L'Eclairage Elec.," May 11; he found that the resistance diminished notably by the action of electric waves and that the diminution lasted for several days without sensible variation, its maximum value being about 2 per cent., which was reached after the passage of the first spark; on heating, the resistance again rises to its original value.

Atmospheric Electricity.—The Lond. "Elec.," May 24, begins a reprint of an interesting lecture by Prof. Schuster and comments on it in the leading editorial.

Alternating and Interrupted Currents.—The first part of the third lecture of Prof. Forbes, is published in the Lond. "Elec. Eng.," May 24. He discusses skin resistance, resonance and oscillations.

Electric Dispersion.—An article by Mr. Drude from the "Wied. Ann." for February is abstracted in "L'Eclairage Elec.," May 11.

Magnetism and Weather.—The Lond. "Elec. Rev.," May 24, calls attention to a paper by Mr. Hasen in "Science," Vol. 1, No. 9, in which he states that after 13 years of study he is satisfied that the pressure of the air, or perhaps the fluctuation of the dew point, are by far the best means to use in determining a possible connection between magnetism and the weather; such a relation if it exists would be found to be only an indirect one; a connection has certainly been found with auroras, and facts warrant the assumption that the diurnal range of air pressure is a thermo-electric phenomenon allied to the diurnal range in the swings of a magnetic needle; but up to date very little positive knowledge exists.

Magnetic Shielding.—The Lond. "Elec. Rev.," May 24, calls attention to a paper by Mr. Ascoli in the "Wied. Ann.," 54, p. 381, in which he objects to the idea of screening, arguing that the effects are more properly explained as being the result of the different specific resistances; he considers that it is a misuse of terms to speak of a sheet as screening a medium having a permeability similar to its own. The editorial expresses the belief that the subject has not yet been fully investigated.

Electric Discharges.—The Lond. "Elec. Rev.," May 24, begins the publication of an abstract of a recent Royal Society lecture by Lord Armstrong and reproduces some very interesting and exceptionally fine photographs and dust figures produced by the action of very powerful electric discharges; those interested will do well to study these figures. Most of the effects were obtained by the use of a large multiple Wimshurst machine capable of giving a 17.5-inch spark; the photographs were obtained by the well-known method of causing the discharge to pass over the surface of a photographic plate; the dust figures were produced by discharging on glass or metal plates over which had been sifted various more or less non-conductive powders such as calcined magnesia mixed with lampblack, or tripoli powder and pulverized carbon; many of the results are said to be quite inexplicable and, therefore, of great interest to the electrical theorist. The well-known experiment of Lord Armstrong with a thread of cotton connecting two glasses of water (see Digest, March 18, 1893), is also described.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolysis of Hydrochloric Acid without a Diaphragm.—In a short article by Dr. Oettel in the "Zeit. f. Electrochem.," May 20, he shows that the efficiency in the production of chlorine is very low but that if one uses a concentrated solution of salt mixed with sulphuric acid there is less tendency for the chlorine to dissolve and the efficiency in the yield of chlorine would therefore be higher; even with as low a density as 240 amperes per square metre the efficiency will be 70 per cent. and with 600 to 700 it will be 92 to 98 per cent.; if there is too much sulphuric acid there will be a tendency to produce oxygen with the chlorine, and if there is an excess of salt the evolution of gas on the anode will cease almost completely; the output, voltage and efficiency are given in the form of curves.

Conductivities of Solutions of Salts in Acetone.—The "Zeit f. Electrochem." May 20, contains a short article by Mr. Von Laszczynski in which he gives the results of conductivity determinations of a number of salts; the conductivities are much worse than those of the solutions in water; he also gives the results of the electrolysis of these solutions.

Tests of Electrolytic Copper Tubes.—Results of some tests of Prof. Unwin, with copper tubes made by the Elmore process, are published in Lond. "Engineering," May 24; they show that the material possesses a high ratio of elastic limit to ultimate strength.

Electrometallurgy of Gold.—According to the Lond. "Elec. Rev.," May 24, Mr. Goyder in investigating the action of potassium cyanide, noticed that the presence of oxygen is required to effect the solution of gold, that such solutions deposit their metallic contents when electrolyzed while the potassium cyanide gradually undergoes decomposition into potassium and ammonium carbonates and that if the current is broken the gold redissolves. Attention is also called to a new method proposed by Mr. Lossen described in the "Ber. Deutsch. Chem. Gesell.," 27, p. 2726, (abstracted in Digest, May 4); he electrolyzes a solution of potassium bromide and obtains an alkaline solution which contains hypobromite and bromate which is capable of dissolving gold; the ore is treated with an excess of this solution in rotating cylinders, after filtration the gold is precipitated by iron and coal and the solution is then electrolyzed and used over again.

[illegible]—The recent Institution paper of Dr. Keith is published in full with illustration and discussion in the "Jour. Inst. Elec. Eng." for May.

Electrometallurgy of Zinc.—A brief description of a plant in Germany is published in the Lond. "Elec.," May 24. Pyrites containing a large proportion of zinc are first used for the production of sulphuric acid, the residue is then lixiviated, roasted with salt to obtain the purple iron ore and the residue of this after being again lixiviated is electrolyzed, yielding zinc from the lye; the zinc is said to be much purer than the best hitherto obtainable and commands a high price; the works have been in operation only a few months and at present yield three tons of zinc a day; when completed they will yield 12 tons per day; no further information regarding the process is given.

Primary Batteries.—Descriptions of several forms, taken from patent specifications, are given in the "Zeit. f. Electrochem.," May 20; among others, is a small primary battery placed in the end of a cane, and sufficient for lighting a small lamp: it is said to yield three amperes at 12 volts (for how long is not stated).

Secondary Batteries.—"L'Eclairage Elec.," May 11, contains an article by Mr. Poincaré on "A Class of Secondary Cells"; it appears to be practically the same article, a translation of which was abstracted in the Digest, April 27.

Accumulator Patent.—According to the Lond. "Elec.," May 24, the Swan British patent No. 2,272, May 24, 1881, legally expired in England May 24, 1895.

Maximum Possible Efficiencies of Galvanic Batteries.—"Cassier's Mag." for June contains a short article by Dr. Morton, in which he shows the theoretical maximum output or the minimum consumption of zinc, of different kinds of batteries, limiting himself to those which long experience has proved to be the most efficient for supplying large currents. In all these the energy is derived from the combination of zinc with sulphuric acid; the oxidation of one pound of zinc generates 2,340 British thermal units (lb. Fah. heat units) and the solution of the oxide in dilute sulphuric acid generates 666 more or in all 3,006 units; no arrangement of parts or employment of other materials in other parts of the cells can add anything to this, while some must always be subtracted; the hydrogen generated must be taken care of, which will require energy; subtracting this gives the following figures of the useful heat units generated; in the Smee 900, Daniell 1,419, Grove or Bunsen 2,722.4, Poggendorff or chromic acid 2,827.5; these figures represent the absolute maxima of energy which a pound of zinc can develop excluding all losses from resistance, etc.; he reduces this to foot-pounds and to horse-powers for one minute; the matter are: Smee 21.05, Daniell 33.19, Grove 63.66, Poggendorff 68.57; they show that in the best forms of battery an allowance of one horse-power for each pound of zinc consumed per hour would be a liberal one if something is allowed for resistance, etc.; he shows that no great improvement over the Poggendorff battery is possible, as the figure for it corresponds to 1 1-7 hp per hour, while the absolute maximum that could be reached would be 1 1-6 hp; if anyone claims to obtain more than this there is certainly some mistake or fraud.

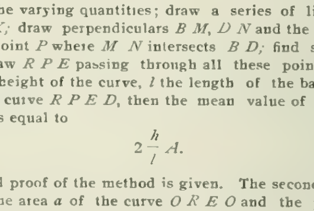
Studies on the Voltaic Cell.—"Tech. Quart." for December published a translation of a very long article by Dr. Goodwin, from the "Zeit. f. Phys. Chem." 13, 577, 1894; it deals with the fundamental question as to what energy-transformation takes place when a metal and a liquid are brought in contact, and he formulates a theory by which the voltage thus generated can be calculated from other measurable physical quantities; he refers to the osmotic theory of Prof. Nernst and describes experiments suggested by Prof. Ostwald for testing the generalization of the theory; he reviews and formulates the fundamental ideas on which the theory rests.

Multivolt Battery.—Prof. Anthony in the Lond. "Elec. Eng." May 29, shows that there must be considerable waste from local action in the Boynton battery recently described in the electrical journals, as the three cells are in the same liquid and there will therefore be local currents from one cell to the other through the liquid, which currents represent waste; he believes that this current is not negligable and suggests that it would be much better to have each cell in a separate jar.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Iodine Voltameter.—A Physical Society paper by Mr. Herroun is abstracted in the Lond. "Elec." and "Elec. Eng.," May 24. (After discussing the usual methods for determining the values of small currents, and discussing the errors, he gives his reasons for selecting iodine: with the exception of mercury in the mercurious state iodine has the largest electrochemical equivalent, and by titration (volumetric method) with sodium thiosulphate it is possible to determine the quantity of iodine liberated to a greater degree of accuracy than is possible by weighing a deposit of copper or silver with a balance; (the balance must, however, be used in making the solution used in titration). The solution used in the voltameter contains 10 to 15 per cent. of zinc iodide; the solution may be kept some time without liberating free iodine, by introducing a small piece of metallic zinc in the solution and it should not be exposed to a strong light; the anode consists of a plate of platinum at the bottom of a tall and fairly narrow beaker; the wire for the anode is encased in a glass tube so that the iodine is liberated only at the bottom where it tends to collect; the cathode consists of an amalgamated zinc rod enclosed in filter paper or vegetable parchment; during two hours' use none of the iodine will diffuse to the part of the solution near the zinc cathode but if the action lasts longer, a U-tube is used with two small plugs of asbestos at the bend, which form may be used for tests lasting several days. On account of the production of electric convection currents this apparatus is not as suitable for the accurate measurement of strong currents; after the current is stopped the zinc is immediately removed, the solution stirred and the amount of iodine liberated is determined by titration with sodium thiosulphate; a convenient strength of the latter solution is one in which one cu. cm corresponds to the amount of iodine liberated by five coulombs of electricity; this solution contains 12.8375 grams of pure re-crystallized sodium thiosulphate per litre; it is possible to perform the titration to within 0.1 cu. cm which corresponds to 0.5 coulomb or in one hour to 1-7,200th of an ampere; in a comparison made with a silver voltameter a difference of somewhat less than 2 per cent. was found, part of which the author believes was due to the effect of oxygen dissolved in the solution of silver nitrate. (No further description of the apparatus or method is given in the abstract from which this is taken.) In the discussion which followed Prof. Foster considered this method a most valuable one, believing the application of the volumetric method to be new; he did not see the advantage of using a substance with a high electrochemical equivalent if a volumetric method was used; Mr. Enright stated that he had used porous diaphragms in iodine voltameters and found that the iodine collected in the positive department while the water was driven into the negative one; with strong currents it was possible to get almost pure iodine in one compartment; Mr. Watson thought that the difference between the silver and iodine voltameters could hardly be due to the cause suggested; Mr. Elder warned the members that volumetric measurements were not as accurate nor as easy as they seemed to be and he particularly mistrusted a solution of sodium thiosulphate as he found that it changed even in 24 hours; the difficulty of accurately reading the burette might be overcome by weighing it before and after the measurements; the author in his reply stated that the electrodes he used had about nine square cm surface and that with this 0.1 amperes was the maximum current it was safe to use; the only substance, likely to be produced by too great a current density was periodate, which, being insoluble, would immediately be noticed; in the silver voltameter the influence of the dissolved oxygen was appreciable only with small currents lasting some time; in conclusion the chairman, Captain Abney, stated that he found zinc salts to be very untrustworthy.

Graphical Method of Finding Mean-Square Values.—The following methods are described by Mr. Russell in the Lond. "Elec.," May 24. In the adjoining cut let $O\ R\ E$ be the curve the ordinates of which are the values of the varying quantities; draw a series of lines like $B\ D$, parallel to $O\ X$; draw perpendiculars $B\ M$, $D\ N$ and the diagonal $M\ N$ marking the point P where $M\ N$ intersects $B\ D$; find similar points like P and draw $R\ P\ E$ passing through all these points; measure h the maximum height of the curve, l the length of the base $O\ E$ and A the area of the curve $R\ P\ E\ D$, then the mean value of the squares of the ordinates is equal to



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$$2\frac{h}{l}A.$$

A mathematical proof of the method is given. The second method is as follows: find the area a of the curve $O\ R\ E\ O$ and the position of its centre gravity, by the well-known experimental methods; measure the height y of the centre of gravity above the base and the breadth l of the curve (presumably $O\ E$), then the mean square of the heights of the curve is equal to

$$2\frac{y}{l}a.$$

A New Method of Harmonic Analysis.—A Physical Society paper by Mr. Sharp is abstracted briefly in the Lond. "Elec." and "Elec. Eng.," May 24; he "applies the principle of the form of harmonic analyzer for giving direct readings of the amplitude and epoch of the various constituent harmonic terms, previously described by him, to the performance of harmonic analysis without the use of an instrument."

Determination of Dielectric Constants.—The method of Mr. Nernst mentioned in the Digest, Dec. 29 last and Jan. 19, is described briefly in the Lond. "Elec. Rev.," May 24.

Determination of the Potential of the Atmosphere on the Eiffel Tower.—A Physical Society paper by Mr. Chauveau, briefly describing the method and apparatus, is published in "L'Eclairage Elec.," May 11.

Resistance of Solutions of Sugar.—A short Academy paper by Messrs. Gin and Leleux giving the results in the form of formulas is reprinted in "L'Eclairage Elec.," May 11.

Submarine Cable Testing.—In his serial in the Lond. "Elec.," May 24, Mr. Wilkinson described Kennelly's modification of the Mance test for fracture.

Hot Wire Device.—The "Elec. Eng.," May 29, contains a number of communications and some articles referring to the suggestions and statements in the recent article of Mr. Irish, abstracted in the Digest, May 18. In a article by Prof. Stine on "Electrical-thermo Devices" he shows that although the hot wire is in general an inferior device when compared with an electromagnet, there are cases in which it can be used to advantage; he discusses several of the applications; for galvanometers it offers advantages for limited uses; he believes that it could be developed into a fairly sensitive galvanometer for portable work and, though dead beat, its sensitiveness is lower than that of the better types of galvanometers; he has in use one whose figure of merit reduced to an ordinary rating is 0.0001 and he believes it possible to construct one which is at least 1,000 times as sensitive He thinks the difficulties connected with its application to ammeters, voltmeters and indicators, can be overcome, and that accurate and durable instruments can be constructed although the complexity and the cost are against it; regarding the merits and faults he believes that the latter greatly preponderate, and he does not think such instruments likely to ever come into general use. Regarding arc lamps he believes the thermo principle offers many advantages, the feeding being gradual and uniform; such lamps show a curve which closely approximates a straight line and on this basis it would seem that this principle should be exclusively employed; "in a few cases electromagnetic feeding of the carbons has been attempted but the results have been far from satisfactory; in use, however, the thermo lamps invariably break down and they are affected by extreme heat and cold."

Mr. Sheldon discusses the thermo device unfavorably and states that it would be unwise to rely upon an accuracy of the ratio between the length and current within 5 per cent. Mr. Lundell states that a number of years ago he used the device for moving the brushes of an arc light machine, but was so disgusted with its sluggish and freaky performances that he abandoned it. Prof. Anthony criticises the original article unfavorably, calling attention to some of the faults of such apparatus, intimating that there is little new in Mr. Irish's suggestion, and suggesting that it would have been well to have described how the difficulties which others have met with have been overcome.

Zero-Torque Meter.—The description of this meter, which was abstracted in the Digest last week, is reprinted, with illustrations, in the "Elec. Rev.," June 5.

Specifications of the Legal Ampere and Volt.—Those drawn up by the National Academy of Sciences by direction of Congress, are reprinted in full in the "Elec. Eng.," June 5; the original was mentioned in the Digest, April 13.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telegraphy by Induction.—An abstract of a recent address by Mr. Preece is published in the Lond. "Elec. Eng.," May 24; after describing induction telegraphy in general he gives a detailed description of the system which was used on the Island of Mull the cable to which was recently broken and it was decided, while waiting for the arrival of the new one, to establish connection by this means; the width of the channel varied from 1½ to 2 miles and there existed an overhead wire on the island; a gutta-percha insulated wire was laid along the ground on the mainland for a distance of 1.5 miles, being earthed at both ends; 156 messages were sent during a period of four days and the result was very satisfactory. In conclusion he states that there is no reason why it should not be possible to duplicate and quadruplicate the messages; each particular circuit has its own sympathetic frequency and each telephone responded more energetically to one particular note than to any other, which two facts could be taken advantage of.

Currents in Cables Used with Hughes Apparatus.—An article by Messrs. Breisig and Bokelmann describing researches to determine the currents in cables which are used with the Hughes apparatus, is begun in the "Elek. Zeit.," May 23; the method used for measuring these rapidly varying currents is said to be a very accurate one and the apparatus is entirely independent of the inertia of its parts.

Railroad Telegraphy and Telephony in Switzerland.—Some statistics for the year 1893 are published in the "Elek. Zeit.," May 23.

Telephone System in the Arlberg Tunnel.—A description of this system is given briefly in the "Elek. Zeit.," May 23; extraordinary difficulties were encountered owing to the combined action of the moisture and the products of combustion from the locomotives.

Installation of Calling Batteries at the Paris Telephone Station.—An illustrated description by Mr. Montillot is published in "L'Elec.," May 25; the installation is that at the large Gutenberg station in Paris.

New Indicator Movement.—Illustrated descriptions of the system described in the Digest, April 27, of the annunciator which will indicate three different signals, are published in the London journals May 24.

Telegraphing Without Wires.—Prof. Dolbear, in the "Elec Eng.," May 29, shows that the method which has lately been employed so successfully in England across bodies of water with no conducting cable, was fully described by Prof. Trowbridge in 1880 in the "Proc. Amer. Acad. Arts and Sciences"; he made his original researches between Cambridge and the city of Boston; a telephone was connected to a wire 500 or 600 feet long, parallel with the original circuit and grounded at both ends; he quotes briefly from the original publication.

Mexican Government Telegraph Service.—The "Elec. Eng.," May 29, contains a descriptive article by Mr. Guy, including some statistics, and a description of the zone system of rates.

Non-Inductive Telephone System.—The Marshall system is described and illustrated in the "Elec. Eng.," June 5; in this system the metallic circuit with its accompanying expensive adjuncts is not necessary; direct current transmission is used without an induction coil in the transmitter; the receiver is provided with two coils wound in opposite directions, one connected to earth and line and the other to earth and line through a condenser; the induced currents on the line are divided, half passing through the condenser and half through the other coil and thus have no effect on the diaphragm, while the direct current signals coming in on the line cannot pass through the condenser and therefore traverse only one coil and reproduce the signals; the batteries are all located at the central station, and it is claimed that one third the usual number of cells are required.

Telephone Transmitter Without Electrodes.—The Cottrell device is illustrated diagrammatically and briefly described in the "Elec. Eng.," May 29; it is said not to come within the scope of Berliner's claim, as it has no electrodes.

Mercadier and Anizan Microphone.—An illustrated description of this instrument is published in the "Elec. Eng.," May 29; the apparatus was described in the Digest, Feb. 2.

Telephone Situation.—"El'ty," June 5, publishes an article of some length on this subject, pointing out the growth of the independent companies, and discusses it editorially.

MISCELLANEOUS.

Gutta-percha.—The Lond. "Elec. Rev.," May 24, reprints a short article from the "Sarawak Gazette," regarding the project of Mr. Hourant. Two new enterprises have recently been started in the home of that journal, the collection and export of the dried leaves of the gutta-percha tree and the manufacture of cutch from the bark of a variety of the mangrove which is found in almost unlimited quantity in the swamps and on the coast; the former of these industries was commenced a year ago by Mr. Hourant; an excellent quality of pure gutta-percha is extracted from the leaves which are said to yield 7 to 10 per cent. of their weight or even more; the exporting is increasing month by month; the native plan of cutting down a tree to obtain the sap is wasteful in the extreme; an adult tree 25 or 30 years old yields only one catty of pure dry gutta-percha, while as much can be obtained from two pluckings of the leaves of a tree without injuring it, and it will long continue to put out fresh foliage; the gutta percha obtained from the leaves is chemically pure and dry; millions of the trees already destroyed by the old process are still of service as their stumps have sprouted, yielding leaves which are as good as those of an adult tree. (An article on this same process was abstracted in the Digest, March 25, 1893.)

Therapeutic Action of High Frequency Currents.—A translation of the short paper of Messrs. Apostoli and Berlioz, abstracted in the Digest, May 11, is published in the Lond. "Elec. Rev.," May 24

Production of Phosphoretted Hydrogen and Calcic Phosphide.—According to an anonymous article in the "West. Elec.," June 8, it appears that calcic phosphide was produced by fusing bone charcoal with lime in an electric arc furnace; by immersing this compound in water, phosphoretted hydrogen is given out which explodes when it comes in contact with the air at the surface of the liquid.

Photographs of Lightning.—Several photographs taken recently in Texas are reproduced in the "Elec. Rev.," June 5.

Educational.—A paper from the "Technograph," by Messrs. Morrison and Junkersfield on "The College of Engineering," referring to the University of Illinois, is reprinted in abstract in the "West. Elec.," June 8.

New Journals.—A new journal called the "Electrical Journal" is to be published in Chicago every two weeks by Prof. Barrett; it appears from an advance circular to have some connection with the National School of Electricity; it is stated that it "shall also invade a new and unique field in this class of journalism," but what this field is is not described.

According to the "West. Elec.," June 1, a new electrical monthly called the "Electrical Journal" is about to be started in San Francisco; Mr. George P. Low is the editor and proprietor with Prof. Perrine as associate editor; it is to be an illustrated monthly review of the industrial applications of electricity, gas and power.

New Book.

[illegible] MOTIVE POWER. The Transmission and Distribution of [illegible] Power by Continuous and Alternate Currents, with a Section on the Application of Electricity to Mining Work. By Albion T. Snell. London: "The Electrician" Printing & Publishing Company. 405 pages, [illegible] illustrations. Price, $4.00.

The preface states that this work is designed to be a practical treatise for mechanical and mining engineers and other students of applied electricity, and that an elementary knowledge of the theory of electricity and magnetism is taken for granted. In developing the principles governing electric transmission of power the author has deemed it advisable, in addition to treating the various systems in vogue of transmitting and distributing power, to discuss the design of continuous and alternating current dynamos and motors, and of transformers, and to pay especial attention to the subject of electricity in mining, particularly with reference to collieries and coal getting.

The first of the ten chapters deals with the general plan of electrical transmission of power; the functions of the dynamo, motor and line are rather unnecessarily described, but some useful practical information relating to them, as well as to the steam and gas engine and steam boilers, are given.

In Chapter III. the design of continuous-current dynamos and motors is very satisfactorily treated from a practical standpoint, and while the mention of some of the factors involved is rather brief, the information is always to the point, and the example given to illustrate the method of design will be found very instructive. The following chapter takes up the line, its material and insulation, and the theoretical considerations affecting the loss in the conductor being considered in the opening pages; line fittings, underground conduits and lightning protection devices complete the chapter. The portion on line drop is rather perfunctory, being largely a discussion of the considerations entering without any very definite conclusions, while considerably more space is given to lightning protection than to underground lines and conduits. It should be added, however, that the information here, as elsewhere throughout the book, is of a direct practical character and, therefore, of more value to the engineer than would be a more exhaustive treatment in the usual manner.

Chapter IV. treats of direct-current systems of transmitting and distributing power, including series and parallel working, three-wire and feeder systems, storage battery auxiliaries and dynamotors. Alternating currents are taken up in Chapter V. and the real value of the book lies in this and the following chapters on the same subject. The explanations of the various alternating-current phenomena are given in simple language and with reference to their practical bearing, no mathematics beyond a few formulas appearing in the text. Among the matters treated are the subject of harmonic functions, the cause and effect of phase differences, the effect of iron cores and, finally, a section giving brief allusions to the design of alternators, but which has some value in assisting to an understanding of the principles of the machines.

Chapter VI. is on transformers, from which an excellent idea of their principle construction and working may be obtained, the section on designing having here also an interest merely in that connection.

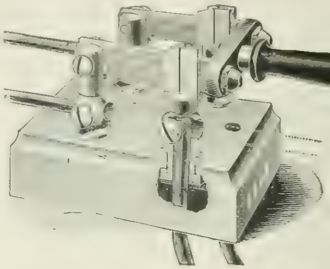
Chapter VII. takes up alternating-current transmission, and the sections on inductive drops on the line and the effect of capacity will give the reader a very good idea of these important points. Various methods of compensating for drop are described, and some points connected with alternating-current working, such as coupling in parallel, measuring instruments, earthing devices, etc., referred to; some remarks on precautions to be observed in alternating-current working will be found of practical interest.

Chapter VIII. is on polyphase-current working and contains more information on the practical side of the subject than can be found in any other work, the descriptions of the various systems being such as to be easily followed by the beginner. The two final chapters form a special treatise on the application of electricity to mining work, the information being given in much detail and apparently representing a considerable experience of the author in this branch of electrical engineering. As such it will be found of value to the mining engineer, the subject being treated from an engineering standpoint and much more fully than can be found in any other publication.

The chief value of the work lies in the practical light in which the various points treated are viewed, and in the discussion of their bearing on actual working. The author has apparently made a careful study of the recent literature relating to alternating currents and their working, particularly with respect to polyphased currents, and we believe that a more satisfactory practical idea may here be obtained in regard to these important subjects than in any other work yet published.

A "Baby" Knife Switch.

For some time the Electric Engineering & Supply Company, of Syracuse, N. Y., has been furnishing to the trade a neat and practical knife-blade switch, with a carrying capacity from 15 to 25 amperes, which is shown in the accompanying engraving. This switch is mounted on a porcelain base, fitted with combination terminals which will admit of either a face or a rear connection, the wires being held in either place by the same screw. The switch is small and compact, being only 2½ inches long by 1⅞ inches wide, and stands 1¾ inches high, base included. This little switch has become a great favorite in the construction of panel-board work, and has almost entirely supplanted snap switches. It is also furnished without the porcelain base, so that it can be mounted directly upon the switchboard.

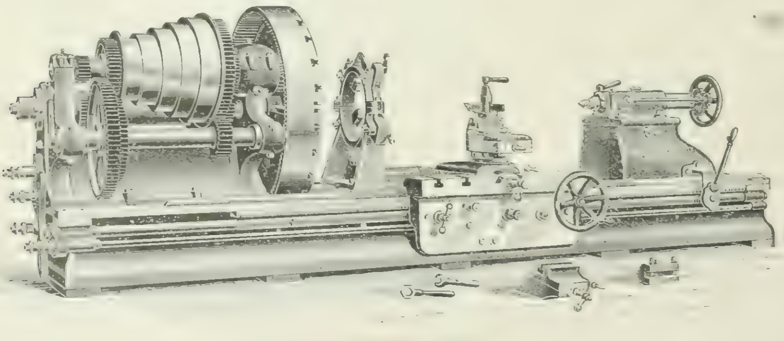


SMALL KNIFE-BLADE SWITCH.

A Large Engine Lathe.

The accompanying engraving illustrates the latest advance in heavy triple-geared engine lathe construction, made by the old established concern of the Fitchburg Machine Works, of Fitchburg, Mass. This concern has for over 31 years manufactured large numbers of lathes, planers, drills, shapers and other machine tools, which have ever been noted for the quality and quantity of work they would produce, and this lathe is no exception to the rule.

The main spindle is relieved of all unnecessary weight by putting the cone and its back gears upon separate shafts, which goes far toward insuring permanent alignment of the spindle in its bearing. This is also made more certain by carefully and accurately prepared boxes of best bronze and best babbitt. This bearing has already produced good results, and is said to have shown absolutely no grooving in practice. The cone is well proportioned, as also are the back gears, giving uniform changes of speed. The lathe has a 60-inch swing and 18-foot bed. Gear feeds are used entirely, and by means of a clutch the deal screw is run only when used for cutting threads. By a simple device in the apron the lead screw nut cannot be locked and the feed rod thrown into gear at the same time.



A 60-INCH ENGINE LATHE.

The tailstock spindle is provided with an attachment so that it can be run from either end of the tailstock; the tailstock itself may be easily and quickly moved along the bed in either direction by means of a convenient lever. The lathe weighs 17 tons and the metal is most judiciously distributed, the tool being perfectly rigid and free from chattering or vibration.

Some Interesting Alternating-Current Installations.

An interesting power transmission plant is in course of installation at Bayonne, N. J., where the three phase system of the General Electric Company will be employed to operate the machinery of the Tide Water Oil Company. The nature of the process is such that spark-proof apparatus is an imperative necessity, and multiphase apparatus was selected as being peculiarly adapted to meet the special conditions. The generator will be a 550-volt, three-phase machine, having eight poles and a capacity of 75 kilowatts. The several induction motors will be of 5, 10 and 15 horse-power. Some of these are spark proof, and have a permanent resistance in the armature circuit, as they will be employed in places where there exists an ever present danger of explosion from gases, which a spark could readily ignite. They will be used to operate pumps, elevators, and other machinery. The switches will be of special construction, with the blades immersed in oil. The generator also supplies current for about 525 lights scattered throughout the different parts of the works. Regulation of the lighting circuits will be effected by special revolving regulators of novel design.

The Oakland Gas & Electric Company, of Oakland, Cal., will also use a three-phase transmission plant for general power work. Current to a number of induction motors ranging from one to fifteen horse-power will be supplied from a 75-kw. three-phase machine, and there will be extensive lighting in connection with the plant. The E. M. F. at the generator will be 2,000 volts, and this will be reduced at two centres of distribution to the necessary potential for the secondary network, which will cover a territory of 1,200 feet in every direction from both centres. From these points pressure wires will be run back to the power house, and the voltage will be there controlled by potential regulators.

A plan somewhat similar to this will be followed by the Fall River Electric Company, of Fall River, Mass., but monocyclic apparatus will be used instead of three-phase. Two 75-kw generators will be installed, and they will be used for lighting purposes during the dark hours, supplying current during the day for general power work. The motors will be of the General Electric induction type, ranging from 1 to 10 horse-power, and will be wound for 110 volts, to which pressure the current generated at 2,000 volts will be reduced.

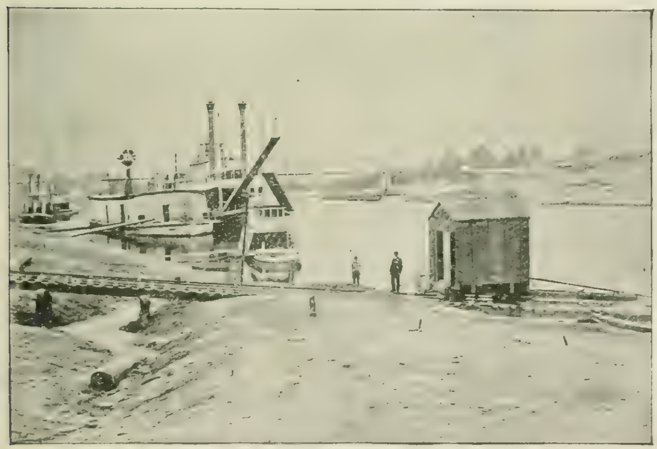


FIG. 2.—PUMP HOUSE HALF WAY UP RAILWAY.

The first application of the three-phase long-distance system to street railway work will be made by the General Electric Company at Lowell, Mass., where a plant is in course of construction for the Lowell & Suburban Street Railway Company. Its special features will render it one of the most interesting three-phase installations ever effected. The generators will deliver both alternating and continuous current, and when not in use for transmission work will be run in parallel with the railway generators now in the station. They will be wound for delivery of low voltage current at the alternating side, and this current, raised to 5,000 volts, will be carried to two sub-stations, one nine miles and the other 14 miles distant from the generating station. The sub-stations will each be provided with suitable step-down transformers of the General Electric air blast type, and two rotary converters. These machines are constructed to maintain at the commutator brushes an E. M. F. of 500 volts at no load, and 550 volts full load. Another transformer sub-station for 400 incandescent lamps will be installed six miles from the generators.

The success of this plant will go far towards solving the problem of the operation of railways over long distances, taking the current from the one power station. When it is completed we shall present a full description to our readers.

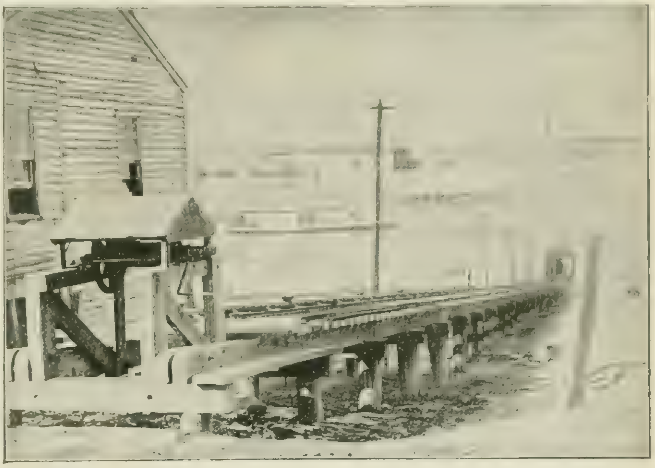


FIG. 1. PUMP HOUSE AT EXTREME END OF RAILWAY.

An Electrical Pumping Plant.

A rather novel and quite unusual electrical pumping plant is shown in the accompanying illustrations of an equipment at Monroe, La., which was furnished by The Goulds Manufacturing Company, of Seneca Falls, N. Y.

The great variation in the height of the water in the river rendered it necessary to have a changeable location for the pumps in order that the suction pipe should be always sufficiently submerged. With this end in view a railway was built so as to extend well into the river at low water. Upon this railway, mounted on a four-wheeled truck, a pump house was constructed, in which is an 8 by 10 foot Gould triplex power pump driven by a 15-hp slow speed Westinghouse electric motor. When rendered necessary by the rise and fall of the water, the position of the pump house on the railway is changed by means of the windlass shown at the head of the railway in Fig. 1. This view shows the pump house at the lower end of the railway, the water being low. Fig. 2 shows the pump about half way up the incline, with the discharge pipe extending from the rear of the pump house into the water.

Owing to the variation in the location of the pump house, special provision had to be made for connecting the pump with the discharge pipe, and this has been accomplished, as may be seen from Fig. 1, by extending the main the entire length of the railway, and putting flanged tees at regular intervals, connection between the pumps and main being established through the nearest tee. In order to supply the necessary current for operating the motor, a line of poles was erected alongside the railway to carry the wires which lead current to the motors.

This electrical pumping installation is the property of the Monroe Water & Light Company, from whose central station the current for the motors is obtained. In spite of the conditions under which the pump is operated and the frequent changes of the pump house, the performance of the outfit has been eminently satisfactory from the start.

The Snaefell Mountain Railway.

Work on the electric railway to the summit of Snaefell Mountain, Wales, is progressing rapidly, and the road is expected to be ready for July. The overhead system will be used, and when this line is completed there will be a complete stretch from Douglas to Laxey, and thence to Snaefell, about ten miles in all.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, June 8, 1895.

AMERICAN BELL has apparently reached its upward limit, having remained practically unchanged for two weeks.

GENERAL ELECTRIC was rather strong this week, and its friends claim that the firmness of the stock is a sure indication of some practicable plan to put electrical manufacturing upon a firmer basis than heretofore, though the connection seems rather vague. One of the principal General Electric bears has recently climbed the fence and expresses the belief that Mr. Pierrepont Morgan contemplates the organization of a gigantic corporation to absorb both the General Electric and the Westinghouse companies. Another rumor is current to the effect that the element in the General Electric board which was formerly opposed to the Westinghouse alliance is now in favor of it. It is safe to say that these reports have much to do with the bullish feeling as to G. E. stock, though their authenticity does not follow.

BALTIMORE TRACTION was bid up over 19 early in the week and continued strong. The advance has given rise to the report that insiders are buying the stock in order to put it above 25 and enable the company to issue the balance of the authorized stock—$4,250,000—which cannot be sold below par. Philadelphia directors of the company say that the matter has not even been considered, as the money is not needed. Last month the earnings increased about $400 per day; the increase during the first three days of June was $4,500!

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	99	101
" " " Brooklyn	100	..	108
" " " Boston	100	129	130
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	..	26½
General Electric	100	36½	36¾
General Electric, pref	100	..	65
Westinghouse Consolidated, com	50	33	33½
" " pref	50	52	52½

BONDS.

	Par.	Bid.	Asked.
Edison Electric Ill., New York	100	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co. deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

	Par.	Bid.	Asked.
American Bell Telephone	100	202	203
American District Telegraph	100	30	40
American Telegraph & Cable	100	94½	..
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
†Erie Telephone	100	57¼	57¾
Gold & Stock Telegraph	100	105	
New England Telephone	100	73	73½
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63½	.
Western Union Telegraph	100	92	92½

ELECTRIC TRACTION STOCKS.

	Par.	Bid.	Asked.
Baltimore Traction	25	19¾	20
Binghamton RR. com	100	100	..
Brooklyn Traction	100	11½	14
" " pref	100	..	53
Buffalo St. Ry	100	79	83
Cleveland City Ry	100	68	70
Cleveland Electric Ry	100	59	60
Chicago City Ry	100	305	315
Columbus St. Ry	100	48½	..
Consolidated Traction of N. J	..	26	30
Electric Traction, Philadelphia	50	..	74½
Hestonville	100	60	..
Long Island Traction	100	11	11½
Louisville St. Ry. com	100	37	39
" " " pref	100	87	88
New Orleans Traction	100	20	22½
" " pref	100	69	71½
North Shore Traction	100	23	28
" " pref	100	78	81
People's Traction $30 pd	25	62¼	62⅜
‡Philadelphia Traction	50	83⅛	83¼
Rochester St. Ry	..	38	.
Union Ry. (Huckleberry)	100	112	115
West End, Boston	100	70	70½
" " pref	100	..	92
Worcester Traction	100	13	16
" " pref	100	83	37

BONDS.

	Par.	Bid.	Asked.
Buffalo St. Ry. 1st con. 5s	100	104	106
*Binghamton Railroad Co. 5s	100	99	100
*Columbus St. Ry. 1st 5s	100	98	..
Rochester St. Ry. 1st. 5s	100	95	97
*Union Ry. 1st. mtge 6s	100	105	108
*Westchester Electric 1st. mtge. 5s	100	98	101

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* With accrued interest.

† Ex-Div.

‡ Ex-rights.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 BROADWAY, NEW YORK, June 10, 1895.

THE TROLLEY SYSTEM WAS INAUGURATED last week on all the lines in Elizabeth, N. J., which are controlled by the Consolidated Traction Company.

MR. JOHN STARR, of the electrical supply firm of John Starr, Son & Co., Ltd., Halifax, N. S., was in the city last week. Mr. Starr reports a very decided improvement in electrical trade in Canada.

THE ELECTRICAL CONTRACTORS' ASSOCIATION has been organized in Brooklyn. Peter D. Myers is president, Wm. H. Dean, vice-president, Wm. H. Pearson, secretary, and Geo. J. Soper, treasurer.

NO SUBSIDY.—The Staten Island supervisors have adopted an opinion from George M. Pinney, Jr., to the effect that it is not within their power to offer a $1,000,000 subsidy to the General Electric Company as an inducement to concentrate its various factories at Staten Island.

THE BOARD OF ELECTRICAL CONTROL last week, at a special meeting unanimously voted to grant the request of the Union Railway Company for permission to string trolley wires the entire length of the Southern Boulevard in the annexed district, a distance of three and one half miles.

ELECTRICAL WORKERS are getting restive again, this time over Clause 2 of the agreement made by the arbitrators of the recent strike, under which clause the Electrical Contractors Association claims the right to keep non-union men at work, while a majority of Electrical Workers No. 3 argue otherwise.

CONSIDERABLE ANNOYANCE was experienced yesterday by the Union Electric Railway, which runs through Westchester towns to 129th Street, New York. Passengers from Westchester and Wakefield insisted on paying only one fare to 129th Street, in compliance with the law recently passed prohibiting a charge by railways of more than one fare within the city limits, which now enclose the towns above named.

FOUND GUILTY.—Judge Kirkpatrick has decided that the indictment is legal which was returned some time ago against the Consolidated Traction Company for maintaining a nuisance by laying a third rail on Market Street, Newark, in changing the gauge of the roadbed. As the company had admitted the presence of the rail he ordered a verdict of guilty entered against it. The company is liable to a fine of $500.

THERE IS A DIFFERENCE OF OPINION between Mayor Wanser, of Jersey City, and the Western Electric Light Company, concerning a contract for wiring the new city hall. The mayor and the City Hall Commission desire iron-armored conduit to be used without extra compensation to the contractors, but there is no provision for the tubing in the contract. The contractors argued for extra compensation, but the mayor said "No," and said it emphatically.

RECEIVER APPOINTED.—The Electrical & Mechanical Engineerin Company, of No. 41 Cortlandt Street, has become insolvent, and Judge Andrews has appointed Jonathan H. Vail receiver, on the application of the directors. Mr. Vail is president of the company and the largest stockholder. The liabilities are $26 441 and the principal asset is a contract with the Brooklyn Bridge trustees for electric lighting of the cars. This asset is set down as $19,419

EXTENSIVE TROLLEY CAR FACILITIES.—The New Jersey Electric Railway Company has arranged with the North Hudson County Company for a system of transfers by which passengers from the former may be transferred, without extra charge, to practically any part of Hudson County, including all the New York ferries from Pavonia to Weehawken (Forty-second Street), the Hudson County Court House, Union Hill and other points. It is confidently expected that the company will, in a few weeks, be running its own lines through Hoboken to the various ferries.

LIVELY COMPETITION FOR BROOKLYN'S LIGHTING.—Bids were opened last week from the Municipal, Citizens' and Edison illuminating companies for furnishing Brooklyn with electric lights. All the bids offer 1,200-cp lamps at 40 cents per night from Jan. 1, 1895, until the new contract is made, and 35 cents during the remainder of the year provided they can put in 20 per cent. more lights. The Edison Company also put in a bid of 20 cents per night for 600-cp lamps. City Commissioner White expresses himself as very well satisfied with the results of the bidding. The reduction of five cents per lamp per night will effect a saving to Brooklyn of $42,000 a year. This year's appropriation will allow the 20 per cent. increase stipulated by the bidders.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
ROOM 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., June 8, 1895.

ELECTRIC METERS IN MASSACHUSETTS.—The gas commissioners' report on meters, presented to the senate last week, states that about 15,500 meters were in use during 1894.

THE WEST END STREET RAILWAY COMPANY, Boston, has issued its order concerning the carrying of mail pouches on cars other than those fully equipped as United States mail cars, and the employees regard the movement as a cunning scheme to avert a tie-up on the road.

THE MASSACHUSETTS LEGISLATURE has finally adjourned and it may be said to its credit that it passed no legislation materially affecting electrical interests The subway of Boston will now proceed toward construction without interruption. The legislative attempts to obstruct the work were a failure and now Judge Knowlton, of the Supreme Court, has denied the application for an injunction.

THE FITCHBURG MACHINE WORKS have nearing completion in their shops in Fitchburg, Mass., a massive iron planer, to plane 73 inches x 73 inches x 26 feet long, with two cross and two side heads, all from 1895 patterns. This well-known company reports an increased demand for its tools. The Stanley Electric Manufacturing Company, of Pittsfield, Mass., is one of its larger patrons and strongly endorses its tools.

THE NARRAGANSETT MACHINE COMPANY, of Providence, R. I., reports increased demands just now for its well-known Providence foot lathe, one of its standard manufactures and which has been before the public for a number of years, always receiving liberal recognition. For electrical and experimental work and for all classes of mechanics, practical and amateur, this lathe is regarded as possessing excellent features and merit.

ELECTRIC LINE BETWEEN HINGHAM AND NANTASKET.—At a meeting of the stockholders of the Hingham Street Railway Company, held this week, it was voted to sell the franchise for a railway to connect with the Nantasket Beach branch to the Braintree & Weymouth Street Railway Company. The terms are $5,000 bonus and reimbursement for expenses already incurred by the Hingham Company. It is intended to have the road in operation by July 10.

THE BUCKEYE ENGINE COMPANY continues to make an excellent showing of business in the New England territory through the energetic efforts of its New England agent, Mr. W. D. Hoffman, whose offices are at 620 Atlantic Avenue, Boston. Mr. Hoffman's business for April was very gratifying and has been particularly so during the ten days commencing with the latter part of May and entering into June, during which time he disposed of five engines. The business, by the way, of the Buckeye Engine Company was exceedingly good during the month of May, orders for 34 engines being booked, aggregating 4,484 hp.

THE SESSIONS FOUNDRY COMPANY, Bristol, Conn., has in course of construction on a large tract of land adjoining the railroad in a different part of the town, its immense new iron foundry plant, and hopes to have it ready for occupancy early in October. Meanwhile the business is being conducted as usual at the old works. When finished the new plant will be one of the most complete establishments of its kind to be found anywhere and will possess unsurpassed facilities for producing iron castings of the best quality and in large quantities. The main foundry building will be 530 feet long and 110 feet wide. There will also be large shipping buildings, power house, electric power and lighting plant, machine and pattern work shops, pattern storage, office building, etc , all of which will be practically fireproof. There will be several spur tracks running into the yard, affording excellent facilities for receiving and shipping freight. The Sessions Foundry Company has always enjoyed liberal patronage from the electrical industry because of the excellency of its manufactures, and which will undoubtedly be increased to a large degree upon the completion of its new plant

CANADIAN NOTES.

TORONTO, Can., June 8, 1895.

HAMILTON, ONT.—Tenders for lighting the city will be asked for at once by the City Council.

MR. R. E. T. PRINGLE has been given the sole agency in Canada for the Boudreaux Dynamo Brush.

MUNICIPAL OWNERSHIP WAS REJECTED by the taxpayers in Toronto a few days ago by an overwhelming majority, the vote being 4,510 to 817.

COLLINGSWOOD, ONT.—Tenders are wanted, in whole or in part, for the steam plant, electrical plant and electrical supplies necessary for the extension of the electric light system of the town of Collingswood, Ont., and will be received until June 19, by C. James Guilfoyle, chairman of the water works committee.

General News.

TELEGRAPH AND TELEPHONE.

KINGSTON, N. Y.—The West Shore Telephone Company is about to extend its lines to Ellenville.

QUINCY, FLA.—The Florida Telephone & Construction Company will equip an exchange in Quincy.

TOMAHAWK, WIS.—The Standard Telephone Company has most of the poles set for its new line here.

DULUTH, MINN.—An ordinance granting a franchise to the Duluth Telephone Company to place its wires in a conduit is before the Council.

GAINESVILLE, GA.—A local telephone exchange will be established with probability of an extension to Jefferson. G. G. Leake can furnish information.

VICKSBURG, MISS.—Proposals for the construction of an automatic fire alarm telegraph system will be received until June 17. W. L. Trowbridge is mayor.

BOWLING GREEN, KY.—The East Tennessee Telephone Company is extending its line to Hays and the telephone line from Brownsville to Rocky Hill station is being extended on to Hays and Smith's Grove.

BURLINGTON, IA —The Burlington Electric Light & Street Railway Company, E. C. Walsh, president, is receiving bids for telephone instruments for the new exchange and for the long line to Columbus Junction.

BALTIMORE, MD —Sealed proposals will be received by the construction committee of the underground system of the police and fire alarm telegraph and police patrol until 12 m., June 20, for the construction of about 45,000 feet of electrical subway conduits, in accordance with drawings, etc., prepared by the engineer.

ELECTRIC LIGHT AND POWER.

CANTON ILL.—J. Krishke is inviting bids for furnishing the city with electric arc lights.

PUEBLO, COL.—Judge Halleck has ordered the Pueblo City Railway sold to satisfy a $500,000 mortgage.

ALBANY, N. Y.—The bill appropriating $16,000 for an electric light plant for the Albany Armory has become a law.

FRANKLIN FALLS, N. Y.—The Franklin Falls Company will erect a new power house on the island in the river.

KANSAS CITY, MO.—The Kansas City & Independent Air Line Railway will probably build an electric power plant.

BALTIMORE, MD.—The plant of the defunct Baxter Electric Motor Company was sold recently to bondholders for $25,000.

ATHENS, GA.—The Athens Electrical Railway Company is in the market for electrical equipment for light or power lines.

NEW ORLEANS, LA.—The Orleans Railway Company will erect a brick power house and power building to cost $13,975.

BRISTOL, CONN.—The Consolidated Electric Company will build a power house to be equipped with engines, dynamos, etc.

WELLSVILLE, O.—E. H. Wells & Co. are arranging to put in position a new electric light plant in the basement of their building.

SCOTTSDALE, PA.—E. L. Rutherford is inviting bids for furnishing electric lights for streets and public buildings for Brooklyn for 1895.

LEXINGTON, KY.—The mayor can give information concerning an electric light plant now being considered and for which bids are being invited.

WOONSOCKET, R. I.—The machinery in a shoe factory to be erected on Brooke Street by Assemblyman Dulude will be operated by electric power.

PENSACOLA, FLA.—The Pensacola Electric Light & Power Company is arranging to run motors during the day for propelling fans and light machinery in the city.

NORWALK, O.—The Norwalk City Council has passed resolutions submitting the proposition to a vote of the people for $25,000, to construct its own electric light plant.

WORTHINGTON, MINN.—The Village Council of Worthington has called a special election for June 15, to vote on the question of putting in a $15,000 electric light plant.

KOSSE, TEX.—Fletcher Allen is in the market for a complete electric light plant, including a 50-hp engine, 60-hp boiler, 500-light dynamo, 3,000 pounds of wire, 250 lamps, with sockets, insulators, brackets and arms.

LAUREL, MD.—The Laurel Electric Light plant has been purchased by a local company of which Dr. De W. Snowden is president, and has been reorganized under the name of the Electric Company of Prince George's County.

ANNAPOLIS, MD.—An ordinance has been passed authorizing the Chesapeake & Potomac Telephone Company, of Baltimore, to erect and maintain poles and string wires on the streets of Annapolis, for a period of 10 years.

HELENA, MONT.—The City Council has awarded W. J. Bradshaw the contract for lighting the streets. The contract is for three years from July 1. Equipment for 75 arc lights and a medium size incandescent plant will be purchased at once.

MERRIMAC HIGHLANDS, MO.—The Merrimac Highlands Company has purchased the franchise of the Sunset Hill Water, Light & Power Company, and will construct works to supply a number of towns in St. Louis County. The president is Marcus Bernheimer

BALTIMORE, MD.—Arrangements have been completed for building the Washington & Baltimore electric road, between the two cities. A director of the company says that the Widener Elkins street railway syndicate of Philadelphia has become interested in the new line.

BELLEFONTAINE, O.—Bids will be received until June 25, by the mayor for an electric light plant comprising two 50-light arc dynamos, one 650-light alternator, with lamps, converters, pole line, wiring and steam plant complete. Specifications are on file at the office of the engineers, E. P. Roberts & Co., Cuyahoga Building, Cleveland.

DAVENPORT, IA.—The business of the Davenport Power & Light Company, of Davenport, Ia, has been rapidly growing under the successful management of William Mullen. When he took charge of the property the company's business was small and unsatisfactory, but since that time it has become necessary to install a 500-hp engine, and the capacity of the plant is soon to be doubled. The increase in business was secured at the same time in the face of very active competition from other illuminating companies.

THE ELECTRIC RAILWAY.

PORTLAND, ME.—The Portland Street Railway will be operated by electric power.

TORRINGTON, CONN.—The Derby Street Electric Railway will be extended to Seymour.

NORRISTOWN, PA.—The Schuylkill Valley Traction Company will extend the road to Collegeville.

ANNISTON, ALA.—The Anniston City Railway Company has decided to change its line to the trolley system.

CONCORD, N. H.—It is proposed to extend the Concord & Penacook Electric Road to the Hannah Dusfin monument.

LITTLE ROCK, ARK.—J. H. Hee's and others have asked for a franchise to [illegible] several streets of the city.

MILFORD, MASS.—At a special town meeting $2,000 was subscribed upon condition that the proposed electric road be constructed.

CHESTER, PA.—The preliminary surveys are completed for the Prospect Park Street Railway, and work will soon be commenced.

ASHLAND, MO.—An electric railway from Ashland to Mexico and passing [illegible] is reported to be under consideration.

CLARKSVILLE, TENN.—The Clarksville City Railway Company is in the market for electrical car equipments. Wm. Daniels is president.

ST. LOUIS, MO.—The People's Railway Company, Charles Green, president, is about considering the plan of an underground electric conduit road.

FORT MADISON, IA.—J. C. Hubinger has petitioned the Council for a franchise to operate an electric street railway on certain streets of the city.

GREENVILLE, S. C.—W. A. Hudson and J. C. Smith, with Atlanta parties, are endeavoring to secure a franchise to build an electric road in Greenville.

NIAGARA FALLS, N. Y.—The Buffalo & Lewiston Electric Railway Company has a petition before the Council asking for a franchise in Third Street.

ELIZABETH, N. J.—The Elizabeth Street Railway Company will extend its tracks up Morris Avenue to the city line. Electricity will be used as the motive power.

NEW ORLEANS, LA.—The Canal & Claiborne Street Railway Company is preparing plans to change its line into an electric system. There are 13 miles of road.

SOMERVILLE, MASS.—The Somerville car line will use electricity for its motive power and a new carhouse is to be erected near the terminus in West Somerville.

PRINCESS ANNE, MD.—An electric line will probably be built from Princess Anne to Deal's Island. The distance is about 10 miles. T. Bock and others are interested.

SAN FRANCISCO, CAL.—The Market Street Railway Company is about to expend $100,000 in the improvement and extension of the Ellis and O'Farrell Street lines.

BOWLING GREEN, KY.—The Park City Railway Company will erect a power plant to contain 150-hp generators and to operate eight to ten miles of railway, etc.

FORT WAYNE, IND.—A. B. White, of Fort Wayne, is interested in the project of building an electric railway in Fort Wayne and in the town of New Haven, six miles distant.

NEW HAVEN, CONN.—The managers of the Centreville Electric Road are making arrangements for the extension of the line from its present terminus out to Centreville.

WILLIAMSTOWN, PA.—The City Council has passed an ordinance granting right of way to the Williams Valley Electric Railway Company, over the veto of Chief Burgess Lebo.

HYDE PARK, MASS.—The Selectmen have received a petition from the Norfolk Suburban Street Railway Company for permission to extend its tracks on Hyde Park Avenue.

PAINESVILLE, O.—The Cleveland & Painesville Railway Company has been granted a franchise for an electric railway along the public highway from the west line of Lake County to Painesville.

FORT LEE, N. J.—The Bergen County Traction Company has filed with the township authorities the consents of the propery owners along the route of the proposed extension of the company's lines.

TROY, N. Y.—Steps are being taken to extend the electric line from Albia, the terminus of the Troy City Railway, to West Sand Lake. The estimated cost is $150,000, which amount has been partly subscribed.

RAHWAY, N. J.—J. H. Zingley has secured the right of way from the property owners for an electric railway from the Tottenville Ferry landing at Perth Amboy to Smith's factory, and work will begin at once.

VICKSBURG, MISS.—All difficulties in the way of building an electric line here have been removed by a recent Supreme Court decision, and the citizens are anxious for a road, as well as an electric light plant.

PERSONAL NOTES.

DR. FREDERICK BEDELL, of Cornell University, will sail for Europe on June 1st for a summer on the Continent, and in the fall will attend the meeting of the British Association at Ipswich.

MR. ARNOLD SPILLER, who has been associated with the Buckeye Electric Company, of Cleveland, O., for the last four years, has resigned his position as expert and factory superintendent. He will, after a brief holiday at his home in London, England, make an extended visit to the continent of Europe to take up several matters relating to that branch of electrical manufacture in which he has so successfully been engaged in this country.

Trade and Industrial Notes.

MR. W. J. NEWTON wishes to announce to his friends in the trade that he has severed all connections with the Newton Electric Company and has established the W. J. Newton Company, at 39 and 41 Cortlandt Street, New York, where he is prepared to take orders for his well-known specialties.

AN ALL IRON CAR BARN 40 x 100 feet, is to be built by the Berlin Iron Bridge Company, of East Berlin, Conn., for the Norwalk Tramway Company, of Norwalk, Conn. The Berlin Company has also been awarded the contract for the various extensions of the Central Railway & Electric Company, of New Britain, Conn.

A PROFITABLE TRIP through the South has just been completed by W. C. McKinlock, the genial secretary of the Metropolitan Electric Company, of Chicago. He secured some nice orders, and reports a decided improvement in business. The Metropolitan Company has secured an order for its portable fire hose bridge from the Chicago Transit Company.

J. A. MACHADO, electrical machinery, 203 Broadway, New York, has become the New York manager of the Louisville Electrical Works, Louisville, Ky., and has added their excellent and very complete line of transformers to the other well-known standard goods handled by him. Mr. Machado reports increasing inquiries and sales for Triumph motors, Hill switches, Whitney instruments and other specialties.

GRATIFYING RESULTS are reported by the Electrical Appliance Company of Chicago, as having been secured from numerous tests of Packard lamps made independently by lamp users themselves in different parts of the country. In several cases, it is claimed, it was demonstrated that the Packard lamp would only have to burn a few hundred hours to make its increased efficiency over the other lamps tested pay for the entire first cost of the lamp.

THE NEW KNOEDLER ART GALLERIES, at 355 Fifth Avenue, New York, have been most satisfactorily fitted up throughout with the latest improved reflectors, made by I. P. Frink, 551 Pearl Street, New York. The same firm is now fitting up the Carnegie Library and Art Gallery in Pittsburgh, Pa., putting in their system in three large galleries on each of two floors, and also in the residence of Mr. Joseph Jefferson, Buzzard's Bay, Mass.

STREET LIGHTING.—Nations may be ungrateful, but the chief officials in our western cities are not so constituted, judging from a letter recently received by the Standard Electric Company, of Chicago, from which the following is an extract: "The Standard arc dynamo we bought of you has been in constant use in all-night service, since November, 1893, and has not cost one cent for repairs. I find it more economical to operate—in the amount of power required—than any other dynamo we use."

A NEW ATTACHMENT PLUG AND RECEPTACLE are being put on the market by Wm. T. Pringle & Co., 1028 Filbert Street, Philadelphia, into which they have introduced several features of merit and novelty. This firm's success with switches, switchboards and electric light fittings is largely due to the fact that they do not accept the common opinion that such standard device, are not amendable to further notable improvement, but, on the contrary, find constant occasion for changes in the direction of greater efficiency.

CONGRATULATIONS WERE EXCHANGED BY TELEPHONE between the municipal authorities of Paris, Sherman, Dallas, Fort Worth, Waco and Austin, Tex., upon the recent occasion of the opening of the Erie Telephone Company's long-distance system in Texas, and the lines worked perfectly, the longest distance talked over being from Paris to Austin, which is 350 miles. The Erie Company expects to complete its Austin-Galveston long-distance circuit by July 1. This will make the longest circuit in Texas, from Paris to Galveston, 510 miles.

NEW QUARTERS have been secured by the Chicago branch of the Prentiss Tool & Supply Company, of 115 Liberty Street, New York City, at 62 and 64 South Canal Street. The new quarters are finely located, and equipped with every essential for the convenient and efficient handling of the large business done by the Prentiss Company at this point. The show room and offices occupy a floor space of 40 x 140 feet, and a complete line of new and second-hand machinery of the latest and most improved design will be carried at all times.

THE WHITNEY ELECTRICAL INSTRUMENT COMPANY, of Penacook, N. H., has opened an office at Buffalo, N. Y., in the Erie County Bank Building, where will be carried at all times a large stock of its standard instruments so that the trade in that locality may be promptly suppled. Mr. Frank C. Perkins is in charge of the office as selling agent, and a better selection could not possibly have been made, as Mr. Perkins is as well and favorably known to the trade as are the excellent instruments manufactured by the Whitney Company.

A TREATISE ON THE STEAM SEPARATOR is being distributed free by C. D. Mosher, No. 1 Broadway, New York. The book discusses the object, principle of action, and practical application of the separator, and also contains an abstract of Mr. Kerr's Franklin Institute paper on "The Steam Loop." Concise illustrated descriptions are given of the Mosher separators for steam and oil, with full directions for installation and care and a table of dimensions. Though primarily a trade catalogue, the pamphlet is thoroughly interesting and instructive.

STREET LIGHTING RATES.—Many municipalities have determined to pay a lower rate for street lighting during the coming fiscal year, and where the local lighting company has refused to accept the lessened price, the question of municipal ownership is being agitated. Naturally the central station manager is in a quandary. How best can this problem be solved is the question of the hour. The Standard Electric Company, of Chicago, believes that the solution offered by its Mr. F. E. Drake is worthy of careful consideration, as he claims to effect a very material saving in the operating expenses of arc lighting stations.

THE COST OF OPERATION is one of the most important points discussed by the Sulzer-Vogt Machine Company, of Louisville, Ky., in its new catalogue of electric elevator equipments. Other interesting features of the pamphlet are comparisons between electricity and steam, and electricity and water for elevator operation; a list of advantages embodied in electric elevator mechanism, and descriptions of the controlling and safety devices used by the Sulzer-Vogt Company. The pamphlet here mentioned is a supplement to the company's general catalogue of elevators and elevator machinery, every description of which it manufactures.

PURE DRAWN COPPER is the material which the General Incandescent Arc Light Company, 572 First Avenue, New York, claims to use in its knife blade switches. A catalogue of these switches has recently been issued in which attention is called to this point, and which contains descriptions and prices of every kind of blade switch known to the trade, including special high voltage switches and an electric clock switch designed to turn off the current at any predetermined hour of the day or night. This switch is in extensive use on the circuits of the Edison Illuminating Company, of Brooklyn, and is reported as giving entirely satisfactory service.

STEAM HEATING by the Williames vacuum system is the subject treated in a 55-page catalogue issued by Warren Webster & Co., Inc., of Camden, N. J. In addition to a full explanation of the system, well-illustrated, and some forcible arguments concerning the economy obtainable by the use of it, there are copious testimonials from users, who are practically unanimous in declaring the Williames system entirely satisfactory and capable of fulfilling all the claims made for it by the manufacturers. An interesting detailed statement is presented from Mr. Albert J. Farrell, of the Chicago & Northwestern Railway Company, regarding a large plant in use at the Chicago station of that company.

CHLORIDE SURGICAL BATTERIES.—James G. Biddle, Drexel Building, Philadelphia, as special agent of the Electric Storage Battery Company, has recently brought out a complete line of "Chloride" surgical batteries which promise to meet the requirements of the medical profession in a most satisfactory manner. The lead plates are contained in sealed hard rubber cells, which in turn are handsomely mounted in mahogany cases with rheostats, pilot lamps, commutators, etc. Mr. Biddle is arranging with prominent houses throughout the country to handle these outfits, so that physicians, hospitals and medical colleges can obtain them through local dealers in any large city.

RAW SILK MACHINERY WIPERS.—The American Silk Manufacturing Company, of Philadelphia, the original manufacturer of the genuine raw silk waste machinery wiper in this country, has recently acquired the trade of the Royal Silk Manufacturing Company, of New York, the latter company having gone out of business. It is claimed by the American Silk Manufacturing Company, and freely testified to by users from all parts of the Union, that these original wipers, in connection with their improved special washing compound, furnished free, save over 100 per cent., as compared with cotton waste, in any large steam plant or mill, besides affording immunity from fire due to spontaneous combustion.

STEAM ECONOMY is the object of an adjunct for central stations and power stations which the Holley Steam Engineering Company, 344 Butler Exchange, Providence, Mass., is now manufacturing, and which it has lately applied in the power house of the Broadway Cable road, of New York, and the tunnel power house of the Baltimore & Ohio Railway Company, Baltimore. The Holly gravity return, as it is known, is a system for returning condensation water from engines and piping of steam plants to the boiler without pumps, traps or similar devices. The apparatus employed for this purpose is vastly more simple and reliable than the devices it replaces, and enables a notable saving in coal to be made.

INCREASING NUMBERS.—The Ball Engine Company, of Erie, Pa., continues to add to the number of its patrons. Ball engines, direct-connected to "C.& C." dynamos, will be used in the new National Bank of Commerce Building, Pittsburg, and the Tradesmen's Bank Building will have an electric light plant driven by three Ball engines. A 225-hp engine has been sold to the Edison Light & Power Company, La Crosse, Wis., to drive two General Electric dynamos, direct-connected, one on each side of the engine. The Mount Washington Light & Power Company, Hollins, Md.; the Juvenile Offenders' Home, Geneva, Ill., and the Catholic University, at Washington, D. C., are among recent purchasers of Ball engines.

INTERESTING INFORMATION is contained in a pamphlet just published by the Electric Storage Battery Company, of Philadelphia, in which the use of accumulators for telegraph work is exhaustively treated. "Chloride" accumulators, of course, form the "burden of the song," and the fact that these have been adopted by the Western Union, Postal Telegraph, American Bell Telephone and Gold & Stock companies would seem to furnish ample justification for the claim that they leave practically nothing in reason to be desired. The pamphlet contains diagrammatic illustrations of storage battery installations in several large telegraph offices, including the Western Union office at Atlanta and the Postal office at Baltimore. Particular attention is called to the great convenience and cleanliness of accumulators as compared with [illegible] the sulphate of copper batteries generally used heretofore. Although the pamphlet has been out only a week, the company has received a great many inquiries regarding storage batteries for telegraphic and general work.

A NEW ENGINEERING ENTERPRISE.—Messrs. Shepard & Searing, mechanical and electrical engineers, of Denver, Col., in conjunction with Mr. William T. Miller, formerly owner of the Miller Forge Company, of Pittsburg, Pa., have purchased the machine shops and foundry of the Overland Machinery Company, of Denver, and have incorporated the Denver Engineering Works Company to manufacture mining, milling and smelting machinery, and take contracts to design and erect complete mining, steam and electric plants. Especial attention will be given to the electrical transmission of power as applied to mines and smelters, in which they have had considerable experience. The officers of the company are: President, William T. Miller; vice-president, Frank E. Shepard; secretary and treasurer, Lewis Searing. The Board of Directors contains some of the best men of Denver: Henry R. Wolcott, president of the Denver Equitable Company; Julian A. Kebler, general manager of the Colorado Fuel & Iron Company; John L. Jerome, treasurer of the Overland Cotton Mills, and H. H. Dunham, of Wolcott & Vaile.

THE CRY MADE AGAINST OVERHEAD WIRES has caused a considerable increase in the demand for underground conduits, and, as a consequence of this demand, the Michigan Pipe Company, of Bay City, Mich., a large manufacturer of wooden pipe, situated near the finest forests east of the Rocky Mountains, has recently put in special machinery and a modern creosoting plant for making and treating underground conduits. It has been found necessary to have the holes in the conduit smooth and straight, without "shoulders" in the holes or "lips" at the joints, and to have as few joints as possible. It is also desirable to have the materials from which the conduits are made softer than the lead coverings of the cables so as not to scratch them or offer resistance in pulling them through from manhole to manhole. Wooden conduits fill all these requirements, and when treated with dead oil of coal tar will last for years. The superior qualities of creosoted wooden conduits have been recognized from the first in Philadelphia, where 625 miles of buried wires have been said in them, and in Brooklyn where the New York and New Jersey Telephone Company has 150 miles of it. In Boston large quantities have been laid, and a great deal is being laid there at the present time. The Michigan Pipe Company is now turning out large quantities of creosoted conduit for eastern points.

Business Notices.

ELECTRIC LEAGUE.—Meets every Thursday evening, 100 West 24th Street. Electrical engineers and electricians cordially invited.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren Street, Syracuse, N. Y.

NOTICE IS HERBY GIVEN that I have no connection with the old Newton Electric Company and am not in any way responsible for debts contracted by them since April 11 last. W. J. NEWTON, 39 Cortlandt Street, New York.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 4, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

REISSUE of 527,958. 11,498. ELECTRICAL SIGNALLING SYSTEM; B. A. Fiske, United States Navy. App. filed Feb. 16, 1895. The combination of a source of electricity, two bodies of conducting material, two contacts moving thereon, an electrical indicating instrument, the said elements being connected in a Wheatstone bridge circuit, the said circuit being constructed so that when the two contact arms on the conductors press at points similarly marked at the two stations, the bridge is not in equilibrium, and the indicating instrument is normally deflected, so that any disarrangement of the circuit will cause it to fly back to a neutral position and thus indicate the defect.

540,239. TELEPHONE SYSTEM; W. W. Dean, St. Louis, Mo. App. filed Feb. 21, 1895. The combination of a number of lines extending to a central station, a battery at the said central station connected with all of said lines, a retardation coil included in circuit between each line, a storage battery in the line circuit at each sub-station and adapted to be traversed by current from the said battery, and switch contacts controlled by the removal of the telephone from its hook for closing the said storage battery in a local circuit with the microphone and the primary of the induction coil, whereby the storage batteries are charged by the central station battery, the interposition of the said retardation coils preventing the diverting of the voice currents.

540,244. ELECTRIC HEATER; E. E. Gold, New York, N. Y. App. filed Jan. 29, 1895. The combination of horizontal coils of resistant wire and vertical insulating supporting plates, having end projections between which the coils are stretched and lateral projections embracing the coils at intervals on opposite sides and constructed to leave air spaces between the plates and free openings at top and bottom for the circulation of air through the coils.

540,264. APPARATUS FOR EXTINGUISHING FIRES; J. G. Lorrain, London, England. App. filed Sept. 28, 1893. The combination of a valve and a piece of fusible conducting material inserted as a wedge between two parts of the apparatus and serving to sustain the valve in normal position, a source of electric energy having a circuit, and a circuit closer for the said circuit.

540,305. CLOSED CONDUIT ELECTRIC RAILWAY; M. F. Flynn, Stamford, Conn. App. filed July 28, 1894. The combination of a conduit having supply and return wires therein, a contact rail with a trolley mounted thereon, switches at intervals on the said contact rail adapted to connect with the supply and return wires, and mechanism carried by the trolley to successively close and open the switches to the supply wire.

540,323. ELECTROMAGNETIC WINDING; O. F. Loomis and C. A. Pierce, Bound Brook, N. J. App. filed March 9, 1895. A winding or coil comprising a tape composed of sets of strips of metal arranged end to end, the strips of each set being placed flatly together, said sets being connected together at the overhanging ends and forming smooth lap joints wih each other and wound on edge.

540,325. ELECTRICAL TROLLEY FOR CANAL BOATS; A. C. Mather, Chicago, Ill. App. filed Dec. 1, 1893. A canal boat fitted with a trolley having special arrangements to enable the trolley to swing with the movement of the boat and prevent the said trolley from jumping from the wire.

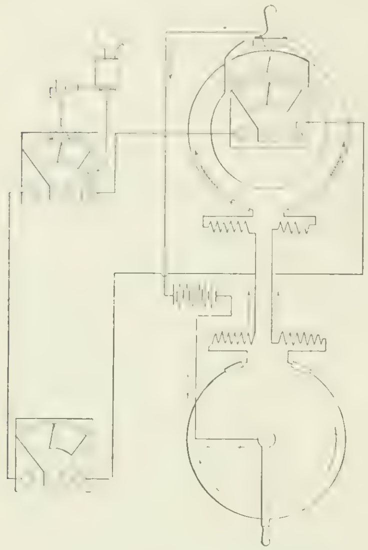
540,333. ELECTRIC ARC LAMP AND CARBON; C. A. Pfluger, Chicago, Ill. App. filed Oct. 13, 1894. The combination of a carbon-feeding mechanism with two electrodes, each elliptical in cross-section and composed of an outer wall of carbon with an inner carbon material, also elliptical and varying in texture from the outer wall.

540,340. TROLLEY POLE WITH LOCKING WHEELS; T. Thomson, Newark, N. J. App. filed Oct. 29, 1894. The combination of a trolley pole, having a suitable arm, trolley wheels set one in advance of the other and adapted to be forced together by a spring to clutch the wire, and a device attached to the trolley leader to release the wheels from the wire.

540,341. ELECTRIC BURGLAR ALARM; J. Tomney, New York, N. Y. App. filed May 2, 1892. The combination of a circuit extending through the premises to be guarded, a signaling instrument, a commutator for bringing into circuit temporarily a predetermined resistance at the time of closing up the guarded premises.

540,351. DYNAMO-ELECTRIC MACHINE; G. De Camp, St. Louis, Mo. App. filed Sept. 24, 1894. The combination of a shaft having bearings between the field magnets, an armature mounted on such shaft on the opposite of the field magnets from the armature and balancing the same, such armature and fly-wheel adapted to revolve parallel to the field magnet coils.

540,352. PAPER REGISTERING MACHINE, T. C. Dexter, Pearl River, N. Y. App filed Aug 8 1894. A paper registering machine having mechanism for shifting the paper laterally, a plurality of electric circuits, electromagnets therein, controlling the action of the said mechanism on the paper, and two separate circuit controllers at opposite sides of the longitudinal path of the paper, adjusted independently of each other.



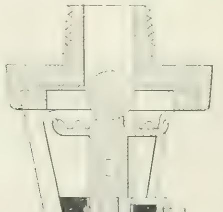
No. 11,498.—Electrical Signaling System.

540,358. ELECTRIC SWITCH; J. O. Heinze, Jr., Lynn, Mass. App. filed Dec. 4, 1894. A switch having one or more blades attached to a shaft, one or more boxes on the shaft for receiving one end of each blade, the shaft having a handle for actuating it, a pin secured to the shaft, and a spring having a seat for receiving the pin and holding the shaft in a fixed position when the blades are in contact with the contact pieces, and means for moving the shaft from engagement with the spring as the blades leave the contact pieces to permit the spring to exert its tension on the shaft and thereby give an increased impetus to it.

540,367. CONTACT POST; R. Segerdahl, Chicago, Ill. App. filed March 29, 1894. A hollow standard of non-conducting material with an adjustable contact passing through it, and a connector which is part of an electric circuit arranged to engage with the contact, so that the same may be introduced in and maintained as a part of the circuit.

540,398. ELECTRIC HEATER; J. E. Meek, Denver, Col. App. filed Feb. 5, 1894. A heating conductor laced with the threads of a flexible non-conducting and non-combustible fabric.

540,404. ELECTRIC ARC LAMP; H. Radcliffe, Milwaukee, Wis. App. filed March 19, 1895. The combination of a carbon holder, a movable arm secured thereto and passing within a casing but insulated therefrom, another carbon holder secured to the casing and insulated from it, and a nut or block secured to the movable arm and a screw rod in engagement with the nut or block.



No. 540,264.—Fire Extinguisher.

40,422. SIGNAL TRANSMITTING APPARATUS AND SYSTEM; H. A. Chase, Boston, Mass. App. filed Sept. 1, 1892. The combination of a box or case provided with a normally closed door, a signal transmitting mechanism therein, arranged and constructed to transmit one kind of signal with the box door open, and another kind when the door is closed, an actuating device for the transmitting mechanism, and means operated by the actuating device to prevent the door being opened or closed while a signal is being transmitted.

540,443. AUTOMATIC SWITCH; A. H. Hobart, Bridgeville, Mass. App. filed Oct. 6, 1894. A switch having a rotating disc, a sector-gear adjustably held on the disc, a gear to be meshed by the sector-gear, and an electric switch composed of a rotating carrier having metal contacts and adapted to be rotated by the gear.

540,456. ELECTRIC MOTOR; F. Pierce, New York, N. Y. App. filed Dec. 3, 1890. The combination of electromagnets, armatures, a rotating shaft, a circuit-breaking arm and contact points, and a spring fastened to one end of the arm and to a rigid support and a block on the armature shaft for vibrating the circuit-breaking arm.

540,463. ELECTRIC GAS LIGHTER; G. W. Shepherd, Philadelphia, Pa. App. filed March 13, 1895. The combination of a screen, a removable crown, a fixed terminal carried by the crown but insulated therefrom and detachably secured to the conductor, and a movable conductor also carried by the crown and made detachable so that the head with the two terminals can be removed from the burner for repairs.

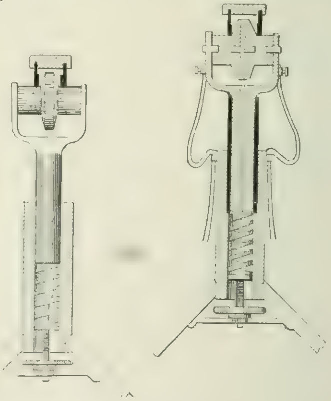
540,477. TELEGRAPHY; C. R. J. Willot, Paris, France. App. filed April 24, 1894. The combination of a transmitting key connected to the cable by two polarized relays, one acting under the influence of positive emissions, and the other acting under the negative emissions, the relays so adjusted that they are only operated by emissions having a greater duration than that corresponding to a dot of the code, and so determine the blank space operating the signals.

540,480. APPARATUS FOR USE WITH ELECTRICALLY ILLUMINATED SIGNS OR ADVERTISEMENTS; E. L. Berry and F. Harrison, London, England. App. filed Nov. 21 1894. The combination of two or more circuits and a switch provided with contacts arranged to break contact with the brush alternately at opposite edges of the brush.

540,486. TROLLEY FOR ELECTRIC RAILWAYS; T. Euphrat, Darien, Conn. App. filed March 5, 1895. The combination of a fork having an ordinary wheel pivoted in the jaws by the usual trolley wheel pivot and the beak resting on the head of the fork, and the trolley wheel having the grease chamber and the detachable trolley pivot confined by the jaws of the fork when in the working position.

540,487. ICE DETACHING TROLLEY FOR ELECTRIC RAILWAYS; T. Euphrat, Darien, Conn. App. filed March 22, 1895. A trolley wheel having a grooved serrated ice-breaking face in combination with the usual trolley wheel and pole.

540,529. ELECTRICALLY CONTROLLED SPEAKING TUBE; G. Williamson, McKeesport, Penn. App. filed Feb. 18, 1895. A speaking tube provided with a signal box comprising a casing divided into chambers of which one is connected with the main speaking tube, and the second is provided with a mouth-piece, a valve controlling the connection between the first and second chambers, a whistle arranged between the first and third chambers, and a lever for closing the whistle.



No. 540,325.—Electrical Trolley for Canal Boats. One of the Blower Motors.

540,540. UNDERGROUND ELECTRICAL CONDUCTOR AND METHOD OF MANUFACTURING SAME; J. H. Croskey and J. Locke, Pittsburg, Pa. App. filed Jan. 17, 1895. An insulated electric conductor section comprising a wire or wires, a solid mass of pressed glass in which the same is imbedded and a split metallic tube inclosing said glass.

540,557. ELECTRIC REGULATOR; J. McKim, Weir, Kan. App. filed Sept. 12, 1892. An electric regulator consisting of a hollow coil located in an alternating current circuit, electric lamps in said circuit, a core, a switch lever connected to said core in such manner that the movement of the one affects the position of the other, and a contact plate also located in the circuit and in the path of said switch lever, so that when the same is in contact with said plate the circuit is completed, and the movement of the lever in one direction or the other and the consequent movement of the core farther in or out of the coil, either diminishes or increases the brilliancy of the electric lights.

540,500. CONDUIT ELECTRIC RAILWAY SYSTEM; C. M. Allen, San Francisco, Cal. App. filed Oct. 3, 1894. A conduit having a series of contact boxes fixed therein, and at one side of the opening an insulated main conductor, movable plates also within the conduit having shanks extending through the boxes and provided with rollers, a contact bar supported from the car and adapted to travel with it to form contact with the rollers and force the contact plates together as it passes, and means for withdrawing the movable contact from a stationary one.

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RECENT PATENT DECISIONS.

In the course of some editorial remarks recently made under the above caption, we were led by the misinterpretation of a leading patent decision, into a misstatement as to the effect on an American inventor of the prior issue of a foreign patent for the same invention. As pointed out by Messrs. Hey & Parsons in another column, our construction is only true if the American inventor applies for a domestic patent on an invention he conceived and reduced to practice in a foreign country. In this instance his application will be barred by that of a foreign patentee, even though the former is the prior inventor, as the priority of the conception and reduction to practice of an invention made abroad will not be recognized as against the foreign patent of the other applicant. As the conditions referred to are rarely likely to exist, the principle quoted is one of little practical importance.

ELECTRICITY ON THE ELEVATED ROADS.

Quite a flurry was created last week by a positive announcement in the daily papers that the management of the Manhattan Elevated Railway system had entered into a contract with the Westinghouse Company for the equipment of its lines with electric power—the contract calling for an expenditure of $8,000,000. The following day as positive a contradiction of the report was published on the part of the Manhattan Company, but with the admission that while it had not yet been definitely decided to abandon steam power, that matter was being seriously considered, and that an examination is now under way with a view to finally determining the question. It was also denied that any preliminary arrangement had been entered into with the Westinghouse Company or that the rivals of that company would be discriminated against in the purchase of a prospective equipment. While the adoption of electricity is thus not yet absolutely determined upon, it seems very probable that the time is near at hand for that consummation.

MAGNETIC SYMBOLS AND UNITS.

Our English contemporary, the *Electrician*, in a slashing editorial which brings up remembrances of a time when such editorials in its columns were not the exception, refers to the use of the symbols recommended by the Committee on Units of the International Electrical Congress, and the employment of the names adopted by the American Institute of Electrical Engineers for the magnetic units, as an "anarchic tendency" which it refuses to countenance any further. If we may be pardoned for imputing a motive we would say that such a motive might be inferred from the remark that "block letters have become well established in this country, "where modern magnetism took its growth"; in other words, block letters are "English," the Congress symbols and A. I. E. E. names are foreign, and, therefore, "anarchic." The symbolism of Ampere, the father of magnetism, but a foreigner, must retire before the symbolism of—whom?—the father of modern magnetism—but an Englishman. Having thus asserted the time-honored principle of insularity, our contemporary proceeds to deface its editorial page with block letters in an attempt to prove that quantities expressing a flux density in air and in iron are as "distinct from each other as amperes are from volts!" Of course, the statement is not made in these words, but it is implied in the conclusion quoted. We also quote the following sentences (in which, however, we substitute the International Congress symbols), as a further illustration of the peculiar views of our contemporary with respect to magnetic quantities: "While $\mathcal{B}$ is, perhaps, the magnetic quantity which can most easily be "measured under all circumstances, $\mathcal{H}$, on the other hand, is, we "venture to think, the magnetic quantity which never has been "directly measured. It has been calculated from the magnetizing "current, and has been determined from the mechanical force "exerted on magnets suspended in air, or from the density of lines "of force produced in air; but when we have to deal with a solid "magnetic medium, there is no means, direct or indirect, of determining $\mathcal{H}$ at any particular point. All that is possible is to "measure the magnetizing current, and to calculate, by means of "assumptions, an average value of $\mathcal{H}$." No stronger argument for the introduction of the term *gauss* could exist than the apparent deplorable misconception which so eminent a paper as the *Electrician* reveals concerning the relation between these two quantities. This looseness of thought and expression arises only from a want of a proper terminology, for as soon as proper units are introduced, such errors become impossible.

THE BERLINER OPINION.

We print elsewhere a synopsis of the belated opinion of the United States Circuit Court of Appeals, at Boston, in the Berliner case, which confirms the prediction made in these columns that the important issue with respect to the validity of the 1891 Berliner patent remains practically unaffected. To many the opinion will appear to possess an *ex parte* tone not usually associated with judicial utterances, but this may reasonably be ascribed to a probable tendency on the part of the legal mind to treat a decision after it has once been definitely determined, as if it were the subject of a brief. There are others, however, who do not consider the atmosphere of Boston a particularly healthy one in which to try a telephone case, and these may be inclined to place on this feature another construction than the one just suggested. It will be seen that the court showed little respect for the fraud issue, going so far as to say that the record rather suggests hostility on the part of the Patent Office toward the American Bell Company. Nor is it any more patient with the contention of the Government that it was incumbent upon the officials of that company to suggest methods to speed the microphone application, and that its possession of the fundamental Bell telephone patent added a duty in this respect. The court considers that a certain situation existed, unfavorable, perhaps, toward the public interest, but since the American Bell Company had done all that reasonable usage required, it is not subject to just criticism for accepting that situation as it found it. The unusual delay in the issue of the patent is ascribed to the Patent Office system and the first portion of the opinion concludes with a suggestion that Congress should pass the necessary legislation to correct this evil, which is declared to be beyond the reach of the judiciary. On the other issue of the suit—that the 1891 Berliner patent is void on the ground that the 1880 Berliner patent was granted for the same invention on the same application to the same inventor—it was decided that, as the grant of the later patent was within the lawful authority of the Commissioner of Patents, and no proof of fraud or gross error existing, the courts have no jurisdiction in the present action. With a remarkable exception that will be referred to later, this portion of the opinion is confined to arguments showing that the court is barred by statute from jurisdiction to determine the identity of the two patents, and it is expressly stated that the question of the validity of the later patent is left without prejudice, to be tested, if desired, by other methods provided by law, should it involve other individual or corporate rights. The exception above mentioned is a suggestion by the court that the case at bar does not, as contended by the Government, come under the Miller vs. Eagle decision; the suggestion seems to be an entirely gratuitous one, as it is made as a remark and then dismissed with the statement that, as the point was not made by the Bell Company the court cannot take cognizance of it. The point made in the suggestion is rather obscure, but apparently means that as the Eagle vs. Miller case involves two patents for the same invention issued to the same applicant, it does not fit the facts in the Berliner case, where the 1880 patent was issued to Berliner, and the 1891 patent to the American Bell Telephone Company as the assignee of Berliner. Assuming, however, that this is true, and that the Miller vs. Eagle case cannot be applied to the facts as presented by the Government in the present case, the issue thus presented is merely a technical one, and does not imply that the 1891 patent is valid. As we recently observed in these columns, the Miller vs. Eagle decision was of importance, not on account of establishing any new principle, but because it authoritatively interprets the old established principle that two patents cannot be issued for one and the same invention. If the Government has erred, as suggested, it has done so in attempting to correlate one set of facts to another set when the conditions of the two were different. The result will be that in future litigation, should the suggestion be considered to have weight, the test of validity will probably be directly applied, instead of indirectly, as in the present case. The refusal to permit the filing of an amendment to the bill, alleging collusion between the Bell and Drawbaugh interests, is based upon the ground that in a case on appeal no new matter can be considered, so that the refusal does not affect the strength of allegations. In conclusion it may then be said that while the opinion may dispose of the issue of illegal delay as based upon the facts presented, it leaves unprejudiced the additional charges made in the amendment. As to the validity of the 1891 patent, this issue is in better condition than before Judge Carpenter's opinion, for it has the weight of his adjudication in its favor, and is unaffected by the decision on appeal, not excepting, we believe it may be said, the suggestion of the latter court. The opinion, therefore, as predicted in these columns, materially modifies the adverse conclusions that might have been drawn from the bare decision, and the course now indicated is a contest by an alleged infringer of the validity of the 1891 patent on all of the points entering. Such a suit would seem to have a more favorable prospect than the Government suit at any time presented, for it would involve none of the complications that have entered into the latter.

The Buffalo-Niagara Franchise.

At the meeting of the Buffalo Council on June 6, the astonishing announcement was made that the Niagara Falls Power Company had not yet been officially notified of the action some weeks ago of the Council with respect to granting a franchise to that company for the introduction of current from Niagara into the city. At the same meeting of the Council, Jacob Busch and Thomas Murphy, on the part of another company, asked permission to lay conduits, string wires and erect poles throughout the city.

The petition stated that the Niagara Falls Power Company had been negotiating with the city for about a year without accomplishing anything. It was also stated that the applicant company would arrange to connect with any power company, and that it desired the privilege of using any and all of the streets of the city subject to reasonable restrictions. The application was tabled by the committee for two weeks, and the corporation counsel requested to prepare a franchise and to advise the aldermen of the power vested in the city to grant a franchise.

Niagara Meeting of the American Institute of Electrical Engineers.

Since the preliminary programmes of the Niagara Falls meeting were distributed to the members, the convention rate of one and one-third fare on the certificate plan, has been granted by the Central Traffic Association and the Boston Passenger Committee. This together with the concession of the Trunk Line Association covers practically all the territory east of the Mississippi River and north of Richmond and St. Louis, conditional upon an attendance of 100 who have traveled by rail to the meeting. Those who expect to attend the meeting, whether members or not, are requested to send their names to the secretary at 26 Cortlandt Street, New York.

Production of Copper and Zinc.

Comparing the production of copper and zinc for the years 1893-94, the *Engineering and Mining Journal* says that while our total production of copper showed an increase of 26,250,000 pounds, the estimated value at the place of production was lower by $1,640,000 in 1894 than in 1893. The output of copper during the last year was 110,483 metric tons, and of zinc, 74,004 metric tons. Similarly, the production of zinc decreased only 2,250 tons or about 3 per cent., while the value reported was less by about $1,000,000 or 16.6 per cent.

The Berliner Opinion.

The opinion of the United States Court of Appeals in the Berliner case, which was made public on Friday of last week, is of unusual length, covering 40 large octavo pages as printed. The opinion was written by Justice Putnam and concurred in by Justices Colt and Nelson. The greater portion is devoted to considering the issue of illegal delay, and of this we shall abstract merely the more general clauses, as the arguments refer principally to technical points in Patent Office procedure, and to the course of the Drawbaugh patent litigation.

The opinion first takes up the point of illegal delay in issue, and proceeds to dismiss from consideration the point, that since the Berliner patent extends "against justice and equity" the original monopoly of the Bell Telephone Company, the latter company should therefore have exercised extraordinary diligence in speeding the Berliner application. So far as the law is concerned, it is held, the patent in suit is to be tested independently of the Bell patent. There can be but one law touching alleged delays in the progress of an application through the Patent Office, and touching the duty of applicants with reference thereto, whether the invention was from the outset seen to be valuable, or only afterward proves to be so, or always remains of little account. To deny this is to deny that the laws are equal, and would furnish a standard for the determination of the rights of patentees too fickle and imaginative to form a proper basis for the use of a court of law.

Exception is taken to Judge Carpenter's statement that the Bell Company "intentionally delayed" the prosecution of the Berliner application, the evidence only admitting of a claim that it submitted to delays which it was in its power to prevent. In order, however, to undertake to lay down a rule of law or of fact that acquiescence in the delay of a public official who is bound to perform a certain act involves an unlawful purpose because it may result to the advantage of the applicant, an important element should not be omitted. If the applicant is under no obligation touching the delay, there is no rule of law by which it can be said that, because he may receive an incidental benefit therefrom, his purpose in relation thereto is unlawful. A man's motives will not make wrongful an act which, in itself, is not wrongful.

Referring to the epithets charging the commissioner, and other officers of the Patent Office, with conscious violation or neglect of duty, or ignorance and incapacity, the opinion states that they are unsupported by the proofs in the case, unless it can be claimed that they constitute the language which the law applies in consequence of delays which possibly might have been prevented by the public officials.

The court feels compelled to say that if the record suggests any dereliction of official duty, it was in the form of a continued hostility to the American Bell Telephone Company, and of an indisposition to grant the application for the Berliner microphone, with a concurrent disposition to nurse and favor the Drawbaugh application, either for its own direct advantage, or for the purpose of defeating inventions controlled by the defendant corporation. Notwithstanding the proofs do not convict the officials, they show enough to have warranted the American Bell Telephone Company in guarding itself against the possibility of such a disposition on their part during the period covered by the nine years between June 9, 1882, and the issuing of the patent now in dispute. Under these circumstances, and after the American Bell Telephone Company and its solicitors had performed the customary duties with reference to the forwarding of its application, including all those things required by statute, or by the Patent Office, the prompt performance of all which is conceded by the United States, it is not for a court of law to say that that corporation, as to all the unofficial methods which it might take, or might omit to take, for the advantage of its case, was not entitled to use its own judgment with reference to the methods and persistency of representation to public officers, especially those whom they had some reason to regard as unfriendly.

As to the extreme diligence incumbent on the part of the Bell Company, the court holds that the United States has not established that such a duty was necessary. As far as the proofs go, the course of the application was in accordance with the usages of the Patent Office, and was such as the officials there, acting in good faith and according to their practical experience, determined at the time to be on the whole the best. To say that the Bell Company was, as claimed, bound to do in the public interest all that it had a right to do in its own, and that if it did not do this it should pay the penalty of a forfeiture of an invention said to be extremely valuable, is, the opinion states, a proposition so unreasonable that the mere statement of it by the United States seems to confess the weakness of its case. It declares that the whole tenor of the case of the United States, so far as it is supported by the proofs, has this same aspect, through the appearance of requiring of the defendant corporation a degree of diligence and astuteness apparently greater than that which would be expected from other inventors.

After examining the evidence the court states that it is plain the commissioners were at various crucial points personally acquainted with the magnitude of the controversy, and with some of its details. Knowing its magnitude, they knew, at least in a general way, that detriment to the public interests would come from delay in the progress of the case, in the event that it was followed by the issue of a patent. This was all which it was necessary they should know, as it is the pith of the entire complaint of the United States. Having this knowledge, the claim of the United States that the American Bell Telephone Company should have suggested on the record, or anywhere else, that delay in the application was prolonging the monopoly of the microphone, falls, of course, to the ground, unless the extreme proposition is accepted that it was the duty of that corporation to keep this fact constantly before the eyes of the commissioner personally.

Discussing the claim that the Patent Office could have disposed of the Drawbaugh application, and thereby released the Berliner, the court says that the American Bell Telephone Company was compelled, with reference to the progress of this application, to meet the practical condition of things, and, therefore, whatever may now be said as to the theoretical side of the law, it is more appropriate to the purposes of this case to observe that Drawbaugh's solicitors did succeed in practically retaining his application under adjudication by the Patent Office, until near the close of October, 1891. The American Bell Company is not subject to just criticism if it accepted the situation as it found it.

In regard to awaiting the result of litigation in the Drawbaugh case, the court says it is satisfied from the evidence, and the reason and probabilities of the thing, that whatever common consent there was to abide the result of the litigation, was the consequence of the independent judgment, formed fairly and honestly—at least by the officials of the Patent Office and by the representatives of the American Bell Telephone Company—that on the whole this was the best thing to do; and the common consent consisted only in the interchange of these views. But assuming, the opinion continues, that it was not wise, that, under the circumstances, the commissioner made an error of judgment, that it was his duty to have proceeded regardless of the pending litigation, and that also the American Bell Telephone Company committed an error in sharing his judgment, is the court to impose on this corporation the penalty of losing its valuable patent on that account, and give the United States, whose officers also shared in the same error, the entire benefit of the penalty? On every principle such a conclusion would be an outrage on justice, and in violation of the fundamental rules by which the law refrains from imposing punishments on parties who honestly exercise their judgments under the existing circumstances, especially circumstances of difficulty. The court concluded that in this connection the American Bell Company had done all that reasonable usage required of it.

The practical summing up of the various suggestions of the Government, according to the Court, amounts virtually to a censure of the American Bell Company for not reforming both the practice and officials of the Patent Office, and it thinks that the case may be justly stated in this form; this demand is declared without parallel or precedent, and thus put, the case shows itself so revolutionary as to require the legal mind to request it on mere statement.

The opinion on the issue of illegal delay concludes by stating that the United States has not established that there rested with the Bell Company an extraordinary duty which could be discharged only by the greatest possible diligence in the prosecution of its application. Moreover, if there was any such rule in law, the United States has failed to meet the burden resting on them, of proving that the lack of compliance with it in this case had any practical result in producing the delays complained of. It would, indeed, be quite plausible to declare that the American Bell Telephone Company, with all its resources, could have found some way to break the deadlock if it had earnestly desired so to do. But the courts have never yet been vested with authority to deprive any person or corporation of property or rights on the strength of any such mere assertion, nor without allegations and proofs in a definite and practical form. The lack of these aids the proposition that there is no such obligation as claimed by the United States. There is no precedent, nor does the proposition of the United States rest on any principle which can be supported by authority from any quarter, or by any method of reasoning which connects it with any fundamental legal doctrine. By granting a patent for a meritorious invention the United States parts with nothing which it before had, but only recognizes and supports for a limited period the equitable title of the patentee. The court thinks this is the first instance where the common law prevails, that it has been sought to revoke by legal proceedings, on the ground of imputed or merely legal fraud, a grant of this character, issued to a subject after full official knowledge of all the facts, where there has been no deceit, collusion or corruption, and where the subject duly complied with all statutory and departmental requirements, merely because the officers in charge have been dilatory and the subject failed to use zeal in spurring them on. The law goes quite far enough in protecting the State against the acts and omissions of its agents, without the court pushing to the extreme of adopting this heretofore unheard of proposition.

The court adds that while the delay in this case was unusual, it was not unprecedented, as shown by the record, and results from something in the Patent Office system which should be corrected by Congress and cannot be reached by the courts.

The other issue in the suit is then taken up—that the 1891 Berliner patent is void on the ground that the 1880 Berliner patent was granted upon the same application to the same applicant for the same invention. Referring to the fact that the United States rests its case on this point on the Miller vs. Eagle Manufacturing Company decision, the court remarks that the facts in the case at bar on their face are not like those of the Miller vs. Eagle, as here the two patents claimed to interfere were not issued to the same applicant, and the acquirement, after it issued, by the American Bell of the 1880 patent would not necessarily estop the assignee. As this point is not made by the Bell Company, the court considers that the case raises an estoppel, of which the parties were aware, not brought to the attention of the court, and, therefore, it is compelled to investigate the question independently of that suggestion.

The opinion proceeds to say that the most that can be claimed by the United States is that the officials of the Patent Office, having all the law and facts before them, erred in the exercise of their free judgment in the determination that the earlier patent did cover the invention described and claimed in the later one. Even were this so, the result was not a mistake in the sense of the law in its application to the principles of cancellation of deeds and other instruments; but it was merely an erroneous judgment and determination of the ultimate fact deduced from the primary facts, all of which were known.

As the court is clear that this proposition of the United States cannot be sustained on the law, even admitting the facts to be as claimed, it adds that it will not undertake to determine the question of the substantial identity of the respective claims of the two patents, or any of them, preferring to leave that without prejudice' in the event it hereafter involves other individual or corporate rights.

The court considers the main question to be, whether the issuing of the second patent to the same applicants for the same invention, under such circumstances that it was not clearly manifest that the inventions were the same, and that there might be a reasonable difference of opinion on the point of identity, involved in the view of the statutes touching patents such an excess of power as would justify a court in equity in rescinding the second patent thus issued. The court states it cannot put the case more strongly than this in favor of the United States, because at the best it must be admitted by the United States that there is a reasonable doubt on the point of identity. A number of decisions are cited and discussed, and the court concludes that it is evident that the action of the commissioners, so far as this issue is concerned, was merely a finding of facts, and that a statute quoted vests in the commissioner of patents authority to issue such patents as on examination he deems proper to issue, that none such issued are *ultra vires*, that all such are within the scope of his powers within the meaning of expressions cited from the Supreme Court, and that there is nothing in this case which excepts it from the general rule, that, under these circumstances, the courts can exercise no jurisdiction.

"But," concludes the opinion on this point, "we have pursued the matter already further than was necessary. It is clear, on this part of the case, that we are barred from taking jurisdiction by reason of the statute provisions which give special remedies to an applicant whose patent is refused, and, passing by this, that also the issue of this patent was within the scope of the authority of the Commissioner, and no mistake being proven, and no other equitable ground appearing, we cannot revise his action in this suit."

The court refuses permission to file an amendment to the bill, alleging that the Bell Company and representatives of the Drawbaugh application acting in concert procured the consent of the commissioner of patents to await the decision in the Drawbaugh cases, the Bell Company thereby violating its duty to speed the patent for the microphone. The court states that it had already found that, as the record now stands, it contains no proof to sustain an allegation of this character. Therefore, an amendment of this nature would require the opening of the record below for further proofs. It is not at all a case where a complainant has proved his case, but his allegations are found by the Appellate Court to be inapt. To grant this motion would, under the circumstances, violate all the rules requiring diligence from parties complainant.

The decision reverses the decree of the Circuit Court and remands the case to that court with directions to dismiss the bill.

Twaddle.

The following, clipped from a non-technical exchange, is a characteristic specimen of the literature which the public accepts as scientific on account of the jumble of scientific terms employed.

"The time is fast coming when it will be easy to understand the physics of the breath of life, or of the oxygen of respiration, which is also the oxygen of combustion; how the inrush of oxygen by way of the capillary gates of the lungs, and the corpuscles of the blood, to the tissue cells of all parts of the system, carries a ceaseless volume of vital energy; how this animating and life-maintaining energy is nothing less than electricity of absolute dynamic strength and sureness—every breath, according to its size, a definite quantity of vitalizing, heating and sustaining energy; and how the flow and charge of this energy, in all parts of the system, will maintain functions and operate organs, which it has in fact created. The knowledge from which we speak is not yet recognized, because it is new, and belongs to a new system of nature so comprehensive as to require for its demonstration a survey for which the present teachers of science are not prepared, not even the most eminent of them. It requires long and elaborate research to bring into one view the facts of chemistry, of physics, of electricity and magnetism, of zoölogy, anatomy, physiology and botany, and of medicine and surgery, which fall into the demonstration that life is not, as the system now in vogue has it, 'a mysterious potency, always associated with a peculiar form of matter called protoplasm'; and which 'so far as we know, has always resided, as it does to-day, in little masses of protoplasm, called cells' (Dr. T. Mitchell Prudden); but is the definite direct effect of a stream of electrical energy blown into the protoplasm by the oxygen of respiration; but in view of the whole history of science, from Aristotle and Hippocrates to Darwin and Koch—in view of the long roll of demonstrated facts, and of the theories that have held on in the struggle of systems for existence; we may declare with the utmost confidence that the electrical function of the oxygen of respiration in all living things, animal and plant, and the electrical character of vitality in both animals and plants, is by far the surest and best demonstrated, as it is also by far the greatest and most comprehensive discovery the human mind has ever made —even if we take no note of the demonstration, which the system embraces, that all matter is electrically animated, however motionless it seems; that all atoms receive their character from the electrical charge which they carry; that all active properties and functions are electrically established, and that whatever motion exists anywhere in the material universe, from invisible particle to planet wheeling on its vast orbit in space, is due to electrical agency."

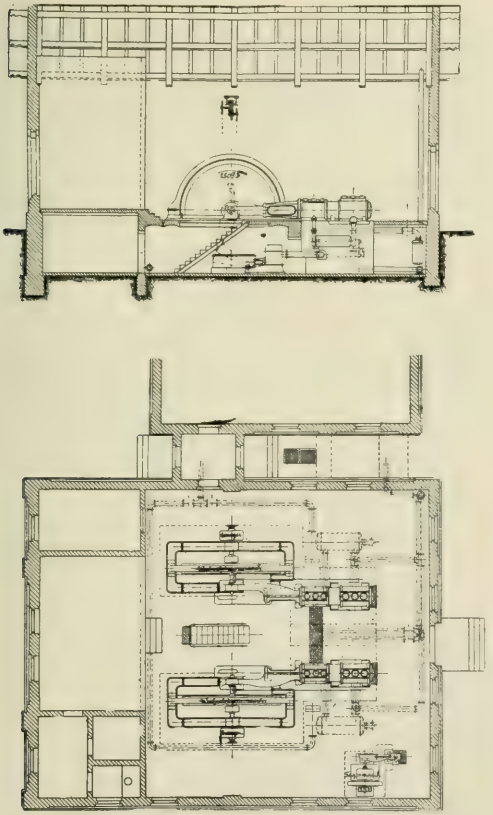
A Western Pennock.

We have received a letter from a subscriber who asks for some information in regard to an "electrician" of St. Louis who has recently interested financially a friend in a new electrical "invention." The St. Louis Pennock claims "to do away with all friction in obtaining electricity, developing all of his power from a mixture of chemicals," and that a box one foot in cubical dimensions will contain enough of his mixture to give 16 hp for 400 hours at a cost of 25 cents for the whole period; moreover, a box of his mixture will run "a storage battery street car" for one month at a cost of $2, developing 16 hp during that time.

The Electric Lighting of the Baltic Canal.

BY CARL COERPER.

A PROBLEM such as the lighting of the 61.3 miles of the Baltic Canal was one that was new to electrical engineering. It is true that the electric current had been carried over a greater distance, to be there used for power and lighting; but this is a comparatively simple problem, which was first solved with practical results by Ganz & Co., of Budapest, in their transmission of the water power of the Arno at Tivoli, 17 miles to Rome, and which cannot be compared in difficulty with the lighting of the whole length of the Baltic Canal. It is easy to conduct the electric current to one point and there regulate it, while there are considerable difficulties in operating at great distances a large number of lamps in line with each other so that the safety and economy of the operation and of the plant is assured. The Helios Company, of Cologne-Ehrenfeld, which during the last ten years has developed and brought into use the alternating-current transformer system in Germany, was in a position to solve the given problem in a complete manner.



PLAN AND ELEVATION OF STATION.

As it was necessary not only to light the line of the canal itself, but also to provide for the great demand for illumination of the locks, harbors, buildings and lighthouses, the following fundamental conditions were laid down:

1. Two operating plants to be built, one at Holtenau, the other at Brunsbüttel.

2. The plants to have the most reliable and economical machinery and apparatus, and a complete reserve is provided.

3. The potential automatically to be kept constant in the two operating plants, however much the load may vary.

4. Each light to be completely independent of the others, so that the extinguishing of a great number of lamps will have no influence on those left burning.

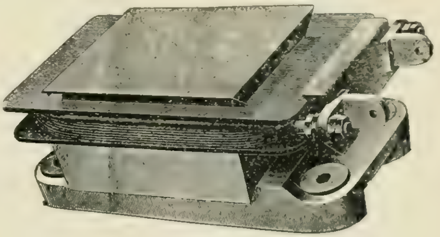
5. All minor accessory apparatus, such as main current regulators, oil insulators, etc., to be avoided.

This programme was carried out in the following manner:

At the two locks at Holtenau and Brunsbüttel central engine plants were erected, containing the hydraulic pressure apparatus for operating the gates of the lock and the windlasses; connected with this was a large boiler plant, which was to be used for operating the electrical machines also.

In accordance with this plan, the buildings for the electrical machines were erected beside the central engine plant, as shown in the accompanying plan.

Each plant contains two Helios low-speed, direct-connected generators. The machines run at only 85 revolutions a minute, and have a capacity of 200 effective horse-power apiece. The steam engines are horizontal tandem with valve governing, and were built by the Augsburg Engine Works. The cylinders are 15.75 and 24.41 inches in diameter, with 39.37 inches stroke. At Holtenau surface condensation is contemplated, but the engines can also be connected with the central condensing apparatus of the hydraulic plant, or can exhaust into the air. Between the two bearings of each steam engine one alternating current machine is mounted on the shaft, the magnetic field forming the fly wheel, while the armature rests on the beams connecting the two bearings. The rim of the fly wheel is hollowed out, and in the recess all around are fastened the 72 magnets, made of laminated plates .02 of an inch thick. Care is taken to have the magnetic circuit complete. The exciting winding is held in place by heavy shoes. The diameter of the magnet wheel is 15 feet 6 inches; the speed at which the lines of force are cut is, accordingly, 65.94 feet per second, with 6,120 alternations per minute.



AN ARMATURE COIL.

The armature is not only divided in the plane of the shaft, so that the upper part can be lifted off, but the whole rim can be moved aside, by means of a track on which it slides, far enough for the magnetic field and the armature coils to be entirely free. Besides this, the armature coils are so arranged that they, together with their cores, can be taken out sideways by loosening four screws.

The accompanying illustration shows an armature coil with an armature core; it is to be remarked that the former ⊥ form is here abandoned; the iron is considerably broadened over the coil on the side toward the magnetic field, so that the cores placed next to each other present a surface, interrupted only by small interstices, to the magnetic influence. The first of these designs was delivered to Amsterdam by the Helios Company in 1889. It has been found that with proper calculations of this arrangement a very considerable improvement of the machine is attained, without having combined therewith the great deficiency of the so-called "hollow armatures."

The potential of the alternating current at the binding posts amounts to 2,000 volts. The current curves and the design of the magnetic and electric parts are so chosen that on the one hand an economical operation of the arc lights with eight volts at the binding posts of the lamps is assured, and on the other, the phase shifting following from the distant transmission, exerts as little influence as possible.

The exciter is a four-pole shunt-field machine, with laminated armature, mounted on the free end of the shaft beyond the outer bearing. The potential of the exciter is from 120 to 150 volts. The field of the exciter is automatically regulated by a Tesla motor without commutator or collecting rings. This motor cuts resistance into the field of the exciter when the potential rises above the 72 volts to which it is transformed in the generator house, and cuts resistance out when the potential drops too low. As this regulation is effected with, at the most, one ampere on the very heavy contacts, it meets the highest requirements of safe and certain operation.

The generators, at normal load, with a steam pressure of 90 pounds at the valves, deliver 100 kw of useful energy to the conductors, with a steam consumption of 2,750 pounds; that is to say, 1 kw with 27.5 pounds of steam per hour.

One generator at Holtenau, as well as one in Brunsbüttel, suffices for full operation, so that the second set of machines forms a complete reserve.

At Brunsbüttel a small steam dynamo of 9 to 12 hp, has been erected for lighting the lock chambers during the daytime. This machine runs at 150 revolutions, and can also be used as a reserve for the excitation of the alternators. The steam engine has a cylinder of 5.91 inches diameter, and 13.78 inches stroke, and is governed by sliding valves

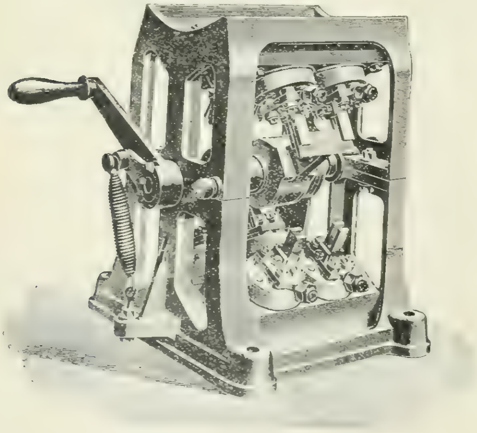
It also was furnished by the Augsburg Engine Works. On its shaft is mounted the laminated armature of a continuous-current shunt-wound machine, with a four-pole field magnet.

As the lock gates at Brunsbüttel have to be moved during the greater part of the day, it became necessary to have this smaller dynamo, as it was not economical to run the large alternators for the small amount of lighting in the machinery chambers in the walls of the lock. At Holtenau, the lock gates are moved only about 25 days in the year, and for this reason a small "day dynamo" was not installed here.

The switching apparatus differs considerably from the switchboard erected by the Helios Company in the large central stations at Cologne and Amsterdam and the one in course of construction at Dresden. Outwardly, considerable attention has been paid to a proper appearance; the Renaissance frame is of gold-colored bronze, beaten work throughout. The operating apparatus is moved by powerful levers, and every connection has a two-pole cut-out switch, as shown in the accompanying cut.

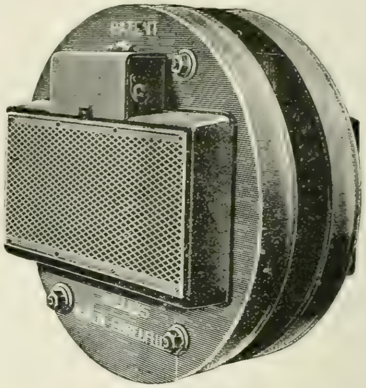
The insulation is triple in every case, consisting of porcelain and a double insulation of hard rubber. All the apparatus is tested with 10,000 volts.

The measuring instruments are all mounted on white marble with hard rubber; these allow not only the potential and current strength of the excitation to be read off at any time, but also the potential and current strength of the alternating current, as well as the useful watts delivered. For parallel coupling there are artificial resistances of asbestos thread wound with nickel alloy wire, which are cut in and out by a key arrangement. The phases are shown not only by two lamps connected with a transformer, whose double high-tension winding is fed by both machines, but also by a phase indicator. This consists of a movable plate in front of two magnet poles energized by the two machines, respectively. In case the phases of both machines agree, the plate stands still, otherwise it moves with the machine whose phase is in advance, in one or the other direction.



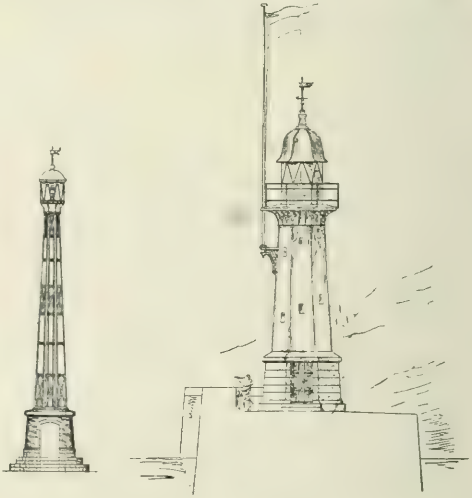
Double-Throw Switch.

For lighting the boiler and engine houses, the buildings, the walls of the locks, the machinery chambers, and the harbors, the high-tension current of 2,000 volts is transformed down to the required working potential by means of standard Helios transformers, such as shown in the accompanying cut. A large number of arc lamps and incandescents have been installed for lighting in and about the plants at Holtenau and Brunsbüttel. The standards on the walls of the locks each hold four lamps of 25 cp apiece. The conductors are almost without exception concentric iron ribbon-armored cables, laid underground. At Brunsbüttel the lighting is as comprehensive as at Holtenau, and concentric cables are also used.



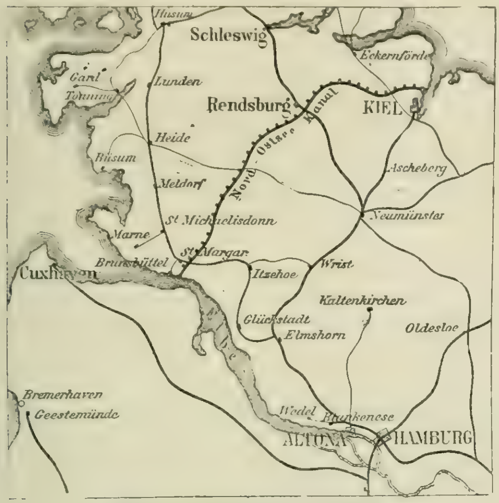
Transformer.

The entrances to the harbors are marked by electric lighthouses. The two harbor lights at Brunsbüttel are at the extreme points of the moles, which extend far into the mouth of the Elbe. At Holtenau, the northern light is placed in the lantern of the "Kaiserhalle," while the southern lighthouse is built of iron frame work on a massive foundation.



Electric Lighthouses.

The line of the canal 61.3 miles long, is divided into four sections in such a manner that one section extends from Holtenau for 29 miles on the north side of the canal and one for the same distance on the south side, and from that point there are two other sections, one on each side of the canal, reaching to Brunsbüttel. In this way there are four rows of lamps, for each of which going and returning conductors had to be provided. From Brunsbüttel the length of this circuit on the north side of the canal amounted to 61.6 miles and on the south side to 62 miles; from Holtenau the north side line was 61.2 miles and the south side 60.2 miles. Each of these sections supplies 250 incandescent lamps of 25 cp each, so that the apparent average distance from lamp to lamp is 643 feet. As, however, the lakes which are traversed by the canal have no electric lighting (the channels in the lakes being marked by gas buoys during the night), the actual average distance between the incandescent lamp is about 524 feet. In reality the distance varies from 250 to 800 feet, as in the straight stretches of the canal the illumination with an 800 feet interval is entirely sufficient, while at the curves the distance apart of the lamps is correspondingly less. For after all, the principal thing is to show vessels their course clearly by night. The conductors along the canal consist of No. 6 B. & S. copper wire insulated with triple "Doppelglocken" first introduced by the Helios Company, and is carried on stout wooden poles at intervals of 130 feet. At the points where lamps are placed the line is in nowise broken, but makes a number of turns about an iron core, so that there is an entirely uninterrupted circuit. The incandescent lamp conductors are attached to the ends of these windings and are in parallel to them. The iron core and the incandescent lamp are so designed with respect to their magnetic and electric properties, that when the lamp is burning, only 9 per cent. of the current consumed at the lighting points goes to the iron core and its windings. If, however, the lamp be defective, the whole current passes through the windings about the iron core, so that, as remarked above, no interruption can occur in the circuit. The calculations have been so exact that over one third of the 250 lamps in each section can be destroyed or out of action without making necessary any regulation of the whole system at the opening plant. The potential at the lamp terminals is 25 volts; besides this, the great resistance of the conductors has to be overcome, so that a potential of about 7,500 volts is continually maintained at the binding posts of the canal conductors in the operating plant. This potential is reached by transforming up the dynamo current of 2,000 volts. The accompanying illustrations give a view of the pole with the lamp which is mounted on a wrought iron bracket together with the iron core and its windings, and also show an enlarged section through the insulator, iron core and lamp. All the poles as well as the line are protected against lightning by means of a barbed fence wire. The line on the north side is carried under the canal itself as well as under the streams emptying into the canal by means of armored cables. The cables are buried three feet deep in the bed of the canal, and consist of two non-inductively arranged rubber tubes covered with gutta percha. The armor is made of galvanized iron wire. The cables have been tested with 15,000 volts, so that they appear to be safe for the operating potential of 7,500 volts. These, as well as all other cables used in the plant, have been furnished by the Rhenish Rubber Goods Works of Franz Clouth in Cologne-Nippes.

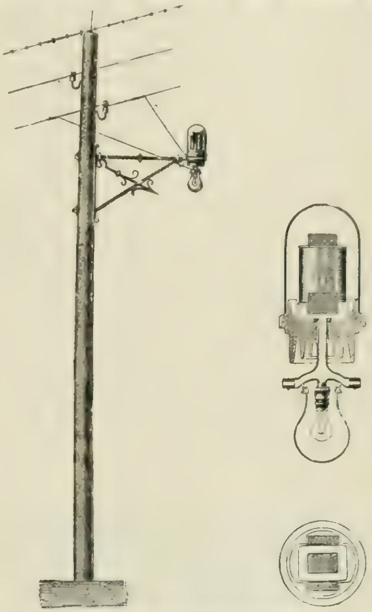


MAP SHOWING ROUTE OF CANAL.

From what precedes it will be seen that the programme announced at the beginning has been completely carried out. The plant operates with entire certainty, is self regulating and very economical, and at the same time every lamp is entirely independent of the others.

For lighting the festival buildings and places in Holtenau during the opening celebration, the operating plant there will furnish current for 165 arc lamps and over 500 incandescents, besides taking care of the illumination of the canal and lock.

For erecting work on the line of the canal, the 12-hp electric launch *Helios*, shown in the initial cut, was used, which at a speed of 9.3 miles an hour can traverse the whole canal in about seven and a half hours.



DETAILS OF POLE AND LAMP.

Alternators.

At a recent meeting of the Royal Society, Dr. J. Hopkinson and Mr. E. Wilson read a paper on this subject. The paper deals experimentally with the currents induced in the coils and in the cores of the magnets of alternating-current machines by the varying currents in and the varying positions of the armature. It is shown that such currents exist, and that they have the effect of diminishing to a certain extent the electromotive force of the machine when working on resistances as a generator without a corresponding effect upon the phase of the armature current. It is also shown that preventing variations in the coils of the electromagnet does not, in the machine experimented upon, greatly affect the result, and that the effect of introducing copper plates between the magnets and the armature has not a very great effect upon the electromotive force of the armature, the conclusion being that the conductivity of the iron cores is sufficient to produce the main part of the effect. A method of determining the efficiency of alternating-current machines is illustrated, and the results of the experiments for this determination are utilized to show that in certain cases of relation of phase of current to phase of electromotive force, the effect of the local currents in the iron cores is to increase, instead of to diminish, the electromotive force of the machine. The large majority of the experiments described were made in the summer of 1893, and a considerable part of the paper was then written. The authors were assisted by Mr. F. Lydall, one of the student demonstrators at King's College at that time.—London *Electrician*.

Electrical Engineers.

An article under the above caption in our issue of May 11, and clipped from an exchange, was erroneously credited to the London *Electrician*.

The Westinghouse Electromagnetic Railway System.

The Westinghouse Electric & Manufacturing Company announced last week that it had purchased the stock of the Electromagnetic Traction Company of West Virginia, which controls the Wheless system. This system is now in use on a road in Washington, D. C., and is similar to one patented by Mr. Westinghouse, and with which he has conducted lengthy experiments at Pittsburg. It is stated that the Wheless patents are broader than those of the latter, which led to their purchase. We give below a description of a working model of a car and track now on exhibition at the Westinghouse offices at New York, and which combine the ideas of both Mr. Westinghouse and Mr. Malone Wheless.

The apparatus employed in this system is simple, and the cost of construction, while greater than that of the trolley system, is claimed to be much below that of the ordinary cable conduit. Very little excavation is necessary, and does not involve going deeper than the ties.

The apparatus consists of contact pins located between the rails, and connected, as shown in Fig. 2, by wires to switch boxes placed between the tracks, the feeder cables being connected to the latter, and of three sliding contact bars attached to the car trucks.

The contact pins are arranged in groups of three each, and are of cast iron, five inches in diameter, and extend above the pavement five eighths of an inch. They are set in granite or terra cotta blocks seven inches square, which, in turn, rest in cast-iron cups having flanges by which they are spiked to the ties.

The group of contact pins are placed about seven feet apart, and while offering no obstruction to traffic, as will be seen in Fig. 1, are sufficiently high to enable the collector bars carried by the car to slide over them, and at the same time entirely clear the pavement. The whole structure is very substantial, and is designed to withstand the heaviest traffic.

Two contact pins of each group are connected by curves to electromagnetic switch boxes of cast iron, measuring 12 by 18 by 14 inches, and arranged alongside or between the tracks. These switches are connected to the feeder cable, which is laid in suitable conduits just beneath the pavement, and are provided with electromagnets having one winding of coarse wire and one of fine wire.

The armature of the magnet is provided with two carbon contacts, each having a contact surface of about two by two inches, through which connection is made between the feeder wire and one of the contact pins. The magnets and their connections are secured to slate supports, the whole being so constructed that by removing the cover of the box and an inner case, they may be lifted out and examined without the aid of tools, the connections with the supply cable being made and broken automatically. Each car is provided with a three-cell storage battery, and as the car moves along and the collector bars slide over the contact pins, the current from the storage battery passes through the outer contact bar to the corresponding contact pin and thence through the fine wire winding of the magnet; as the armature is pulled up by the storage battery current, connection is made by the carbon contacts with the feeder cable. The power current passes through the coarse winding of the magnet, holding the armature securely in place, and thence to the motors through the inner contact pin and the corresponding collector bar. From the motors the current passes through the centre bar and third contact pin to the return cable, which is located under the pavement near the feeder cable. So long as the tracks are not occupied by cars, the contact pins are dead, and only become alive while the car is passing over them.

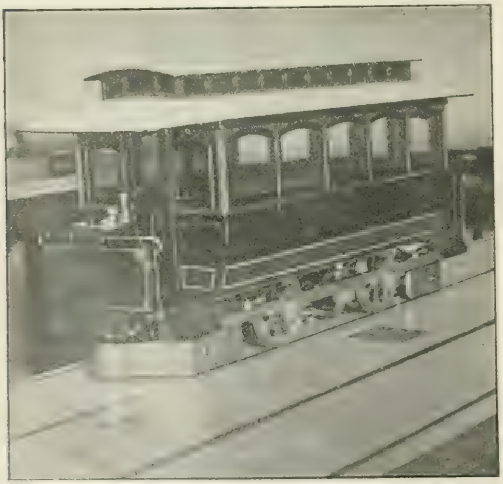


FIG. 1.

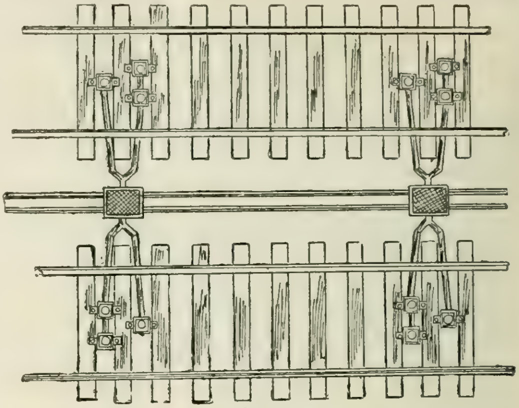


FIG. 2.

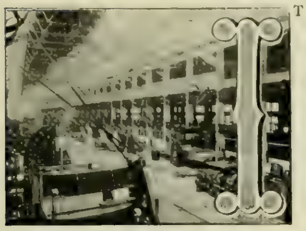
To provide against sparking in the switch boxes, the collector bars are of sufficient length to allow them to slide a distance of four feet over the forward set of contacts before leaving the rear set.

In double track work the switch boxes are located between the tracks, and are provided with two magnets, one for each track. The arrangement of its apparatus in the operation of elevated railways is slightly different from that of surface roads. In place of the contact pins, rails or metal bars, arranged 10 to 20 feet apart, will be employed.

Electric Ploughing in Germany.

Practical experiments in electric ploughing, says the London *Electrical Engineer*, have been made at Halle-on-the-Saale, Germany. Here a two furrow tilting plough was used. The electric motor is fixed to the implement itself. The shaft of the motor, by means of a double spur-wheel gear, drives a shaft fitted with a pinion, over which a chain runs from one end of the field to the other. This chain is held taut at both ends by triple ground anchors. When the motor is put in operation it will haul the plough across the field. When the end of the field is reached the plough is tilted to the other side, and by reversing the motor the plough starts on its return journey, at the same time depositing the chain sideways for the next row of furrows. The anchors are moved by a laborer, who lifts them out of the ground with a hand lever. The current is generated by a portable dynamo and 10-hp steam engine, and the current is conveyed by a cable that follows the car upon light cars, which turn readily in any direction The power used in the heavy loamy clay at Halle-on-the-Saale was an average of eight kilowatts. The plough turned two furrows, measuring together 60 cm in width by 24 cm in depth, and, traveling at 0.9 metre per second; the actual useful effect was equal to eight effective horse-power, which showed that there was a loss of about 4 hp between the portable engine and the plough. A 16-hp engine was used for a four furrow plough, and the depth of the furrow was 24 cm. One of the remarkable features of this system is that, guided by the tightened chain, very shallow furrows can be made with great evenness and regularity, and the balance plough can thus be used for turning over stubble land and other light work. As regards attendance, only one man is needed for the lighter plough, while for the larger one three men are required—a ploughman and a man at each end to shift the anchors. The first cost of an electric plough is said to be much below that of a steam cultivating plant.

The Westinghouse Electric & Manufacturing Company's New Plant—I.

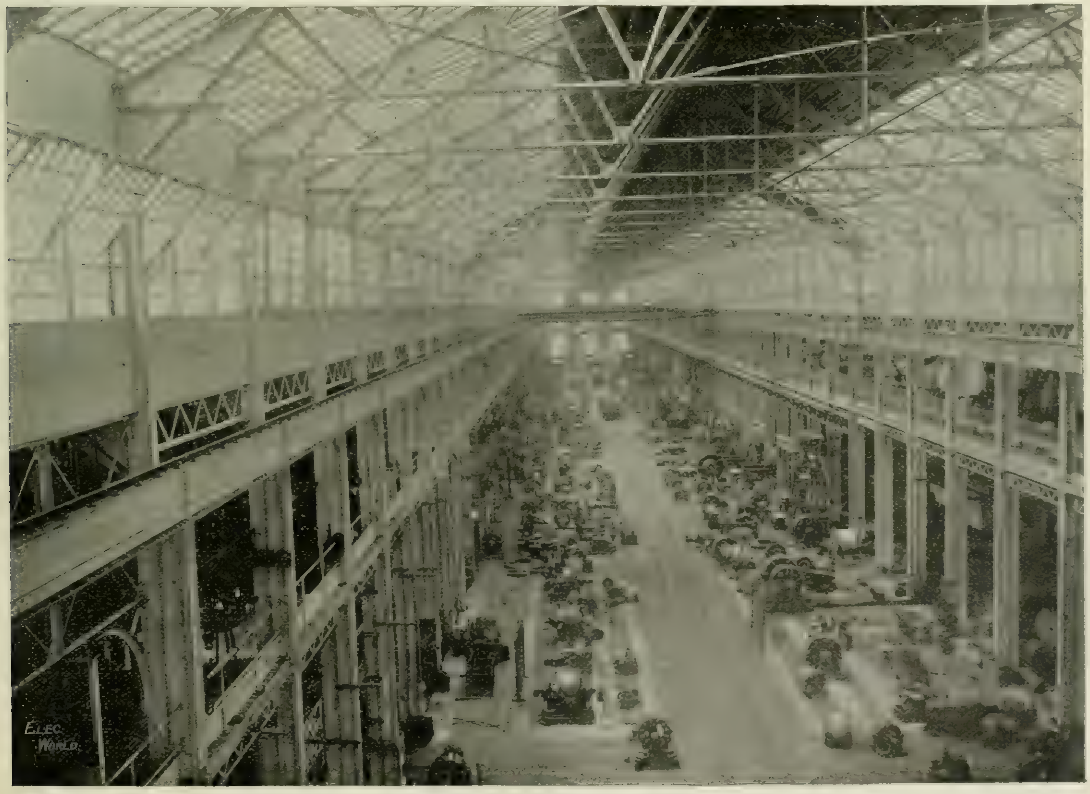


IT is almost six months since the Westinghouse Electric & Manufacturing Company began the centralization of its Pittsburg, Allegheny and Newark factories at its new plant in East Pittsburg. Owing to the vast amount of machinery and material to be transported, the transfer has been necessarily slow, but the new factory is now in complete operation, and we are finally able to place before our readers in this issue a fully illustrated description of these works. A second article will be devoted to the Tesla two-phase system which is used for the driving of all machinery throughout the buildings, and a third and final article will deal with new apparatus that has not heretofore been fully described to the public.

Soon after the consolidation of almost all the competing electric companies into the General Electric Company, the Westinghouse people foresaw that a new and very much larger manufacturing establishment must soon be erected in order to permit them to meet the demands of increased business. With such plans in mind they secured a plot of land adjoining the main line of the Pennsylvania Railway, twelve miles east of the city of Pittsburg. Here, as the result of a year's work and the investment of many hundred thousand dollars, there has been erected one of the largest and most complete manufacturing establishments in the world. A glance at the engravings on pages 710 and 716 will give a general idea of the buildings already erected. The accompanying ground plan shows by full lines the buildings which have already been completed and the broken lines indicate those still to be erected.

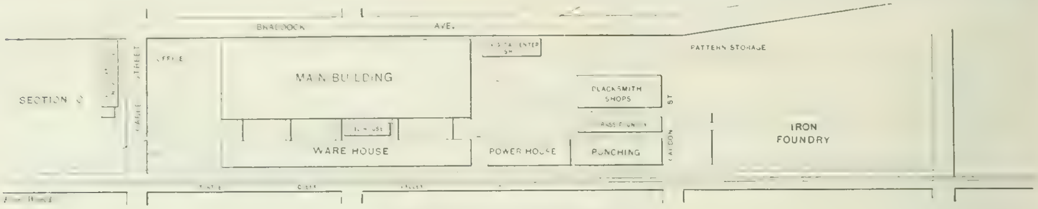
The various Westinghouse interests will soon all be centered at or near East Pittsburg—as the new station on the Pennsylvania Railway is called—for, in addition to the factory of the electric company, the Fuel, Gas & Manufacturing Company, an allied concern, is here located, and the Westinghouse Machine Company, having also outgrown its present quarters in the city, is erecting a new factory about 600 feet west of the electric company's buildings, and nearer the railway. At Wilmerding, only two miles east, are the immense works of the Westinghouse Air Brake Company, and at Swissvale, four miles nearer the city, is located the Union Switch & Signal Company, of which the electric company was originally but a department.

That Pittsburg has developed some of the largest and most successful manufacturing concerns in the world, is of course well known, and, as has been so ably stated by Mr. Andrew Carnegie in explaining the accumulation of his own wealth, these results are attained in that locality, not more by reason of its favorable situation with respect to fuel, raw material, etc., than by the exceptional perfection to which the methods of manufacturing are there brought. This same local characteristic of excellent and systematic organization is very apparent throughout all the Westinghouse Electric Company's manufacturing operations, and is due, no doubt, mainly to Mr. Geo. Westinghouse, Jr., who has been, and is still, at the head of the Westinghouse Air Brake Company, the Westinghouse Machine Company, the Westinghouse Glass Works, the Allegheny County Light Company, the East End Electric Light Company, the Philadelphia Gas Company, the Fuel, Gas & Manufacturing Company, the Union Switch & Signal Company, and finally, his latest and largest venture, the Westinghouse Electric & Manufacturing Company. As a result of his own vast manufacturing experience, and a knowledge of the methods of such companies as the Carnegie, Jones & Laughlin, etc., Mr. Westinghouse, seconded by his able corps of assistants, has developed in the electric company a form of business and workshop organization which, it is not too much to say, is equalled by few, if any, manufacturing concerns in the world.



MAIN AISLE OF MACHINE SHOP.

The situation of Pittsburg is particularly advantageous for any manufacturing concern supplying the American market, for being well inland it is convenient to both the East and West; moreover, it is in the centre of a great coal producing district; many raw materials are near at hand and consequently cheap; the labor market is of the highest grade and always abundantly supplied, and excellent transportation facilities are afforded by both railway and boat. In addition to having available these exceptional natural advantages, the Westinghouse Company has effected a wonderfully efficient manufacturing organization, and having now equipped a new and commodious factory, with all the newest, latest and most approved forms of machinery, claims, with reason, to be in a position to turn out electrical apparatus of the highest class, in almost unlimited quantities and at the least possible expense.



GROUND PLAN OF BUILDINGS.

Organization.—The Westinghouse Company was incorporated in 1886, and at present it has permanent representatives in most of the chief cities of the United States, and in addition a force of salesmen and engineers who are kept constantly on the road, for the purpose of meeting prospective customers and setting forth the merits of the Westinghouse apparatus. A branch company has for some years been established in London, and there does a very handsome business; in fact, it may be said that Westinghouse apparatus has not only been introduced into every State in the Union, but also into almost every country on the globe.

The administrative officials of the company are as follows:

Board of Directors: Charles Francis Adams, Lemuel Bannister, August Belmont, N. W. Bumstead, A. M. Byers, Marcellus Hartley, George W. Hebard, Henry B. Hyde, Brayton Ives, George Westinghouse, Jr.

WESTINGHOUSE FACTORIES, LOOKING SOUTHEAST.

Officers: Chairman, Brayton Ives; president, George Westinghouse, Jr.; first vice-president and general manager, Lemuel Bannister; second vice-president, G. W. Hebard; assistant general manager, W. C. Clark; electrical engineer and assistant manager, L. B. Stillwell; secretary and attorney, Charles A. Terry; treasurer, Ph. Ferd. Kobbe; assistant treasurer, George H. Lewars; auditor, F. H. Ketchum.

A glance at the history of electrical development will show that the manufacturing branch of the business has been controlled very largely by those who also made the discoveries and inventions. Involving, as electrical apparatus does, a grasp of higher mathematics and physics, it is not surprising that mechanical details and construction have frequently been overlooked, and consequently have often been defective. When Mr. Westinghouse undertook the manufacture of electrical apparatus, he naturally approached the subject from an exactly opposite point of view from that referred to, as his training and experience had been largely along mechanical lines, and he thoroughly appreciated the necessity for perfection in this respect; in his organization of the electric company he, therefore, gathered about him a staff of engineers, some of whom knew but little of matters electrical, but were experts on mechanical form and construction; while, on the other hand, there were a number of out-and-out electricians, who have since attained world-wide reputations. It is due to this associating together of the two classes of men that there has resulted an engineering department whose work has won for the Westinghouse Company the enviable reputation that its apparatus is as efficient mechanically as it is electrically. Simplicity, durability and efficiency has been the combination striven for, and the uniting of the various factories in East Pittsburg has unified and strengthened the staff of engineers so that these points will doubtless be more fully emphasized than ever before.

Engineering Staff.—Mr. Albert Schmid, the general superintendent, has been at the head of the electrical manufactory ever since its organization. He is a native of Zurich, Switzerland, where he received his education as an engineer, coming to this country in 1882 to enter the employ of the Westinghouse Air Brake Company. Though Mr. Schmid is still a young man, being but 37 years of age, he has had a wide experience in the manufacture of apparatus in Switzerland, Germany, Belgium, France and England, and the perfection of his mechanical conceptions are too well known to need comment. In fact he shares, equally with Mr. Westinghouse, the credit for the uniformly excellent design and construction of Westinghouse apparatus.

Superintendent Philip Lange, who was in charge of the Newark factory before its removal to East Pittsburg, is now at the head of the manufacturing department. He is also of European birth, coming to this country in 1882, but having had in Germany con-

A. J. WURTS.

PHILIP LANGE.

C. F. SCOTT.

L. B. STILLWELL.

ALBERT SCHMID.

O. B. SHALLENBERGER.

H. P. DAVIS.

B. G. LAMME.

F. S. SMITH.

The Technical Staff.

siderable experience in some of its largest electrical manufactories. Mr. Lange has been with the Westinghouse Company since 1886, and has done much in the development of its electrical detail apparatus and in systematizing its methods of manufacturing.

Mr. O. B. Shallenberger, the consulting electrician of the company, is probably best known as the inventor of the Shallenberger meter. Mr. Shallenberger is a Western Pennsylvanian, and a graduate of our Naval Academy at Annapolis. He resigned his commission to accept a position with the Union Switch & Signal Company for the purpose of developing some electrical work which Mr. Westinghouse then had in mind. Consequently, it was but natural that on the organization of the electric company he should have been appointed its chief electrician. As Mr. Shallenberger was with the company all through its formative period, the influence of his ability and correct appreciation of requirements is apparent in all the Westinghouse alternating-current apparatus. Recently Mr. Shallenberger resigned his position to become the company's consulting electrician, with a private laboratory at Rochester, Pa.

View of Blacksmith Shop, Brass Foundry and Punch Shop.

Mr. L. B. Stillwell, who has recently been appointed electrical engineer and assistant manager, is also a young man and a native of Scranton, Pa. He is a graduate of Wesleyan and Lehigh Universities and has been with the Westinghouse Company from the very first. As its engineer he has been sent to represent the company not only throughout this country, but also abroad, so that his knowledge of the practice on the two continents is both varied and extensive. Mr. Stillwell has been specializing on long-distance power transmission, and in this connection has been entrusted with almost the complete direction of the Niagara work.

Mr. Chas. F. Scott, who succeeded Mr. Shallenberger as electrician of the Westinghouse Company, graduated from the Ohio State University in 1885. After a post-graduate course at the Johns Hopkins University, and some practical experience in outside work, Mr. Scott secured a position on the "student corps" of the Westinghouse Company. His exceptional ability was quickly recognized and he has been rapidly advanced to his present important position. One of his most recent and valuable inventions is the method of two-phase three-phase transformation, which was so clearly set forth in his paper of a year ago before the National Electric Light Association at Washington.

Mr. Alexander Jay Wurts is a direct descendant of John Jay, first Chief-Justice of the United States. He graduated at Yale in 1883, at Stevens Institute in 1884, and subsequently studied two years under Prof. Kohlrausch in Germany. After two additional years of practical experience in this country, he entered the service of the Westinghouse Electric Company in Pittsburg. He has discovered some very important facts concerning the action of electricity that commonly accompanies storms, and upon the basis of his discoveries has devised improved and effective methods of protecting electrical apparatus against lightning. He is more especially known, however, for his discovery of the non-arcing metals and invention of the now well-known non-arcing lightning arrester, for which he has been awarded the John Scott medal by the city of Philadelphia upon the recommendation of the Franklin Institute.

Mr. B. G. Lamme, one of the principal designers of the company, was born at Springfield, Ohio. He took the degree of mechanical engineer from the Ohio State University in 1888, and since that time has been associated with the Westinghouse interests. During the past four years Mr. Lamme has given his attention exclusively to the calculating of the Westinghouse machines, for which important work his ability as a mathematician, and his thorough acquaintance with the best practice at home and abroad eminently qualify him.

Winding Street Railway Armatures.

Assembling Street Car Controllers.

Mr. Harry P. Davis, who is at the head of the detail departments, is a native of Great Falls, N. H. He graduated from the Worcester Institute of Technology in 1890, and after a year's experience with the General Electric Company at Lynn, he came to Pittsburg, where he has since been connected with the manufacturing departments of the Westinghouse Company. Mr. Davis has done valuable work in the perfecting of such apparatus as street railway car controllers, rheostats, arc lamps, etc.

Mr. F. S. Smith, superintendent of the incandescent lamp department, was a classmate of Mr. Stillwell's at both Wesleyan and Lehigh. He specialized in chemistry, in which line of work he has since made his greatest success, having discovered processes for improving carbon filaments and cements. To him belongs a large part of the credit for the development of a lamp, which so auspiciously escaped the injunction put on the manufacture of the old Sawyer-Man lamps.

Equipment.—The main building of the Westinghouse plant is 754 feet in length, 231 feet in width, and 67 feet high to the ridge of the central roof truss. Along either side of the building, 25 feet above the floor, run galleries 80 feet in width. One of the accompanying illustrations gives a general view from one end of the shop, showing very clearly the interior arrangement, while the various other illustrations will give a better idea of the different parts of the building than can be here attempted in words.

The next largest building was designed for a warehouse and shipping room on the first floor, and a detail manufacturing department on the second floor. At present, however, half of the upper floor is occupied temporarily by the offices of the company, which are arranged as shown on the accompanying plan. Later, a separate building will be erected and all the office work transferred there. The warehouse is 574 feet in length, 76 feet wide, and 62 feet in height. The building is of the same general design as the main building, and connected to the latter, on the second floor, by means of five enclosed bridges.

Directly back of the warehouse is the power house, a description of which is reserved for our next article, which will also give an account of the two-phase shop installation.

Behind the power house is a two-story building 258 feet long, 76 feet wide and 62 feet high, used on the ground floor for storing and annealing sheet iron. The second floor is devoted to the punching department, about sixty machines being there employed. We illustrate one of the latest types of these, an armature ring press made by the E. W. Bliss Company. A special feature of this press is that the knock-out pads are operated by a device which obviates the use of springs and consequent strain at a time when the machine is doing its maximum work. For sharpening the dies of the larger presses, a special emery grinder is used, made by the Springfield Emery Wheel Company, Springfield, Mass., a cut of which appears in another column; the emery wheel of this grinder has an oscillating motion so that each time the die being sharpened passes beneath it, there is a change in the surface presented for grinding, thus insuring an absolutely true ground surface.

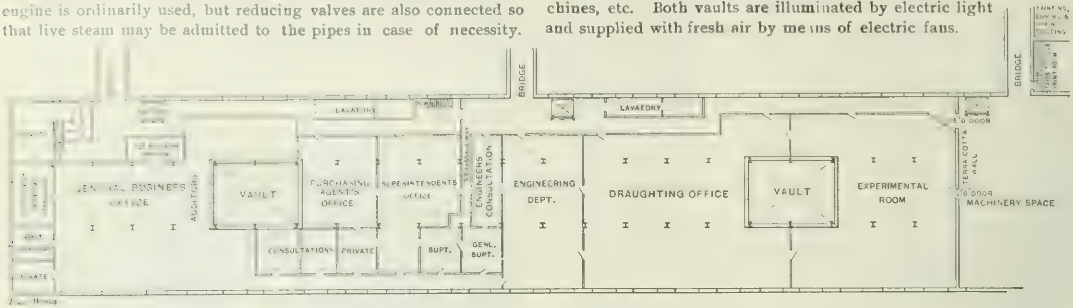
Between the main building and the wareroom is a brick and iron building, completely fireproof, four stories in height, 187 feet long and 25 feet wide, used as a paint shop, drying room, and oil house. Back of the main building is the temporary carpenter and box-making shop, 192 feet by 60 feet by 32 feet. Alongside of the punch shop, and 300 feet east of the main building, is a blacksmith shop, and also a temporary brass foundry, the former 241 feet by 80 feet by 45 feet, the latter 241 feet by 40 feet by 26½ feet. The six principal and permanent buildings are of brick and iron fireproof construction throughout. The floors are slow burning, and designed to sustain 500 lbs. to the square foot. All the buildings are most pleasantly located and completely lighted by double windows 10 feet wide, situated every 16 feet along the side, and by large skylights every 32 feet in the roof.

It is, we learn, the intention of the company to still further extend its works by the erection of an iron foundry in the rear of the main buildings. At present all the castings are made in the Allegheny factory, where also the Sawyer-Man incandescent lamps are being manufactured. The glass factory, an independent concern, supplies all the glass parts of the incandescent lamps.

The arrangements for heating the buildings are of the most improved type. Steam radiators are located at points just under the roof, and 80-inch Sturtevant blowers are used to force the

Winding Departments.

[illegible] through distributing pipes 36 inches in diameter at the heaters, and made gradually smaller as the air is distributed. There [illegible] of these [illegible] in the warehouse, six in the machine shop, and one in the punch shop, all being driven by Westinghouse two-phase motors. For supplying the radiators exhaust steam from the engine is ordinarily used, but reducing valves are also connected so that live steam may be admitted to the pipes in case of necessity.



Floor Plan of Offices.

The Williams vacuum system of Warren Webster & Company, Camden, N. J., is installed, and by its use the back pressure of the non-condensing engines is materially reduced.

Filtered drinking water is distributed through the various buildings by means of pipes connected to a 10,000-gallon filter, of the New York Filter Company, which is located on the first floor of the paint shop. The water supply for use throughout the factory is obtained under a high pressure from a reservoir located on the hills back of East Pittsburg. The sanitary arrangements throughout the buildings are most complete. The water supply is abundant, and the plumbing and sewerage arrangements of the latest and most approved type. The toilet rooms are finished up in slate, and the wash basins are of marbleized iron with polished brass fittings. Hot and cold water are everywhere available and the plentiful supply of soap and towels indicates the company's interest in the comfort of its employees.

For the purpose of providing convenient and quick intercommunication between the various departments and offices, there is installed a local telephone system, with instruments in each office, and a small exchange located in the west end of the warehouse. Long distance lines connect the factory with the Pittsburg Central, and another local wire runs to the city office of the Westinghouse Company. Reference to the office plan will show two vaults, one in the auditor's office and the other opening into the drawing office. These vaults are both alike and measure 32 feet 10½ inches in length and 26 feet in width. In fact, they are small fire-proof buildings within the main building, as they have separate walls and a pitched roof 17 feet 9 inches above the floor. They are built up of 12-inch terra cotta fireproofing, plastered inside and out, and have double fireproof iron doors. The vault in the general office is used for filing vouchers, contracts, etc., and that in the drawing office for the protection of drawings, records of machines, etc. Both vaults are illuminated by electric light and supplied with fresh air by means of electric fans.

Engineering Office.

Draughting Room.

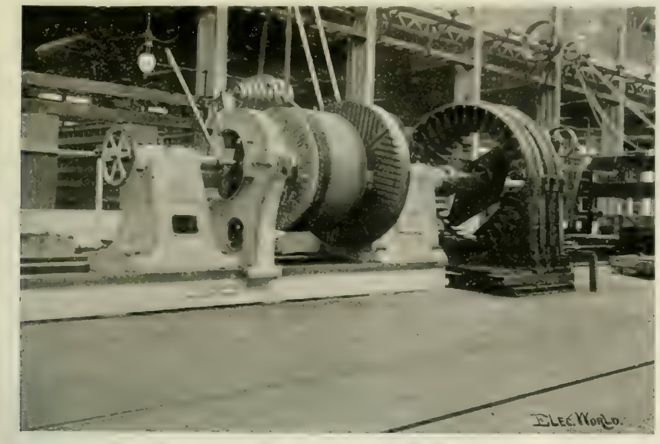
General Office.

All machinery throughout the factory is driven by two-phase electric motors conveniently placed. Despite the fact that motors are used for power and that they are placed as near as practical to the machines they are to drive, there was necessitated, nevertheless, almost a mile of shafting in the machine shop alone.

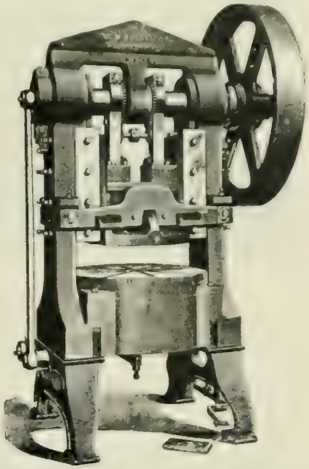
Near the end of the main aisle of the machine shop is a new and large 122-inch lathe, 30 feet between centres, made by Wm. Sellers & Company, Philadelphia; the machine is shown boring the field of a 1,000-hp alternator and turning off the armature of a 1,050-hp direct-current machine, both at the same time.

The Westinghouse Company has always made an object of having special tools for its work, thereby effecting economy in time and cost of manufacture and securing uniform and interchangeable parts; for the new works many additional special tools have been designed, one of which, noted in passing through the works, finishes off motor castings at one cut. For the purpose of making and repairing the tools required, there has been organized a very complete and extensive tool department, where over 130 employees are kept constantly at work making and replacing all sorts of tools, thus saving for the company the profits which otherwise accrue to tool manufacturers.

Another interesting department is the experimental room, where a number of specialists are constantly employed experimenting and carrying on original research. For their use has been fitted up a room most admirably adapted for its purpose. Here are conveniently available direct, alternating, and polyphase currents of any desired voltage, and of any number of alternations. There has also been erected a special glass-protected room for carrying on experiments with high potential currents running up to 50,000 and 60,000 volts pressure. It might be mentioned here that the company has made some rather interesting discoveries in connection with high potential, high frequency phenomena, which have not as yet been made public.

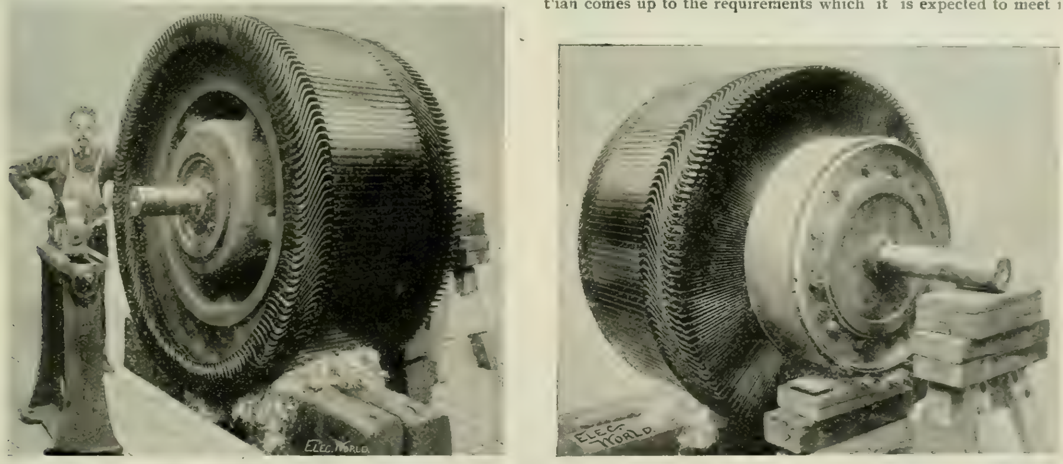


BORING A 1,000-HP ALTERNATOR FIELD, AND TURNING A 1,050-HP GENERATOR ARMATURE.



ONE OF THE PUNCHING PRESSES.

The entire arrangements in the factory are most admirably fitted for manufacturing apparatus quickly and with the minimum amount of labor. Take for example section "A," in which the street car motors are built. In one end of the section the armature discs and shafts are received and built up. The lathe turning and filing departments are immediately adjoining, so that no time or labor is lost in transportation. Next come the armature winders, and following them the men who are employed in machining and fitting up the fields. After the motors are assembled they are turned directly over to the testing department and then passed to the packers, so that the manufacture of these machines is an almost continuous operation from the building up of the armature cores to boxing the motors for shipment. All the apparatus is manufactured in accordance with this same system, and in consequence there exists throughout the factory the most complete order and business-like regime.

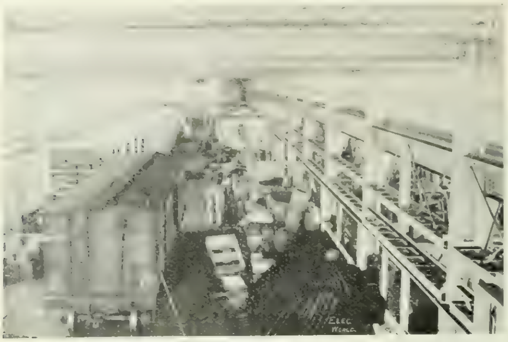


1,050-HP DIRECT-CURRENT ARMATURE.

The organization of the employees is equally satisfactory. There is a head foreman in charge of each of the general sections, and under him assistant foremen for the sub-divisions into which the work is divided. The system under which the men work and earn their wages is best fitted to make them industrious and energetic, and that the relations between the employer and the employee are most friendly and satisfactory is attested by the evident good feeling which prevails throughout the factory. The whole system has been most thoroughly studied and admirably developed and adjusted to meet the conditions for manufacturing on a large scale. In fact, in examining the operations of the factory one is impressed with the military like organization which everywhere prevails.

With many manufactures it is only necessary to assemble the various parts in order to complete the work, but with electrical apparatus it is essential that everything be thoroughly tested before shipment. The Westinghouse Company realizes the importance of this feature in its business and goes to a large expense and much trouble to make sure that each piece of apparatus shipped more than comes up to the requirements which it is expected to meet in actual operation. Not even a single piece of detail apparatus is sent to the shipper without being thoroughly tested. The company has organized a large corps of testers and inspectors, who follow the apparatus through its construction from the beginning to the very end. Tests are applied to various parts before assembling, and then the apparatus is tested as a whole. Records of the final tests are kept and filed, so that at any time it is very easy for the company to know just what any given piece of apparatus has done in its own factory.

All shipments from the factory are made by the Pennsylvania Railway and the arrangements of each building are such as to allow the freight cars to be run directly within the building. Last fall when the main building was used for a reception extended to the Grand Army of the Republic during its encampment in Pittsburg, the whole train load of invited guests was run right into the building, so commodious are the railway accommodations. As will be noticed in the principal view of the factories, both an elevated and grade-level track run along the south side of the warehouse, power house and punch departments, thus contributing in a marked degree to the convenient and rapid reception and shipment of materials and apparatus throughout the works.

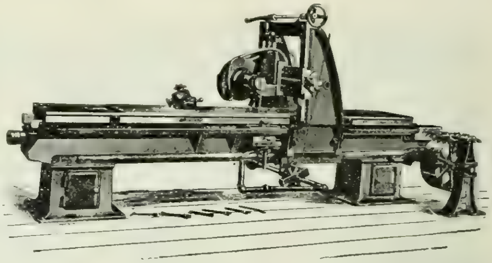


In the Shipping Department.

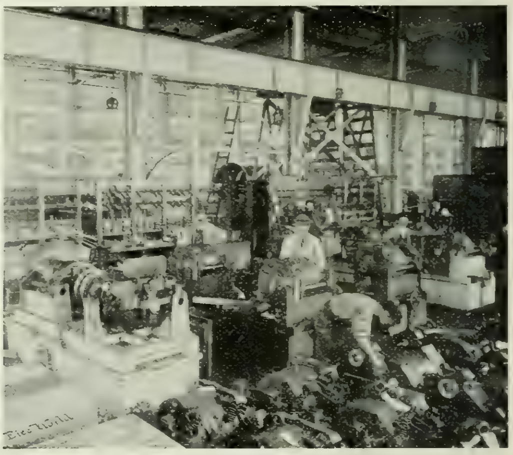
One of the East Pittsburg Club's Dining Rooms.

With the installation of the works at the new factory, the company has undertaken the manufacture of a larger line of electrical apparatus than has heretofore been attempted. Every form and size of motor and generator for direct, alternating and polyphase currents, from 1/8 to 5,000 horse-power, are now being regularly manufactured. The arc and incandescent lamp business has been extended to meet every conceivable want in this direction. Detail apparatus such as fan motors, meters, current indicators, switches, lightning arresters, ground detectors, etc., etc., have been perfected, and are being manufactured on the largest scale.

Through the generosity of the Westinghouse Company and some of its officers, there has been secured as a club house for the use of office employees, a very attractive and convenient brick building within a few hundred feet of the factory. Here meals are served, and a glance at the photograph taken of the dining-room will give an idea of how comfortably and luxuriously the company provides for those in its employ. The club house is also furnished with sleeping rooms, etc., so that it is a convenient stopping place for either officers or guests of the company.



Emery Die Grinder.



Section A.—Testing Street Car Motors.

Electrodynamic Machinery.—XXXIX.

BY EDWIN J. HOUSTON AND A. E. KENNELLY

265. In discussing the magnetic flux surrounding an active conductor we have observed in Par. 34, that it is distributed in concentric cylinders around the conductor, as shown in Figs. 27 and 28. It is evident that if a straight conducting wire *AB*, say *l* cms in length, as shown in Fig. 185, be situated in the uniform magnetic flux represented by the arrows, the flux will exert no mechanical influence upon the wire. If, however, the wire carries a uniform current in the direction of the straight arrows, then, as is represented diagrammatically in Fig. 186, the system of concentric circular flux shown by a single circle of arrows will be established around the wire, appearing clockwise to an observer looking from *A*, along the direction in which the current flows, and, as has already been pointed out, this circular magnetic flux will have an intensity proportional to the current strength.

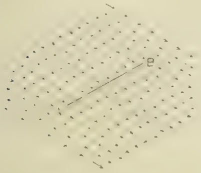


FIG. 185.—STRAIGHT CONDUCTOR IN UNIFORM MAGNETIC FLUX.

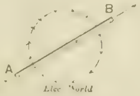
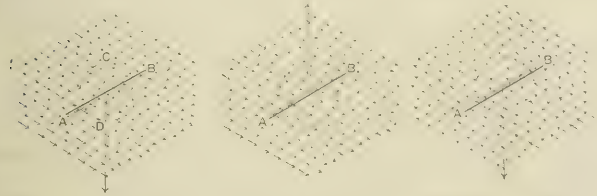


FIG. 186.—MAGNETIC FLUX SURROUNDING ACTIVE CONDUCTOR.

266. If such a conductor be introduced into a uniform magnetic field, as is represented in Fig. 187, it is evident that above the wire at *C*, the direction of the flux produced by the current is the same as that of the field, while below the wire at *D*, the direction of the flux from the current is opposite to that from the field. Consequently, the flux above the wire is denser, and that below the wire is weaker, or less dense, than that of the rest of the field. The effect of this dissymmetrical distribution of the flux density in the immediate neighborhood of the wire, is to produce a mechanical force exerted upon the substance of the wire, called the *electrodynamic force*, tending to move it from the region of densest flux toward the region of weakest flux; or, in the case of Fig. 187, vertically downwards, as indicated by the large arrow. If, however, the direction of the current in the wire be reversed, as shown in Fig. 188, and that of the external field remain unchanged, the flux will be densest beneath the wire and weakest above it, so that the electrodynamic force will now be exerted in the opposite direction, or vertically upwards, as shown by the large arrows.

267. If the direction both of the current in the wire and the flux in the external field be reversed, the direction of the electrodynamic force will not be changed, as is represented in Fig. 189, where the direction of the electrodynamic force is downward as in Fig. 187, though the direction of the current and the direction of the magnetic field are both reversed.



FIGS. 187, 188 AND 189.—DIAGRAMS SHOWING DIRECTION OF ELECTRODYNAMIC FORCE.

268. A convenient rule for remembering the direction of the motion is known as *Fleming's rule*. It is, in general, the same as that already given for dynamos in Par. 70, except that in applying it, the left hand must be used instead of the right. For example, if the forefinger of the left hand shows the direction of the flux, and the middle finger the direction of the current, then the thumb will show the direction of the motion. It must be remembered, that in applying Fleming's rule, the right hand is used for dynamos in determining the direction of the induced E. M. F., and the left hand for motors in determining the direction of motion.

269. We shall now determine the value of the electrodynamic force in any given case, on the doctrine of the conservation of energy. To do this we may consider the ideal apparatus, represented in Fig. 190, where a horizontal conductor *EF*, moves without friction against two vertical metallic uprights *AB* and *CD*. This conductor is supported by a weightless thread, passing over two frictionless pulleys *P*, *P*, and bearing a weight *W*. If, now, a current enters the upright *AB*, and, passing through the sliding conductor *EF*, leaves the upright *CD*, at *C*, then, under the influence of the uniform magnetic flux passing horizontally across the bar in the direction of the arrows, in accordance with the preceding principles, an electrodynamic force will act vertically downwards upon the rod. If this electrodynamic force is sufficiently powerful to raise the weight *W*, it will evidently do work on such weight, as soon as it causes the bar to move. Let us suppose that it produces a steady velocity of the bar *EF*, of *v* cms per second, in a downward direction. Then if *f*, be the electrodynamic force in dynes exerted on the bar, the activity exerted will be, $v\,f$ centimetre-dynes per second, or ergs per second. Since 10,000,000 ergs make one joule, this will be an activity of

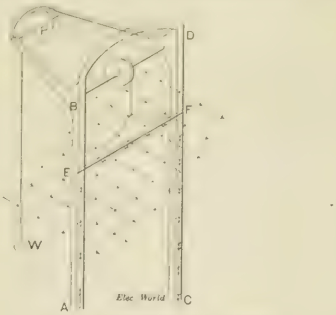


FIG. 190.—IDEAL ELECTRODYNAMIC MOTOR.

$$\frac{v\,f}{10{,}000{,}000}, \text{ joules-per-second, or watts.}$$

This activity will be expended in raising the weight *W*, assuming the absence of friction. As in all cases of work expended, the requisite activity to perform such work must be drawn from some source, and in this case the source is the electric circuit.

270. When the bar of length *l* cms moves with a velocity of *v* centimetres per second, through the uniform flux of density *B*, it must generate an E. M. F. as stated in Par. 71, of $e = B\,l\,v$, C. G. S. units, or

$$= \frac{B\,l\,v}{100{,}000{,}000} \qquad \text{volts.}$$

This E. M. F. is always directed against the current in the wire and is, therefore, always a C. E. M. F. in the circuit. The current of *i* amperes passing through the rod will, therefore, do work upon this C. E. M. F. with an activity of

$$e\,i \text{ watts} = \frac{B\,l\,v}{100{,}000{,}000}\,.\,i \qquad \text{watts.}$$

This activity must be equal to the activity exerted mechanically by the system, so that we have the equation,

$$\frac{v\,f}{10{,}000{,}000} = \frac{B\,l\,v\,i}{100{,}000{,}000}$$

From which,

$$f = \frac{B\,l\,i}{10} \qquad \text{dynes.}$$

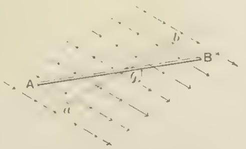


FIG. 191.—WIRE LYING OBLIQUE TO MAGNETIC FLUX.

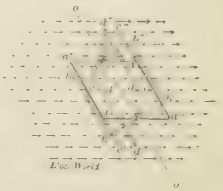


FIG. 192.—LOOP OF ACTIVE CONDUCTOR IN MAGNETIC FLUX.

$\frac{i}{10}$ be the number of C. G. S. units of current, since the C. G. S. unit of current is 10 amperes, so that the fundamental expression for the electrodynamic force exerted on a straight wire, lying or moving at right angles across a uniform flux, is

$$f = B\,l\,I \qquad \text{dynes,}$$

when I, is expressed in C. G. S. units of current. Since 981 dynes are, approximately, the force exerted by gravity upon one gramme, we have

$$f = \frac{B\,l\,I}{981} \text{ or } \frac{B\,l\,i}{9810} \qquad \text{grammes weight,}$$

and since 453.6 grammes make one pound, f, expressed in pounds weight will be

$$f = \frac{B\,l\,i}{10 \times 981 \times 453.6} \qquad \text{pounds weight.}$$

If, for example, the rod shown in Fig. 190 had a length of one metre, or 100 centimetres, and moved in the earth's flux whose horizontal component = 0.2 gauss, then if supplied with a uniform current of 1,000 amperes it would exert a downward force of

$$0.2 \times 100 \times \frac{1000}{10} = 2000 \text{ dynes, or, approximately, 2 grammes weight.}$$

271. We have heretofore considered the wire as lying at right angles to the flux through which it is moved. If, however, the wire AB, lies obliquely to the flux, at an angle θ, as is represented in Fig. 191, then the effective length of the wire, or the projected length of AB, at right angles to the flux will be $a\ b$. In symbols this will be $l \sin \theta$, and the electrodynamic force will be

$$f = B\,l \sin\theta \frac{i}{10} \text{ dynes.}$$

272. Although such a machine as is represented in Fig. 190 is capable of performing mechanical work, and might be, therefore, regarded as a form of electrodynamic motor, yet all practical electrodynamic motors are operated by means of conducting loops, capable of rotating about an axis. We shall, therefore, now consider such forms of conductor.

273. If the rectangular loop $a'\ a''\ a'''\ a^{iv}$, placed in a horizontal plane, in a uniform magnetic flux, be capable of rotation about the axis 00, then if a current of i amperes be caused to flow through the loop in the direction $a'\ a''\ a'''\ a^{iv}$, electrodynamic forces will be set up according to the preceding principles upon the sides $a'\ a''$, and $a'''\ a^{iv}$. There will be no electrodynamic force upon the remaining two sides. Under the influence of these electrodynamic forces, the side $a'\ a''$, will tend to move upwards, and the side $a'''\ a^{iv}$, downwards. The loop, therefore, if free to move, will rotate and will occupy the successive positions b, c and d. At the last named position, the plane of the loop being vertical, although the electrodynamic force will still exist, tending to move the side $a'\ a''$, downwards and the side a''', a^{iv} upwards, yet these forces can produce no motion, being in opposite directions and in the same plane as the axis; or, in other words, the loop considered as a rotatable system is at a dead point.

274. It is clear, from what has been already explained, that if the direction of the current in the loop had been reversed while the direction of the field flux remained the same, or the direction of the field flux reversed with the direction of current remaining the same, that the direction of the electrodynamic forces would have been changed, tending to move the side $a'\ a''$ upwards and the side $a'''\ a^{iv}$ downwards, so that the loop would have rotated in an opposite direction until it reached the vertical plane. Consequently, when a loop, lying in the plane of magnetic flux, receives an electric current, it tends to rotate, and it will, if free, rotate until it stands at right angles to the magnetic flux.

275. An inspection of the figure will show that when the loop is in the plane of magnetic flux, that is to say, when the rotary electrodynamic force is a maximum, the loop contains no magnetic flux passing through it, while when the loop is in the vertical position, and the rotary power of the electrodynamic force is zero, it contains the maximum amount of flux passing through it. The effect of the electrodynamic force, therefore, has been to move the conducting loop out of the position in which no flux passes through it into the position in which the maximum of flux passes through it possible under the given conditions.

(To be continued.)

Laboratory of Houston and Kennelly, Philadelphia, Pa.

Rope Driving.—XXI.

BY J. J. FLATHER.

In the actual construction the centre of bolts must be placed at some distance from the point of application, in which case the bolts are subjected to an additional strain due to the bending moment at the joint as shown at (*c*) Fig. 63; if this bending moment is taken up by the rim, the bolt section will be $\frac{S}{f}$ as before; but if the rim and bolt flanges are rigid and resist any deformation the total strain comes upon the bolts; under these conditions the net section A may be obtained by multiplying $\frac{S}{f}$ by the ratio of the leverage y, of the force S to the leverage x, of the resistance in the bolt; hence, if we assume that $x = \frac{1}{2}\ y$, a common value, we shall obtain $A = 2\frac{S}{f}$. By using studs with nuts at each end the bolt may be placed nearer the rim, in which case, for the same depth of flange, the ratio $\frac{y}{x}$ may be diminished.

In order to obtain ample strength at the rim the bolt section should be determined on the supposition that the full bending moment will be thrown upon the bolts; in this case the bolt-flanges or lugs must be able to resist any bending due to the force S.

The bolt-flanges will be as strong as the rim if we make the respective moments of resistance equal to each other; hence, if

b = face of wheel;
b' = breadth of bolt-flange minus the width of bolt-holes;
t = mean thickness of rim;
t' = thickness of bolt-flange or lug;

$$\text{then } \tfrac{1}{6}\, b\, t^2 f = \tfrac{1}{6}\, b'\, t'^2 f \text{ or}$$

$$t' = \sqrt{\frac{b\, t^2}{b'}}$$

this thickness t' may be reduced somewhat if strengthening ribs are carried from the rim to the lower edge of the bolt-flange, as shown at (*c*), Fig. 63. In the above, t was taken as the mean thickness of rim reduced to a rectangle, and no account has been taken of the strengthening ribs and flanges.

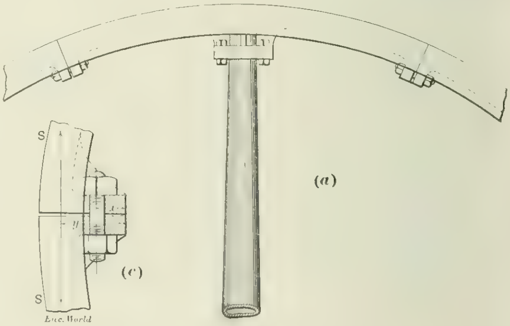


FIG. 63.—SECTIONS OF ARMS.

If the leverage of the bolts is assumed as ½, we may obtain the total net section of the bolts as follows:

$$A = \frac{2\,S}{f} = \frac{1}{f}\left(\frac{F_0}{\pi} + \frac{W}{2}\right);$$

$$\text{since } F_0 = 0.00034\ W\ R\ N^2,$$

$$A = \frac{1}{f}\left[0.000108\,W\,R\,N^2 + \frac{W}{2}\right]$$

In the above formula f may be taken equal to 6,000 pounds ordinarily, but for large bolts 8,000 to 9,000 pounds may be used.

If t = the mean thickness, and b = breadth of rim, both in inches, the weight W may be determined from

$$W = 2\,\pi\,R \times 12\,t\,b \times 0.26 = 19.6\,R\,t\,b.$$

If the rim is properly bolted the principal strains to which the hub bolts are subjected are those due to the weight of hub and arms and the tension produced by keying to the shaft.

As the weight of hub and arms in large pulleys is usually much less than the weight of rim, it will be seen that the strain on the hub bolts due to the weight and centrifugal force of these parts will be less than that on the rim bolts.

In practice some makers design the hub joint so that the net section of all the bolts is equal to the bolt section in one edge of the rim joint; this, however, is not usual practice.

An inspection of a great many pulleys made by various manufacturers shows that the hub bolt section is often twice as great as the rim-bolt section; but in many of these cases the rim bolting is very weak.

It is safe to make the bolt area the same in each case; but if the rim joint be made according to the method indicated, the bolts in the hub will usually be sufficiently strong if their total effective section is equal to that in one rim joint. For light pulleys, however, this should be increased.*

The section of arm for those pulleys in which the arms and hub are cast together is usually elliptical or segmental, as shown in Fig. 64.

The elliptical form as here given is so proportioned that its minor axis is one half its major; in the segmental form the minor axis is four tenths the major. The cross-section of the arm may be determined by considering it as a beam fixed at one end and loaded at the other with the force P due to the pull of the ropes. The bending moment on each arm will then be

$$M_b = \frac{Pr}{N_a}$$

assuming that the load is divided equally among the number of arms N^a.

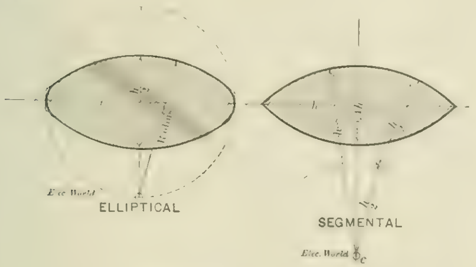


FIG. 64.—METHOD OF JOINING ARMS AND RIM.

Since the bending moment is equal to the modulus of the section Z, multiplied by the stress f in the material, we have

$$M_b = f Z;$$

for an elliptical section whose major axis is h and minor axis $0.4\,h$, $Z = \frac{\pi}{32} h^2 \times .4\,h$, hence, $\frac{Pr}{N_a} = f \times \frac{\pi}{32} \times .4\,h^3$. [1]

If we let T_1, the maximum tension in the rope, equal $200\,d^2$ pounds, and $\frac{T_1}{T_2} = 2$, we shall have the load acting on each arm

$$P = 100\,d^2\,n$$

where n is the number and d the diameter of ropes. Therefore, by substituting the value of P in equation [1] there is obtained

$$h = \sqrt[3]{\frac{100\,d^2\,n\,r}{0.04\,f\,N_a}}$$

assuming that $f = 2{,}500$ pounds per square inch for cast-iron, and that N_a equals 6, we have $h = 0.44\sqrt[3]{d^2\,n\,D}$, where D = pitch diameter of pulley in inches and h is the major axis of arm produced to centre of wheel.

As the smaller pulleys require a larger margin of strength, on account of their greater liability to breakage in handling and casting, the above formula should be modified by introducing a constant; if we let this constant equal one half inch a suitable value for the width of arm will be obtained from

$$h = 0.44\sqrt[3]{d^2\,n\,D} + 0.5''. \qquad [2]$$

As the centrifugal force set up in the rim of the pulley causes an additional stress in the metal, the value of f should be chosen with reference to the speed at which the pulley is to run.

The higher speed not only induces a greater stress in the material, but the liability of failure due to vibration or shocks is greatly increased.

The stress in the rim due to centrifugal force may be obtained by considering the pulley as a cylinder subjected to a force f ($= F$) per square inch. The thickness of a thin cylinder to resist rupture may be obtained from $t = \frac{p\,r}{2\,f'}$

in which t = thickness in inches;
p = pressure per square inch;
r = radius of cylinder in inches;
f' = allowable stress in pounds.

in this case $p = F = \frac{W v^2}{g R}$

where W = weight in pounds = 0.261 pounds per cubic inch;
v = velocity of rim in feet per second;
g = 32.16;
R = radius of rim in feet $= \frac{r}{12}$.

hence $$t = \frac{F\,r}{f'} = \frac{W v^2}{g R} \times \frac{r}{f'} = \frac{W v^2 r}{g\,f'\,\frac{r}{12}}$$

and $$f' = \frac{12\,W v^2}{g\,t}$$

If the centrifugal force act on one square inch of pulley whose thickness is unity, we shall have

$$f' = \frac{0.261 \times 12\,v^2}{32.16} = 0.097\,v^2$$

$$= \frac{v^2}{10} \text{ very nearly.}$$

This is the stress in rim per square inch of section due to centrifugal force alone.

When v in feet per second When V in feet per minute	50 3000	60 3600	70 4200	80 4800	90 5400	100 6000	150 9000	200 12000
Stress f' in pounds due to centrifugal tension	250	360	490	640	810	1000	2250	4000

The stresses due to the pull of the ropes, and those due to contraction in cooling are additional to those here given, hence f should be taken sufficiently low to allow for the various stresses which may be set up in the pulley.

If we assume that the working stress in the arms should not ordinarily exceed 3,500 pounds per square inch for cast-iron, and that it should be less for high speeds where the dynamic effect of shock and vibration is greater, a suitable value may be obtained from the empirical formula $f = \frac{50000}{5 + \sqrt[3]{V}}$.

From this formula the annexed values of f have been calculated. It will be noticed that the value of f used in formula [2], namely, 2,500 pounds, corresponds to a velocity of rim equal to about 3,500 feet per minute.

Velocity of rope in ft. per min. V	1200	1800	2400	3600	4800	6000
Allowable stress f	3200	2900	2700	2450	2300	2150

The arms should taper toward the rim $\frac{1}{16}$ inch per inch of length, that is, $\frac{1}{32}$ on each side, but in no case should the width of arm at the rim be less than two thirds its width at the centre of shaft.

Very wide pulleys in which the proportions for single arms would be inconveniently large may be made with two or three sets of arms; in such cases they may be considered as two or three separate pulleys combined in one, except that the proportions of the arms should be 0.8 to 0.7 times that of single arm pulleys.*

In designing the hubs of wheels practice varies considerably. Some authorities give the thickness of metal around the eye in terms of the pulley diameter only, others take into account the diameter of pulley and also the diameter of shaft, or the breadth of face, while the length is variously given in terms of the diameter of shaft, or the face of pulley or both.

For rope pulleys, if the thickness of metal in the hub is made proportional to the diameter of pulley, and also to the diameter of shaft; and if the length of hub is made to vary with the number

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* For complete analysis of strains in fly-wheel rims see Prof. Unwin's "Machine Design," Vol. II. Also Mr. Stanwood's paper in Vol. XIV. Trans. A. S. M. E., with Prof. Lanza's discussion on same.

* "Reuleaux Constructeur."

[illegible] and the diameter of shaft, we believe the requirements [illegible] and good proportions will be best attained.

[illegible] diameter of pulley in inches;
[illegible] " " shaft " ;
[illegible] " " hub; " ;
[illegible] " " rope " ;
[illegible] number of ropes;
and [illegible] length of hub;

then the diameter and length of hub may be obtained from the following formulæ, which have been deduced by the writer from the proportions of a large number of rope pulleys made by representative manufacturers:

d [illegible] $0.025\,D + d_s + 2$[illegible]"

and l [illegible] $0.6\,d\,n$ [illegible] d_s [illegible] "

For loose or idle pulleys the diameter of hub may be made less than that given by the above formula which allows for keying; in general the thickness of metal around the eye in an idle pulley may be taken as about two thirds as great as that in fixed pulleys of same diameter and face.

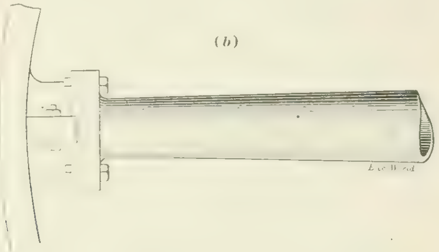


Fig. 65.—Method of Joining Arms and Rim.

The length of hub in idlers should be sufficient to give a good, bearing surface, and may vary from two to three times the diameter of shaft—depending somewhat upon the speed of rotation.

In the construction of large rope pulleys which are made in segments, the usual method is to bolt the rim sections to the arms at the ends of the segments, as shown at (*b*) in Fig. 65.

When the rim segments are joined midway between the arms as at (*a*), the several connections are simplified to some extent, but with this method of connection there is a decided tendency for the joint to open under the influence of centrifugal force which is increased somewhat by the weight of the connecting flanges and bolts. With the rim joints at the junction with the arms, however, a rigid connection between adjacent arms is obtained, and the centrifugal effect of the rim tends to increase the tension in the arm without opening the joint.

Electric Shock from a Secondary Alternating Current.

A writer in a recent issue of the New York Electrical World records several instances of men who received severe shocks while standing on damp earth engaged in turning on lamps supplied from secondary alternating circuits. In one of the instances quoted, the ground detector at the station showed a ground on the line, and upon examination two transformers were found to be burnt out. In another case a man was instantly killed as he reached to turn on the light above his head; an employee afterward was trying to explain the accident to some one, and upon touching a snap switch, and the floor being damp, he was thrown some distance and badly burnt. An examination of the transformer showed a ground of one primary and one secondary wire on the case. In another case, on the same company's circuit, a servant girl stood in her slippers on a damp cement floor and was hurled to the ground senseless by the shock received. An identical instance is recorded of a boiler engineer. The writer thinks of grounding the secondary wire to earth, though, as he has never heard of it before, he is nervous of the probable results. A correspondent writing to us on the subject, says: "It seems to me that the cure for accidents of this kind lies in the use of earthing devices of the Cardew or other types, which will put the secondary circuit to earth automatically, should the secondary E. M. F. from any reason rise above the normal to any great extent. In Scarborough we have one of these earthing devices connected to every transformer, and I think it is a wise precaution to adopt."—*London Electrical Review.*

Electrocution Vindicated.

We are glad, says the London *Electrical Review*, to compliment our contemporary, The Electrical World, on the stand it is making against the cheap sensationalism which other American technical journals have permitted to invade their columns in respect to the subject of electrocution. In a recent issue it published a report of a meeting of the New York Prison Association. At this meeting Dr. A. H. Goelet gave an account of his observations at the recent execution of a negro murderer at Sing Sing. In referring to the controversy recently excited by D'Arsonval's statement that the electric current as employed in the New York State Prisons does not inflict absolute death, Dr. Goelet ascribed it as partly due to the apparently negative results of the official examinations of the bodies of the first six criminals executed. Had the official pathologist, he said, who assisted at the post-mortems, not limited his examination of the brain to one case, he would have been able to have discovered what has now only three years later been demonstrated. A report prepared by Dr. T. E. Oerte on a microscopical examination of the blood and tissues of an executed criminal, was then submitted. From this we gather that (1) The chief action of the current is upon the blood and blood vessels; (2) The red corpuscles have less resistance than the white; (3) One or more of the elements determining coagulation of the blood is destroyed; (4) A germicidal agent is formed in the blood, which precludes the continued existence of multiplication of putrefactive organisms; (5) The liver is the organ most affected; (6) The lungs offer the most resistance; (7) The force exerted is sufficient to rupture the brain tissues and smaller vessels of the brain, and to produce universal hemorrhage in its substance; (8) The cellular elements of the tissues are not apparently destroyed; (9) The deviations from the normal conditions thus noted are sufficient to produce lethal results. In conclusion, Dr. Goelet states that death is instantaneous and painless, the latter being true because electricity travels faster than the nerves can transmit painful impulses. Hence, we may confidently claim that if murder, as the law declares, must be expiated by the death penalty, electricity should be universally adopted as a method of accomplishing this in the most humane manner. But what will the *Lancet* say?

Recent Patent Decisions.

To the Editor of The Electrical World:

Sir:—In reading the editorial entitled "Recent Patent Decisions," in the issue of the 8th instant of The Electrical World, we note the following sentence:

"If the foreign patent is granted to the second inventor prior to the application for a domestic patent by the first inventor, it constitutes publication, and, therefore, bars the latter from obtaining a patent regardless of priority of invention."

If this means that a United States patentee is barred from obtaining a patent by the issuance of a foreign patent to a subsequent inventor this statement does not seem to be in accordance with Rule 75 of the Rules of Practice, and the particular section of the statute upon which it is based, with both of which you are no doubt familiar. If, however, the sentence quoted refers to domestic patentees for *foreign* patents, the sentence quoted seems to be in accordance with the following sentence taken from the decision of Lauder vs. Crowell et al., 1879, 16 O. G. 405:

"When two applicants for patents for the same foreign invention, of whom only one is a foreign patentee, are before the Patent Office of the United States, the foreign patent of one of the applicants is a bar to the issue of an American patent to the other, even though he is in fact the prior inventor."

We do not take the time to call your attention to any other decisions on this point, as it is our impression that the sentence quoted is not exactly as you intend it, and we suppose, of course, that if this is so you will be pleased to have us call your attention to this matter.

Hey & Parsons.

Syracuse, N. Y.

[That part of rule 75 of the Rules of Practice of the United States Patent Office, referred to above, is as follows: "When an original or reissue application is rejected on reference to a foreign patent or to a printed publication, and the applicant shall make oath to facts showing a completion of the invention in this country before * * * the date of the foreign patent, or before the date of the printed publication, and shall also make oath that he does not know and does not believe that the invention has been in public use or on sale in this country for more than two years prior to his application, then the patent or publication cited will not bar the grant of a patent to the applicant."]

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors, or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD 927 Chestnut Street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French, or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS

Theory of Dynamos.—Some of the formulæ from Mr. Farman's article, abstracted in the Digest, March 30, are given in the "Jour. Inst. Elec. Eng." for May.

Improvements in Armature Ventilation.—Prof. Ryan's paper from the "Sibley Jour." for April, is reprinted in abstract in the Lond. "Elec.," May 31, and is editorially discussed.

Thompson and Ryan Dynamo.—An illustrated description showing the details of a dynamo designed by Mr Thompson and Prof. Ryan in accordance with the principles described in their recent Institute paper, is published in "Elec. Ind." for June. The machine shown has a capacity of 100 kw, is direct-connected and is to be installed in a store in Chicago; the total weight is 6,000 pounds, equivalent to 16.7 watts per pound; it is multipolar and contains a pole ring around the pole pieces which contains the balancing coils whose purpose is to balance the magnetic effect of the armature and produce the proper field for perfect commutation and to afford what little compounding is needed; these coils prevent the usual distortion of the field due to the armature reaction and enable the full magnetic strength to do effective work; they form the chief novel feature of the design; there is said to be a great reduction in size secured by the greater efficiency of the fields; the slots in the armature core are deeper than usual and the windings consist of heavy strips of copper; it is unnecessary to adjust the brushes for different loads and there is said to be a remarkable absence of sparking; the makers claim that the saving in material more than makes up for the extra expense of the complications.

LIGHTS AND LIGHTING.

Artificial Lighting from a Hygienic Standpoint.—The "Zeit. f. Beleucht.," May 30, contains an article of some length by Dr. Ploetz. He points out the importance of considering the hygienic effect of artificial lighting and discusses the well-known requirements giving comparative data of various kinds for the different illuminants (the authorities for which, however, are not given). The following figures contained in his article may be of interest. The artificial lighting in Paris per year and per capita in 1855 was 3,765 candle-hours and in 1889, 11,302; the minimum illumination of an object should be 10 metre candles; the illumination below a small light which, without a reflector or globe, is one metre candle, can be increased to 23 by a paper reflector, to 30 by a white glass reflector, to 64 by a polished reflector and to 260 by a hemispherical reflector (of silvered glass?). He gives the brightness, that is the number of candles per sq. cm of surface of the source of light, as follows: the sun 5,300, the arc light 500, the incandescent light 40, the Welsbach light 1.2, large regenerating burner 0 60, Argand burner 0.3, ordinary gas burner 0 06. The amount of heat generated per hour per 100 candles is given for a number of lights, that for the arc light is 57 to 158, for the incandescent light 290 to 536, Welsbach light 1,060, gas burner 12,150; the amount of carbonic acid gas given off per hour by an Argand burner of 100 candles is 0.46 cb. meters, by the Welsbach burner 0.23, while that given off per hour by a human being is 0.02; air containing 0.5 parts carbon monoxide in a thousand is considered dangerous while 0.2 parts is harmless. His conclusions are that from a hygienic standpoint the best lights are the arc and the electric incandescent light, but that one should strive to produce greater uniformity in the illumination from these lights; next to this comes the Welsbach light.

Train Lighting.—In Mr. Weekes' serial in the Lond. "Elec. Eng.," May 31, he gives a detailed and well-illustrated description of the system which was used on the Midland Railway, but has since been abandoned although it is said to have been a success.

Electric Light on the Suez Canal.—According to the Lond. "Elec.," May 31, 3,352 ships passed through the canal in 1894 of which 3,180 made the journey at night by the aid of the electric light; the average time of transit is 20 hours.

Economy in Arc Lighting.—In an editorial in the "Electrical Jour.," June 1, Prof. Carhart points out the recent distinct advances in arc lighting which he says are the increase in the number of closed-coil Gramme-ring dynamos, the improvement in arc lamps and the introduction of much larger machines; very extensive comparisons of cored and common carbons, he states, have demonstrated that the best cored carbons give 10 per cent. more light than the others for the same number of watts; they do not require more than 40 volts.

Arc Lamp for Constant Potential Circuits.—The Rushmore system is briefly described and illustrated in the "Elec. Eng.," June 12; two lamps are connected in series, the novel feature consisting in using an additional shunt coil in the lamp, opposed to the regular one but connected to the other lamp; the effect of the arrangement is to make each lamp dependent on the other and to entirely prevent seesawing and jumping; an additional advantage is that ordinary American carbons can be used while in the incandescent arc lamp it is claimed that expensive foreign carbons must be used; the present arrangement requires the use of two additional wires connecting the two lamps.

Visibility of Lights.—According to some recent experiments made by the governments of the United States, Germany and the Netherlands, mentioned briefly in the "Eng. News," June 13, a 1-cp white light is visible at a distance a little more than a mile, one of 3-cp is visible at two miles; on an exceptionally clear night a white light of 3.2-cp was readily distinguished at three miles; one of 5.6 cp at four miles, and one of 12.2-cp at five miles; a green or red 2-cp light was visible at one mile, 15-cp at two miles, 51-cp at three miles and 106-cp at four miles.

POWER AND HEAT.

Slavianoff Electric Casting Process.—The "Elek. Zeit.," May 30, contains a long illustrated article by Mr. Lohmann describing in detail the Slavianoff process, a description of which was given in the Digest, April 6; some illustrations of the applications were referred to in the Digest last week. The process has been in use for a number of years, chiefly for making repairs of large pieces of machinery, and it is believed that it will be used largely in the future; in this process the metal is melted by the arc in the place where it is required to be cast, one of the electrodes being made of the metal to be melted, and the other being the piece to be repaired. The apparatus for automatically regulating the length of the arc is well illustrated and consists essentially of an apparatus resembling in principle that used in some arc lights; the electrode which forms one of the terminals of the arc and which is melted to supply the metal, is in the form of a rod which is fed by hand, but its distance from the other electrode is regulated by this automatic device, which consists essentially of a series coil having a movable core which, by means of a bent lever, regulates the length of the arc, the whole apparatus being suspended from the ceiling; when several of the mechanisms are to be used in series, a shunt coil is added making a differential action; there is also in circuit a resistance for adjusting the current and a commutator for reversing it, which latter is a very important feature in this process; there is about twice as much heat developed on the positive pole as on the negative, and the positive is therefore made the electrode on which the greatest heat is to be developed; if the movable electrode is to be melted as fast as possible it is made the positive pole; if on the other hand the piece unto which the metal is to be cast, is to be superficially fused in order to assure a union with the molten metal, it is made the positive pole. The chemical action must also be considered and in this connection practice has shown that in melting cast iron the movable rod must be made positive; if the current flows in the reverse direction a white, hard cast iron containing little carbon, is produced; the current must be proportioned to the size of the movable electrode; 7.5 to 8 amperes per sq. mm are used, and the voltage is in all cases from 50 to 70; the smallest rods to be used are 6 mm in diameter (about 1¼ in.). A battery of accumulators is not necessary if the dynamo is sufficiently strong to stand the variable current and if its armature is not too sensitive. The method has been used by the Pintsch Company of Berlin, for the past 2.5 years; casting the metal by this means is of course more expensive than by the usual methods, but the system is applicable in such cases where the cost of fusing the metal is of small importance. The following are some of the applications: small objects may be cast by melting the metal in a graphite crucible in which the arc is formed and in which the molten metal from the positive electrode is collected; cracks in metal pieces [illegible], broken pieces can be joined together; blow holes are easily filled out; worn surfaces can be renewed by casting new metal on them; various metals can be united by casting one on the other, as for instance, cast iron on steel, copper and bronze on cast iron, steel on wrought iron or hard on soft cast iron; holes made by mistake in valuable castings can be filled out; faulty welds can be repaired; parts broken off from castings replaced; hard white cast iron can be converted into soft grey cast iron. It is very essential that the parts to be repaired must first be prepared; in the case of a crack for instance, it must be cut out so as to make room for the new metal; the piece to be mended must first be heated by means of the arc and in some cases a mould must be made; for the latter, retort carbon is used if the metal is cast iron; if the latter is to be poor in carbon, quartz sand is used or the current is reversed; sand is used for casting steel or wrought iron; both materials may be used for copper and bronze; there is an appreciable amount of oxidation and a flux must therefore be used; the preliminary heating is done by means of the arc and on it much of the success depends; for cast iron the electrode to be melted is a rod 1½ yards long consisting of 100 parts of ordinary cast iron and 13 parts of silicate of iron; small pieces of metal may be thrown into the molten mass; for cast iron the movable electrode is made positive but for steel or wrought iron it is made negative; for a flux, powdered glass is used, together with ferro-manganese or chrom iron. For casting copper the movable electrode is made negative as also when this metal is cast on wrought iron or steel, but if cast on cast iron the copper is made positive. The structure of the cast metal is not as good as that of rolled or hammered iron or steel but it is as good as that of cast metals; if, however, it is hammered, a very fine structure is given to it. For converting hard, white cast iron into grey cast iron, a small amount of cast iron is cast on the surface and the molten metal is then heated for some time with an arc formed with a carbon electrode; by this means the carbon in the iron may be increased to any desired amount. In conclusion it is stated that in most cases the cost of making repairs with this system is far less than that of making a new piece, and a very valuable feature is that the time for making the repair is quite short; the process is therefore very valuable on board of ships. Several illustrations of repaired pieces of machinery are given, among them is the main casting of a Westinghouse steam engine in which a large piece had broken off.

Tempering of Steel.—A Physical Society paper by Mr. Charpy is abstracted in "L'Ind. Elec.," May 25, and in the Lond. "Proc. Phys. Soc." for June; he gives the results of a study of the physical and chemical transformations taking place in tempering steel, in which experiments the heating was done by an electrically heated platinum wire and the temperatures measured by a Le Chatelier pyrometer.

Transmission Plant at Aubervilliers.—An illustrated description of a private plant in this city in France in which gas engines supplied by producer gas are used, is published in "L'Ind. Elec.," May 25; it is really a power distribution plant as the distances are short; a table of the results of tests is given from which it appears that the coal consumed per horse-power-hour at the brake was 1.45 pounds for a mean brake power of 80.25 hp. A brief description of this plant is published in the "Elec. Eng." (N. Y.), June 5.

Transmission of Power by Synchronous Motors.—A translation of Mr. Picou's paper (see Digest, March 30, also June 1), is given in abstract in the "Jour. Inst. Elec. Eng." for May.

TRACTION.

Mountain Climbing Railways.—Mr. Scott's long article is concluded in the Lond. "Elec. Eng.," May 31; he describes several other railways and gives two tables, one containing a list of all existing mountain railways, 47 in number, and the other giving particulars about a number of these; he also gives the bibliography on the subject in the form of a long list of references.

Electric Traction in Europe.—A very long abstract from the report of Mr. Van Vloten (made about a year ago) is published in the "Bul. Soc. Belge d'Elec." for January, February and March; it is a general discussion of the subject of electric railways with special references to those in Europe; the costs of operation of a number of European lines are given.

Accumulator Traction.—"L'Ind. Elec.," May 25, gives some additional descriptive matter with illustrations of the plant in Paris, a description of which was given in the Digest, June 1; the present portion refers to the accumulators and the new form of cars but contains little more than has already been noticed in these columns.

Boston.—"L'Eclairage Elec.," May 18, contains a long, well-illustrated article by Mr. Pellissier on electric railways in Boston.

Interurban Electric Railway.—The paper by Prof. Short, mentioned in the Digest, June 15, is reprinted, apparently in full, in the "St. Ry. Jour." for June; a set of curves showing the efficiency and other features of a double 50-hp motor equipment and another of a double 100-hp motor equipment, are given.

Locating Faults in Track Circuits.—A description of the method of Mr. Henry (see Digest, June 15), is given more fully in the "St. R'y Gaz.," June 8.

Surface Contact System.—The system of the Electro-Magnetic Traction Co. (otherwise known as the McLaughlin system) is described and well illustrated in the "St. Ry. Jour." for June; there is a central sectional rail between the tracks which is stitched into the circuit as the car passes over it.

Conduit Railways.—In a short paper by Mr. Levy, reprinted in "Elec. Age," June 8, he discusses and criticises different systems.

Speed Indicator.—A system devised by Mr. Darley is described and illustrated in the "St. Ry. Gaz," June 1; a dial indicates that the speed is greater than a pre-determined amount, thus serving as a check on the motorman.

Cast Welded Rail Joint.—In a brief description of the Falk process (see Digest, Jan. 5), in the "St. Ry. Jour." for June, an illustration is given of the new form of the complete outfit.

Practical Notes for Motormen.—A series of practical articles by Mr. Hanchett is begun in the "St. Ry. Gaz.," June 1; the object is to explain in a clear and simple manner the properties of electricity as applied to railway cars; it will include practical hints as to the method of handling the energy; it is intended for motormen who have no knowledge of electricity; in the first instalment a simple water analogy is given.

Street Railway Troubles.—The "Electrical Jour.," June 1, contains an article of an elementary nature by Mr. Shepherdson on this subject in which he discusses, in a practical way, troubles due to wear and depreciation and those due to accident and unusual causes.

Motor Repairs.—In Mr. Shepherd's series of articles he discusses the General Electric motor in the "St. Ry. Jour." for June.

Electric Railways in Great Britain.—The "St. Ry. Gaz.," June 8, contains a short article by Mr. Bridge giving a brief summary of the electric railways and railroads in England; he believes that the chief reason why England has been so slow in adopting electric railways is that investors delayed operations in order to take advantage of improvements.

Metropolitan Elevated Railway.—Some additional illustrations and descriptions of details are given in the "St. Ry. Gaz.," June 1. An illustrated description of this road is published in "Elec. Ind." for June.

Philadelphia.—The "St. Ry. Gaz.," June 1, gives a series of well-illustrated articles describing the Hestonville, Mantua & Fairmount Co.'s plant, in which the General Electric Co.'s machinery is used. The power station of the Electric Traction Co., using General Electric machinery, is described and illustrated in the "St. Ry. Jour." for June

St. Louis.—A very long and profusely illustrated article on the electric railways in St. Louis is published in the "St. Ry. Jour." for June.

Niagara Falls Park and River Railroad.—A brief illustrated description is published in the "Elec. Age," June 8.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electric Lighting of Small Towns and Villages.—Referring to the article abstracted in the Digest last week Mr. Sowter in the Lond. "Elec. Rev.," May 31, states that the idea of combining the management of a number of small stations in cities neighboring a large one, might be advisable if the distance is more than five miles from the central one, but within that radius he thinks it a far better plan to adopt the alternating-current high-tension system with about 5,000 volts; he thinks it is not likely that such serious accidents would occur as would entirely suspend the supply for any of the outlying towns for any length of time; he believes that a small continuous supply station with a man and a boy in charge would be quite as liable to break down; there are in use to-day high-tension mains which have been at work for years without the least trouble or fault; he does not see why an attendant would be necessary at the sub-stations.

Rules and Regulations.—The Lond. "Elec.," May 31, reprints in full the new set of rules and regulations proposed by the Board of Trade; they are reprinted in a way to show the difference between these and those at present in use; they do not admit of being abstracted; there are quite a number of changes.

The proposed rules for Australasia are briefly summarized in the same journal.

Pressure Curves.—Some additional curves and comments on those mentioned in the Digest last week are published in the Lond. "Elec.," May 31; a pair of curves is given, one representing the voltage of the positive side and the other that of the negative, the form being very irregular due to the fact that most of the motor load carried by that station is on the positive section.

Brussels.—An illustrated description of this continuous-current station is published in "L'Ind. Elec.," May 25.

Cheltenham.—A short illustrated description of this alternating-current plant is published in the Lond. "Elec. Rev.," May 31.

Lightning Arresters and Why They Sometimes Fail.—A lecture by Mr. Wurtz on this subject is reprinted in the "Jour. Frank. Inst." for June. He describes his well-known system of non-arc lightning arresters used in conjunction with choking coils. The chief reasons why lightning arresters sometimes fail to protect, he states, are the lack of insulation of the apparatus, a lack of a sufficient number of arresters and because they are often not properly installed; the defective insulation results either from weak insulating material or a faulty application of it, the latter being the chief cause, as the material used is generally good; faulty application may be due to improper design or carelessness or ignorance, of which he gives examples; he also points out the importance of a proper margin of safety, but notwithstanding this, deterioration may occur, chiefly from moisture or overheating; he shows that the well-known selective property of discharges often explain why arresters sometimes fail; if absolute protection is to be provided by spark-gaps the insulation strength must bear such relation to the spark-gap as to place it beyond the limit of selection; a liberal distribution of line arresters offers the only practical means of protecting widely distributed apparatus. In conclusion he gives a number of examples of carelessly installed lightning arresters some of which are amusing. An abstract of the portion explaining why arresters fail is published in the "St. Ry. Gaz.," June 8; a short abstract is published in "Elec. Ind." for June.

Electrical Fires in Chicago.—The "Electrical Jour.," June 1, contains a short article by Prof. Barret in which he gives a list of the fires of electrical origin in Chicago in 1894, the total losses of which amounted to less than $8,000. He believes that the greatest danger in electrical installations lies in the close and ruinous competition of bidders on the work; of these 61 fires a large percentage were due to either defective or injured wire; he believes there is no reason why ordinary installations should increase the fire hazard; in conclusion he adds some suggestions among which he states that wood of any description is not safe for the bases of instruments on which live portions of the circuits are mounted directly; a few illustrations of burnt out apparatus are given.

Coal Consumption at an Edison Station.—The "Elec. Eng.," June 12, abstracts very briefly a recent paper by Mr. Hale read before the Boston Society of Civil Engineers, on "Approximate Analysis of the Use of Coal in an Edison Electric Light Station of the Type Standard About 1890." He finds that the coal used in a 1,000-kw station, whenever it is completely ready to run, is equal to 500 pounds per hour plus 7.5 pounds per kw hour; a brief analysis is given of the constant loss of 500 pounds per hour. Some curves are reproduced showing the load diagram and the effect of connecting several stations together and by this means supplying the light day load from one common station; the stations referred to are those in Boston.

Accumulators in Central Stations.—The paper by Mr. Howell, abstracted in the Digest last week, is being reprinted in the "Elec. Rev.," beginning with June 12.

WIRES, WIRING AND CONDUITS.

Induction in Armored Cables.—In an article by Prof. Guye in "L'Eclairage Elec.," May 18, he gives the results of experimental demonstrations of the method of calculation which he described in a preceding article (see Digest, Nov. 17, 1894); the experiments were made with the concentric high-tension armored cables which were installed for the Geneva electric lighting plant. In the first series of experiments the inner conductor was used as the lead and the surrounding one as the return; the fall of voltage was found to be practically the same for continuous and alternating currents. In the second series only the central conductor was utilized, the other being disconnected and left on open circuit, the whole cable forming a loop; the loss of voltage was more than twice as great with alternating as with continuous currents and during the experiment it was not possible to send any telephonic messages in the city on account of the induction from these currents. The third series was like the second, only that the ends of the other conductor were connected together through an alternating current amperemeter and the two circuits therefore acted as they do in a transformer; the loss of voltage in the primary was greater than with continuous currents but the difference was less than in the preceding series. He concludes that figures obtained have satisfactorily demonstrated the correctness of the theory.

ELECTRO-PHYSICS AND MAGNETISM.

Unipolar Induction.—The paper of Mr. Lecher which was abstracted in the Digest, Feb. 2, is noticed in the Lond. "Proc. Phys. Soc." for June, where it is followed by an explanation by the abstractor, in which he states that those experiments "can probably be completely explained by treating the rotating magnetic 'charges' at the poles of the magnets as magnetic convection currents, exactly similar to the electric convection-currents studied by Prof. Rowland. If the motion of these 'charges' is steady (whether rectilinear, circular, or of any other type, provided that at any fixed point in space the magnetic force is constant), the magnetic field is exactly the same as if the charges were at rest, and in addition there will be an electric field which possesses a potential at all points where there is no magnetic 'matter' in motion. This potential is, however, many-valued (just like the magnetic potential due to an electric current) if there is any magnetic convection-current passing through the curve of integration."

Conduction of Hot Gases.—A paper by Mr. Pringsheim from the "Sitz. Akad. Wiss., Berlin," 1895, p. 331, is abstracted briefly in the Lond. "Proc. Phys. Soc." for June; it shows that with one to ten dry cells, hydrogen, carbonic acid and air begin to conduct at a red heat, the conductivity increasing rapidly with the temperature and with diminishing pressure; the electrodes show a marked polarization, the highest observed being 0.5 volts.

Action of Electric Discharge on Lead Oxide.—A paper by Mr. Warburg from the "Wied. Ann.," 54, p. 727, is abstracted briefly in the Lond. "Proc. Phys. Soc." for June; lead oxide in a tube containing air at 2.5 mm pressure turns into peroxide of lead when a discharge is sent through the tube, the gas being absorbed; in hydrogen it is changed to metallic lead; the effect appears to be due to the light radiated from the glowing gas making the oxide more ready to react with the gas, and not to a chemical change in the gas which makes it more active.

Potential in a Conducting Liquid Having a Uniform Motion.—A brief abstract of the paper of Mr. de Villemontée, mentioned in the Digest, Feb. 9, is given in the "Jour. Inst. Elec. Eng." for May; he concluded from his experiments that the uniform motion of a conducting liquid through glass tubes of large diameter and of equal section throughout their length, produces no appreciable alteration in the differences of potential between two points in the liquid within the limits employed in the above case.

Conductivity of Salts and Acids in Aqueous Solution.—A paper by Mr. Franke from the "Zeit. Phys. Chem.," 16, p. 463, is abstracted in the Lond. "Proc. Phys. Soc." for June.

Experiments on Electrical Dispersion.—A paper by Mr. Drude from the "Wied. Ann.," 54, p. 352, is abstracted in the Lond. "Proc. Phys. Soc." for June.

Multiple Resonance.—A paper by Mr. Bjerknes from the "Wied. Ann.," 54, p. 58, is reprinted in "L'Eclairage Elec.," May 18; he gives in a general way the theory of multiple resonance.

Effect of Temperature on the Discharge of a Conductor into Air.—A paper by Mr. Oberbeck is abstracted in the Lond. "Proc. Phys. Soc." for June.

Energy Movements in the Medium Separating Electrified or Gravitating Particles.—Prof. Allen's paper (see Digest, April 20), is published in full in the Lond. "Proc. Phys. Soc." for June.

Gradient of Potential.—The recent article by Mr. Herz in the "Wied. Ann.," 54, p. 244, on the determination of gradient of potential on the positive part of the luminous discharge, is published in "L'Eclairage Elec.," May 18.

Dispersion and Dielectric Constants.—A paper by Mr. Paschen from the "Wied. Ann.," 54, p. 668, is abstracted in the Lond. "Proc. Phys. Soc." for June.

Electrostatic Capacity of Coils.—A translation of Mr. Cauro's paper (see Digest, March 23), is given in abstract in the "Jour. Inst. Elec. Eng." for May.

Energy Transformations in Electrical Conduction.—The paper by Prof. Strecker abstracted in the Digest last week under "Conductivity" is abstracted in the Lond. "Proc. Phys. Soc." for June.

Atmospheric Electricity.—Prof. Schuster's paper is concluded in the Lond. "Elec.," May 31.

Earth Currents.—An abstract of Mr. Palmieri's paper (see Digest, May 11), is published in the "Jour. Inst. Elec. Eng." for May. This abstract is reprinted in full in the "Elec. Rev." (N. Y.), June 12.

Kation or Kathion.—In a communication in the Lond. "Elec.," May 31, Prof. Waddell questions the recent statement of Mr. Portheim (see Digest, April 6), in favor of "kathion" and expresses the belief that the Greek word on which Mr. Portheim bases his argument does not exist.

The E. M. F. of Alloys.—The Lond. "Elec. Rev.," May 31, calls attention to a paper by Mr. Laurie in the "Jour. Chem. Soc." for December, in which he gives results of determinations of the E. M. F. of 16 of the 19 alloys referred to by Mr. Matthiesson, confirming the latter's conclusions.

Resistance Variations of Bismuth.—A description of the investigations of Mr. Sadovsky in regard to the changes which occur in the electrical resistance of a bismuth wire in a magnetic field and carrying a current, is given in the Lond. "Proc. Phys. Soc." for June.

Earth's Magnetism.—A paper on "Lines of Equal Disturbance in the Magnetic Potential of the Earth for 1880," by Mr. von Bezold from the "Sitz. Akad. Wiss., Berlin," 1895, p. 363, is abstracted in the Lond. "Proc. Phys. Soc." for June.

Pull of Magnets.—An abstract of Mr. Jones' paper in the "Wied. Ann.," 54, p. 641, is given in the Lond. "Proc. Phys. Soc." for June; he gives an experimental proof of the correctness of the law of the normal magnetic stress; it appears to be similar to the one abstracted in the Digest, March 23.

Experiments with the Electric Discharge.—The article mentioned in the Digest, June 15, is being reprinted with the illustrations in "El'ty," beginning with the issue of June 12.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrochemical Experiments.—In the "Elektrochem. Zeit." for June Mr. Zsigmondy describes a number of striking lecture experiments all of which can be produced with small apparatus. Several show the effect of current density on the nature of the electrolytic deposit, for which purpose he finds that copper and copper sulphate are the best materials to use, the latter being about two thirds saturated; a number of the experiments refer to arborescent deposits, in connection with which he calculates the current density from the speed of the growth of the arborescent deposit; for tin, in which he obtained a growth at the rate of 10 mm per second, he finds that the current density was 1,176,000 amperes per square decimeter. To produce a single crystal he suggests placing the negative terminal in the form of a wire, in a glass tube open at the bottom, the other electrode being in the liquid outside of the tube, the crystal will then grow out toward the end of the tube; for such experiments he finds tin the best material, using the chloride as the electrolyte; a detached crystal lying in the path of the current will be dissolved at one end and will grow at the other, therefore appearing to travel. To show the currents produced by two different liquids and a single metal connecting them, he cuts a round disc of tin leaving a long thin strip attached to it which is bent around so that the end [illegible] does not touch the centre of the disc; it is then suspended horizontally so that the strip and point are immersed in the denser liquid while the disc is in the lighter liquid, which is carefully introduced so as not to mix with the other; for the former he uses a warm concentrated solution of chloride of tin and for the latter concentrated hydrochloric acid; crystals will then be formed on the point and the disc will be dissolved.

Bleaching Oils and Fats.—The Lond. "Elec. Rev.," May 31, describes the following system: a tank is divided into two parts by means of a porous partition, one containing a solution of common salt at eight degrees Twaddell strength and a carbon electrode, the other containing a mixture of the oil or fat with a similar solution and a copper electrode, the oil solution being agitated mechanically while the current passes; no further information is given.

Electrolysis of Chloride of Sodium.—According to a paper by Mr. Cassel, abstracted in the "Elektrochem. Zeit." for June, he states that the use of mercury as a cathode is a theoretically correct one and gives the results of tests with a plant containing 30 cells producing daily 1,200 pounds of sodium hydrate and 1,000 pounds of chlorine, with a 110-hp engine, proving that under favorable circumstances almost 90 per cent. of the theoretical product per watt can be obtained.

Electrolysis of Fused Salts.—Mr. Andreoli's serial is continued in "L'Elec.," June 1; in continuing his historical summary, he gives illustrated descriptions of several forms of apparatus.

Electrolytic Preparation of Natural Dyes.—A second article on this subject by Dr. Foelsing is contained in the "Elektrochem. Zeit." for June.

Disinfection by the Hermite Process.—A translation of Mr Farman's paper (see Digest, March 30), is given in abstract in the "Jour. Inst. Elec. Eng." for May.

Laws Regarding Dilute Solutions.—A paper by Mr. Wildermann in the "Zeit. f. Phys. Chem.," 1894, p. 337, is briefly abstracted in the Lond. "Elec. Rev.," May 31; he discusses the experimental proof of the well-known laws of Van't Hoff, Arrhenius and Ostwald on the dissociations in dilute solutions.

Theory of the Transition Battery Without Metastable Phase.—A paper by Messrs Van't Hoff, Cohen and Bredig from the "Zeit. Phys. Chem.," 16, p. 453, is abstracted with some of the data, in the Lond. "Proc. Phys. Soc." for June.

Multivolt Battery.—In the "Elec. Eng.," June 12, Prof. Carhart shows that the principle of this battery, which has recently been described in all the journals, is not correct, and that the claim that there is no local action, no polarization and no heat "is mere buncombe and has no foundation in fact." In the same issue Mr. Johonnot endeavors to prove why the battery "works without wasteful local action"; he claims that there will be two equal and opposite E. M. Fs. generated in the openings in the carbons by the tendency to local action and that therefore there will be no current through these openings. (There is no question that his argument is incorrect and even absurd; there will certainly be much more local action than if separate retaining cells were used.)

Chlorine and Soda.—The "Jour. Frank. Inst." for June abstracts a brief description from "Genie Civil" of the apparatus recently installed in Birmingham, England, for the electrolysis of salt. The tanks are divided into three compartments, having mercury at the bottom which circulates between the compartments; the daily production is 1,300 pounds of soda and 1,100 pounds of liquid chlorine.

Cyanide Process of Extracting Gold.—The "Eng. & Min. Jour.," June 8, contains a communication and several short articles on this subject.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Photometric Standard.—The recommendations of the Photometric Standards Committee concerning a standard source of light, and embodying the results of three years' investigation, are briefly summarized in the Lond. "Elec.," May 31; it is believed that the recommendation which they make regarding the standard source of light "may be confidently accepted as giving the best solution at present possible of this much-discussed problem." They recommend the adoption of a 10-candle standard produced by some form of flame; only a portion of the luminous surface of the flame is utilized, as in the Methven standard; the gas used is reduced to a constant luminiforous power by passing it over the surface of liquid pentane as in the Vernon Harcourt standard; the height of the flame is adjusted to a fixed mark although slight variations are not important; the form of the instrument adopted is the 10-candle pentane Argand burner designed by Mr. Dibdin in 1886; the committee have satisfied themselves that these burners can be reproduced in any quantities with sufficient agreement among themselves and that the standard is equal to ten times that which has been legally recognized for the last 35 years. The claims of an electrical standard of light have been considered and found wanting. No further information is given.

Measurement of a Varying Temperature.—A Physical Society paper by Mr. Burstall is abstracted briefly in the Lond. "Elec." and "Elec. Rev.," May 31. He describes experiments made to determine the temperature inside of a cylinder of a gas engine at different points of the stroke of the piston; a modified form of platinum thermometer is used, the wire being very thin and unprotected owing to the rapid variations in temperature; the resistance was measured by a Wheatstone bridge; the galvanometer circuit was closed when an explosion took place, by means of a relay worked by the pointer of the steam engine indicator attached to the cylinder.

Determination of the Resistance of a Diaphragm.—A method is described by Dr. Krueger in the "Electrochem. Zeit." for June; the resistance of the liquid is first measured between two fixed electrodes, after which the diaphragm is introduced between them and the increase in resistance is that of the diaphragm; a number of results are given; the method was that of Kohlrausch, with a telephone and a bridge. He believes that this is a good method to determine the porosity of porous cells; the resistance of the diaphragm is proportional to the specific resistance of the electrolytes.

Capacity Tests.—A paper by M. Heinke from the "Wied. Ann.," 54, p. 577, is abstracted in the Lond. "Proc. Phys. Soc." for June; he points out a third source of error in measuring the capacity of condensers with alternating currents, which depends on the particular method of testing and connecting with the bridge; the other two well-known sources of error being the frequency of alternations and the extent of these variations in different dielectrics.

Submarine Cable Works.—In Mr. Wilkinson's serial in the Lond. "Elec.," May 31, he describes Kennelly's break test. The descriptions in this serial do not admit of being abstracted; it appears to be a good practical summary concerning submarine cable testing and may be recommended to those interested in the subject; it will not be referred to again in these columns.

Resistance of New Alloys.—The principal data from the recent article of Mr. Van Aubel (see Digest, April 27), is given in the "Jour. Inst. Elec. Eng." for May.

Idiostatic Electrometer.—A brief description of the Righi instrument, mentioned in the Digest, March 23, is given in the "Jour. Inst. Elec. Eng." for May.

Simple Form of Harmonic Analyzer.—Mr. Yule's paper is published in full with illustrations in "Proc. Phys. Soc." for June (see Digest, Apirl 20).

MacEvoy Explorer.—The instrument mentioned several times before in these columns, which was said to have been used successfully in locating the sunken Russian steamer, is described and illustrated in "L'Eclairage Elec.," May 18; it appears to be simply a practical application of the well-known Hughes induction balance.

Apparatus.—A well-illustrated description of some of the exhibits at the annual exhibition of the French Physical Society, are published in "L'Eclairage Elec.," May 18.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Induction in Single Wire Telephone Circuits Due to Railway Circuits.—In a paper by Mr. Pierard in the "Bul. d'Ass. Ing. El. Montefiore," Vol. 5, No. 6, he discusses the various methods used to avoid the noise in telephones due to induction from railway circuits and describes the one which is used with complete success in Brussells and Liege. He states that the introduction of self-induction coils is not a success and the same is true of the use of a common low resistance return conductor; for neutralizing the effect perfectly, exactly the same electrical factors must exist on the outgoing and the return wire. In the system described there is a common return wire, but the call is so arranged that the earth is automatically substituted for the return conductor during the calling signal; if absolute secrecy is necessary the earthed return may be used in place of the common conductor, but the line will then be subject to the interference of railway circuits.

Lalande Microphone.—An illustrated description is published in "L'Ind. Elec.," May 25. In the ordinary microphone the diaphragm when once disturbed will continue to vibrate, due to its own elasticity, and these vibrations will become mingled with those subsequently produced by the current, thus interfering with them; in order to avoid this, the vibration of the carbons is dampened, by connecting pieces of hard rubber to them, the ends of which dip into mercury placed in the bottom of the cylindrical space between the diaphragm and the back of the microphone, the mercury being also in contact with the diaphragm, and it therefore dampens these parasitic vibrations of both the membrane and the carbons; the clearness and the power of the instrument are said to be remarkable, and there is claimed to be no resonance when connected with even the longest circuits.

Telephony in Germany.—Some large tables of statistics for the year 1894 are published and discussed editorially in the "Elec. Zeit.," May 30.

Municipal Telephony.—A long editorial in the Lond. "Elec. Eng.," June 12, gives a brief review of the recent discussion in England regarding municipal telephony.

MISCELLANEOUS.

Carbide of Calcium—According to the "Zeit. f. Beleucht," May 30, the Neuhausen Aluminium Company, states that as a result of recent improvements it can now sell the compound in lots of at least one ton at 40 pfg. per kg which is equivalent to about $90 per short ton.

Royal Society Transactions.—According to the Lond. "Elec.," May 31, an index has recently been published of the Philosophical Transactions of the Royal Society covering the period from 1800 to 1895 and it appears that each paper may be bought separately.

New Journal.—From the first number of this journal, which has just been received, it appears that Prof. Barret is the president of the company, that the editors are Profs. Carhart, B. F. Thomas, Herdman, D. C. Jackson and Dr. Hornsby. It is to be semi-monthly. In an editorial announcement it is stated that there is a large class of people who are "practically debarred from a knowledge of electrical principles and laws, owing to the deeply scientific and mathematical character of existing text books and current literature"; it is the aim of that journal to keep this class thoroughly posted and to present items for their information and entertainment; subjects are to be treated in a clear, concise, every-day language comprehensive to the ordinary newspaper readers; all important editorials are to be signed by their authors; a portion of the journal is devoted to the National School of Electricity.

Electricity in Medicine.—In an article by Dr. Herdman in the "Electrical Jour.," June 1, he describes the different applications of electricity in medicine.

Therapeutic Action of High Frequency Currents.—The translated abstract of the recent paper (see Digest, May 11), by Messrs. Apostoli and Berlioz, mentioned last week, is reprinted in the "Elec. Rev.," June 12.

A Franklin Document—The "Elec. Eng.," June 12, reproduces a facsimile of a letter of Benjamin Franklin written Aug. 12, 1779, suggesting methods to try if the shock received from the torpedo fish is an electrical one.

Exhaust Steam Heating.

BY I. H. BABCOCK.

The rapid development of electrical industries has involved the construction of many steam power stations of great capacity. The best these stations can do is to utilize about 10 per cent. of the steam generated in creating the required power. The 90 per cent. which escapes through the exhaust pipe represents, to a very large extent, fuel, labor, the wear and tear of apparatus, and cost of management. Several of the more enterprising electrical companies have adopted economical methods whereby this waste product is turned to practical account. They have constructed underground mains for the distribution and sale of their exhaust steam for the heating of all kinds of buildings. This undertaking has proved to be unequivocally successful. One of the latest to adopt the new method is the Terre Haute (Ind.) Electric Railway Company, Russell B. Harrison, president. It has already had constructed by the American District Steam Company, of Lockport, N. Y., about one mile of mains leading from its boiler station, and is negotiating for the construction of two miles more of mains to be ready for the commencement of the heating season in October. The Terre Haute company also does the city and commercial lighting, and thus has a continuous supply of exhaust steam from boilers of 120-hp capacity.

The Danville (Ill.) Electric Light & Street Railway Company has also commenced the construction of an extensive system of underground steam mains, and will be selling its exhaust steam for heating as soon as the heating season opens. About the only expense of this added branch of the business is the construction of the steam mains, as these companies already have their boiler stations and other apparatus ready for use.

Brake Efficiency.

A speaker at a recent meeting of the English Institution of Electrical Engineers spoke unfavorably of braking engine tests. Referring to the engine under discussion, he said he had never had single-acting enclosed engines on the brake and knew nothing at all about their efficiency, but that much was heard about the common or garden engines running into fabulous efficiencies, 91, 92 and 94 per cent., and he certainly could not believe any figures of that kind unless he was given means of verifying the statements made. They knew there was nothing that would lie more consistently than an indicator, except, of course, a voltmeter or an ammeter. It was also known that it was very possible to get wrong indications in the brake. There was great trouble and scandal some years ago about the question of brakes, and it was shown then that the brakes were all wrong and all the results got from them were wrong. He would tell them one thing that made him sceptical about those high efficiencies. He saw a small engine braking 30 or 40 horse-power running empty, just turning round in steam, warm; it was running pretty freely, because three men, big powerful men, separately took hold of the fly wheel and shoved it round to see what they could do. One of them by superior strength or skill after he had let the wheel go, got three revolutions out of her, so there was not much wrong with that engine so far as friction went. It was about as free from friction as they could get an engine, but that engine on careful braking and indicating could only just get a bare 90 per cent. He had once seen a small fraction more, but only once.

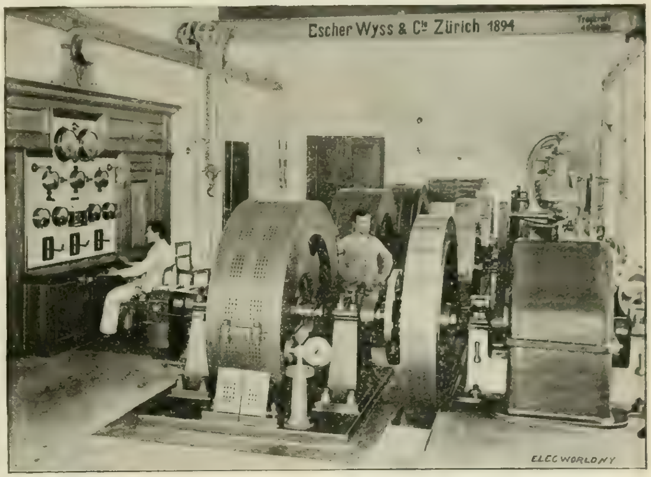
High-Speed vs. Slow-Speed Engines.

It is probable, says the London *Electrical Review*, that the bulk of American electrical driving engines are of the small variety of slide valve or Corliss engines. Americans have laid themselves out to produce small economical engines of these types, and they are run at very fairly high speeds. English engine builders have neglected the type, and large engines have not been employed simply because the division of units has been found desirable, and electrical stations are all so very small as yet. There must be something like 800,000 or 1,000,000 horse power in slow running engines in the spinning branch of the cotton trade alone, so that the frantic cry for the builders of these engines to come forward and say something in their favor may well be received with a smile by the slow-speed men, who, if tackled on the question, would probably tell us that they did not have the same faith in the continuance of the infantile condition of electricity as was held by the supposed best friends of the electrical industry.

A New Swiss Central Station.

A water power central station has recently been installed by the Maschinenfabrik Oerlikon, at Davos, Switzerland, a view of the generator room of which we print herewith. The water is led to the turbines by a pipe about 6,560 feet long. The turbines, which are directly coupled to the dynamos, work under a head of 328 feet, and are provided with automatic regulators to govern the supply by means of hydraulic apparatus.

On the turbine shaft is mounted a fly wheel, which smooths out slight irregularities in the speed. In order to avoid variations in the pressure, which would undoubtedly occur with the long pipe line, an air pressure chamber is connected with the latter.



INTERIOR OF SWISS STATION.

Each turbine is provided with an apparatus for running at no load, which goes into operation automatically as soon as the opening of the supply pipe is closed.

The dynamos, of which there are three, are direct-driven by the corresponding turbines, and operate at a normal speed of 400 revolutions; at a normal potential of 3,360 volts they deliver 40 amperes, equivalent to about 200 hp. The number of periods is 53.

The individual machines can be easily switched in parallel, when they supply the common long-distance transmission line, which is about two miles in length. The transmission line consists of four wires, two 7 mm, and two 2½ mm in diameter. The latter serve to control the potential at the distributing points by making it possible for the engineer to maintain a definite potential at all loads. At full load, the line shows a loss (drop) of 1½ volts.

There are 18 transformers in operation of which seven are of 20 kw, four of 15 kw, two of 10 kw, three of 8 kw, and two of 6 kw. The transformers work normally at 110 volts, with the exception of the three of 8 kw, which serve for arc lighting.

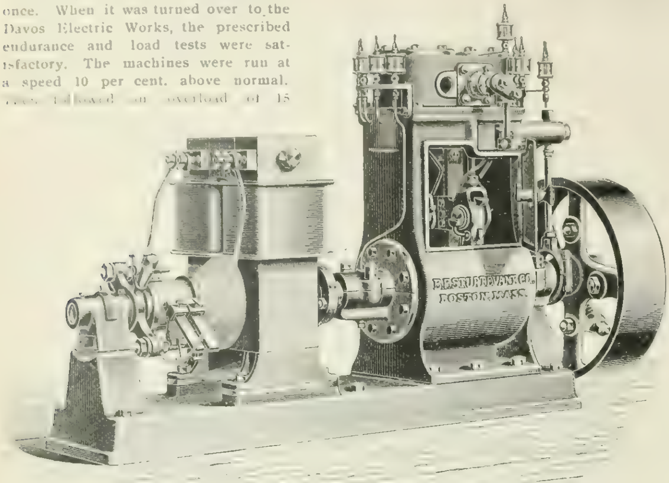
These transformers are placed in specially constructed boxes, out of doors. Each box contains, beside the transformer, a plate with the distributing conductors and their safety fuses so that each box holds all the apparatus necessary for cutting out the transformer on the primary as well as on the secondary side.

The public lighting is done with 30 arc lamps at 15 amperes. The lamps are arranged in three sets of 10 each, each set being supplied by a special transformer of 8 kw. As the lamps operate at about 35 volts, the transformers had to be wound for a potential of 400 volts.

[illegible] incandescent lamps, which increases from day to day. [illegible] to cp each.

[illegible] was built in about six months, from the beginning [illegible] October, 1894, but lighting could be done as early as September, though operation had to be stopped during the day [illegible].

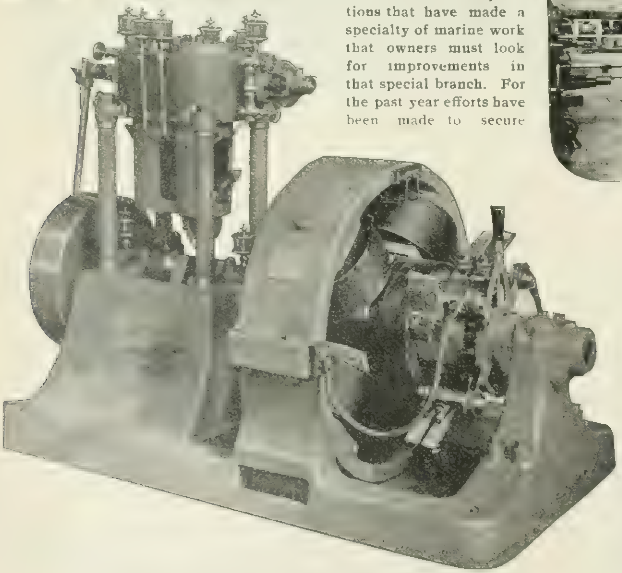
The regular, uninterrupted operation began in the middle of October, and the plant worked successfully at once. When it was turned over to the Davos Electric Works, the prescribed endurance and load tests were satisfactory. The machines were run at a speed 10 per cent. above normal. [illegible] followed an overload of 15 per cent. for several hours. The fluctuations in the voltage, with sudden changes in the load up to 10 per cent., were observed, and, finally, every machine was subjected to a run of 24 hours under normal conditions.



Direct-Connected Bipolar Dynamo and Engine.

Marine Lighting Set.

The peculiar requirements which govern the installation of electric lighting and power plants on shipboard are such that only familiarity with the conditions to be fulfilled and long experience can give the requisite result. And it is to firms or corporations that have made a specialty of marine work that owners must look for improvements in that special branch. For the past year efforts have been made to secure greater compactness in the generator plant, and the latest type which is now being built by the General Electric Company is shown in the accompanying engraving.



Direct-Connected M. P. Generator and Engine.

The combination here illustrated consists of a double-cylinder vertical engine, 4¼ x 4, direct-coupled to an 8-kw multipolar generator. In the generator, which is of the latest type, all the material of the frame is available for magnetic purposes, so that the magnetic leakage is reduced to a minimum—a point of vital importance on shipboard. The frame is of soft cast steel of very high magnetic permeability, and the armature is iron-clad; the windings are interchangeable and can be easily replaced. Provision is made to ventilate the armature thoroughly, and the insulation throughout is unusually substantial. The commutator and brushes work perfectly under all conditions of load, and the regulation has been brought to a high degree of excellence.

This generating set occupies an exceedingly small floor space, which feature constitutes a strong point with shipbuilders and owners.

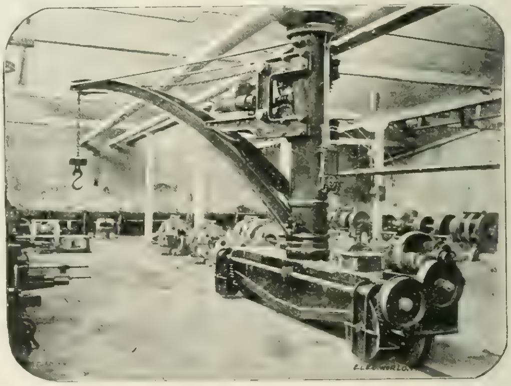
A Compact Lighting Equipment.

The direct-connected outfit illustrated herewith is notable for its small floor space and symmetrical appearance. The output of the combination is 3½ kw at 800 revolutions per minute; the floor space is 48 by 15 inches. The dynamo is the Adams' forged iron field magnet type with smooth-core armature, and is extremely light and compact, its weight, ready to mount on the extended engine base, being 450 pounds; these qualities especially adapt it for direct connection.

The engine is the well-known Sturtevant automatic, which has found general favor for direct connection to dynamos because of its high speed and close regulation.

A French Electrical Crane.

The electrical crane which we illustrate has recently been installed in the large electrical factory of its designer, Fabius Henrion, at Nancy, France. The travel of the crane is 240 feet, and as the reach is 15 feet its use extends over a floor space of 30 by 240 feet. The crane lifts six tons and takes castings at one end of the building, transports them successively to the scales, the various machine tools, to the fitting, testing and painting departments, and, finally, to a car for shipment.



Six-Ton Electric Crane.

The crane is guided at the base by a single rail and on top by two rails with a roller between them. Under the two upper rails are two conductors from which current is taken by a sliding trolley. A dynamo placed on the base furnishes power to move the crane along the track and is governed by a regulator, which can be seen in the illustration to one side of the dynamo. By turning the lever to the right or to the left the crane is given a forward or backward motion and faster or slower according as the lever is moved through a greater or less angle. The dynamo is reversed by reversing the armature connections. Carbon brushes are used which require no adjustment, whatever the load or direction of motion may be. The hoisting dynamo is on the strut which joins the column to the arm of the crane, and its motion is governed by means of the regulator seen fixed on the column. In lowering away, the descent cannot become too rapid for the reason that as the speed increases the dynamo becomes a generator and acts as a brake.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, June 15, 1895.

AMERICAN BELL opened a little weak on Monday, but rallied to 203¾ on Wednesday and continued strong throughout the week. The change was probably due solely to Wednesday's announcement of a regular dividend of 3 per cent., and an extra one of 1½ per cent. The directors of the Bell Company voted, on Wednesday, to call a stockholders' meeting on June 24 to act on a recommendation to issue $1,000,000 additional stock. The outstanding capital is now $20,500,000. The new stock must be offered to shareholders at a price to be fixed by the commissioner of corporations, and any unsubscribed balance must be sold by auction. A prominent officer of the Bell Telephone says the company may again sell new stock at auction, but the last sale was very unsatisfactory and debenture bonds may be issued instead. The money is needed for extensions by sub-companies in which the parent Bell Company is a partner, and for which it has to pay its proportion. The revival of business will help the company materially. Its reduction in rates to sub-companies does not really decrease the revenue, as the sub-companies, because of the lower charges, will pay larger dividends to the parent compay. He thinks the stock should sell around 200 paying 12 per cent., and expects it to sell around 250. Taking the Bell Company and all its sub-companies, probably not over 7 per cent. per annum has been earned in the telephone business on all the money invested.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	99	101
" " " Brooklyn	100	..	108
" " " Boston	100	129	130
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	31	31¼
General Electric	100	36	36¼
General Electric, pref	100	..	65
Westinghouse Consolidated, com	50	36	36½
" " pref	50	53	53½

BONDS.

	Par.	Bid.	Asked.
Edison Electric Ill., New York	100	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co. deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

	Par.	Bid.	Asked.
American Bell Telephone	100	204	204¾
American District Telegraph	100	30	40
American Telegraph & Cable	100	94½	..
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
†Erie Telephone	100	58	58½
Gold & Stock Telegraph	100	105	..
New England Telephone	100	74	74¼
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63½	
Western Union Telegraph	100	93	93½

ELECTRIC TRACTION STOCKS.

	Par.	Bid.	Asked.
Baltimore Traction	25	20⅞	21⅛
Binghamton RR. com	100	100	..
Brooklyn Traction	100	11½	14
" " pref	100	..	53
Buffalo St. Ry	100	79	83
Cleveland City Ry	100	68	70
Cleveland Electric Ry	100	59	60
Chicago City Ry	100	305	315
Columbus St. Ry	100	48½	..
Consolidated Traction of N. J	..	26	30
Electric Traction, Philadelphia	50	75½	75¾
Hestonville	100	..	60½
Long Island Traction	100	11	11½
Louisville St. Ry. com	100	37	39
" " " pref	100	87	88
New Orleans Traction	100	20	22½
" " pref	100	69	71½
North Shore Traction	100	23	28
" " pref	100	78	81
People's Traction $30 pd	25	62¼	62⅜
‡Philadelphia Traction	50	82½	82⅞
Rochester St. Ry	..	38	..
Union Ry. (Huckleberry)	100	112	115
West End, Boston	100	72½	72⅞
" " pref	100	..	92
Worcester Traction	100	13	16
" " pref	100	83	37

BONDS

	Par.	Bid.	Asked.
Buffalo St. Ry. 1st con. 5s	100	104	106
*Binghamton Railroad Co. 5s	100	99	100
*Columbus St. Ry. 1st 5s	100	98	..
Rochester St. Ry. 1st. 5s	100	95	97
*Union Ry. 1st. mtge 6s	100	105	108
*Westchester Electric 1st. mtge. 5s	100	98	101

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* With accrued interest.
† Ex-Div.
‡ Ex-rights.

WESTINGHOUSE remained steady [illegible] yesterday regarding the Manhattan Elevated, when the stock went to 36. As the report was generally discredited by conservative people it is difficult to see how any effect on the stock could result [illegible] there was nothing else to account for the sudden jump. The report was promptly denied, to day, by all parties concerned, but the fact that there has been considerable actual conference between Colonel Hain, of the Manhattan, and the Westinghouse people gives strength to the belief that the Westinghouse Company will eventually equip the elevated roads, notwithstanding the fact that no contract has as yet been effected.

ERIE TELEGRAPH & TELEPHONE COMPANY made a net gain of 149 subscribers in May. Total number connected June 1, 16 756.

EDISON ILLUMINATING, Brooklyn, reports net earnings for May 1895 of $13 687, ditto, 1894, $12 475, increase, $1 212.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 BROADWAY, NEW YORK, June 17, 1895.

MR. J. A. VAN ETTEN, manager of the Edison Electric Light & Power Company, Little Rock, Ark., was a visitor in New York last week. Mr. Van Etten speaks encouragingly of business prospects in the West.

MR. WILLARD W. LOW, president of the Electric Appliance Company, Chicago, was in the city for a few days last week. Mr. Low reports that his company is doing a very satisfactory business and is well pleased with the outlook.

G. S. PARKER, for many years connected with the Electric Supply & Construction Company and of late with R. B. Corey, has severed this connection and associated himself with Chas. E. Bramhall, 39 Cortlandt Street, New York, sales agent for the Standard Thermometer Company, of Peabody, Mass.

ELECTRICAL WORKERS' UNION NO. 34 has elected P. F. Healey, of Brooklyn, president; John Holehan, recording secretary, and S. J. Whalen, financial secretary. John Ryan has been elected president of Electrical Workers' Union No. 36; the secretary is A. H. Moses, and J. P. Casey has been elected financial secretary.

NEW STATION EQUIPMENT.—The Steinway Electric Railway Company recently installed a 500-kw G. E. multipolar generator direct-connected to a Dixson Corliss tandem-compound engine, and the combination was started up on last Friday. The engine and generator ran smoothly from the start, and up to last accounts had continued in service with entire satisfaction.

CHARLES E. GREGORY, president of the Charles E. Gregory Company, Chicago, was a visitor in New York last week. Mr. Gregory enjoys a national reputation as a progressive, energetic business man. Being thoroughly posted on the merits of electrical apparatus and always on the lookout for new acquisitions, his stock can be relied upon to contain everything from a fan motor to the largest dynamo and at advantageous prices. His present eastern trip means the addition of several car loads to his already large stock.

TROLLEY SPEED IN BROOKLYN.—President Lewis, of the Brooklyn Heights Trolley road, President Partridge, of the DeKalb Avenue road, and Vice-President Illersley, of the Atlantic Avenue road had a conference with Mayor Schieren last week in reference to the speed of the trolley cars. They spoke in favor of increasing the present rate of speed and complained of the reduction in receipts since the six-miles-an-hour ordinance went into effect. Mayor Schieren intimated that some change in the ordinance would meet with his approval.

WRAY BILL SIGNED.—Governor Morton has signed the Wray bill, providing that municipal officers authorized by law to contract for street lighting may contract for a period not exceeding 15 years for city lighting. Such contracts are to be subject to competition and shall secure to such city prices lower than any now prescribed by law with a progressive reduction in price for each year during the performance of such contract. The corporation may supply light to citizens by contract over a period of years at prices lower than those charged heretofore and progressively lower for each year of such term of contract.

THE WESTON COMPANY EXPANDING.—The Weston Electrical Instrument Company has outgrown its Newark quarters and has arranged for an extensive plant at Waverley, N. J. The company has purchased about 48 acres of land on both sides of Frelinghuysen Avenue for the purpose. Twenty-three acres will be opened up in building plots for employees of the works, and the property will be rented or sold upon easy payments to the employees. About 100 cottages will be built upon this tract by the company. Prof. Weston has other things in view besides the manufacture of his direct-reading voltmeters and ammeters, and will begin upon a new line of work as soon as the details of the present line of manufacture are completed and the new plant is in perfect operation.

ELECTRICAL MATTERS IN BROOKLYN.—At the meeting of the Brooklyn Board of Aldermen last week the regular weekly effort to give to the state [illegible] company permission to erect poles and string wires in [illegible] stern district was made and thwarted [illegible] The board adopted a resolution directing the city works commissioner to enter into contracts for street lighting with the electric light companies. The prices were given in this [illegible] Recer the time in which the Kings [illegible] should begin work on its conduits was extended four months. This is the scheme of which Charles Cooper, once a conspicuous [illegible] is the chief pusher.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, June 5, 1895.

STANDARD OF LIGHT.—At the instance, mainly, of the London gas companies a [illegible] Standards Committee was appointed some time ago to [illegible] of a better standard of light than the parliamentary candle. The report of this committee has recently been published. It does not propose to alter the unit, namely the candle, but proposes to adopt as a *standard* a 10-candle pentane flame, only a portion of the luminous surface being used, as in the Methven standard.

A NEW SOURCE OF REVENUE FOR RIVERSIDE ELECTRIC SUPPLY STATIONS.—At a recent meeting of the Kingston Town Council a local firm of electrical engineers asked permission to run a main from their works to the riverside for the purpose of charging the accumulators of electric launches. This permission was promptly refused, and it was stated that it was the intention of the municipal supply station to do the job itself, a profitable revenue being anticipated from this source, since there was no other charging station near at hand.

TELEPHONE MANUFACTURE.—Owing to the lapse of the English patents the chief telephone manufacturing company of this country is suffering very severely from foreign, principally German, competition. Its dividend on the ordinary shares has now fallen to 1½ per cent. With a view to reducing the manufacturing cost it is proposing to remove its works from London. The manufactures of this company are of undoubted excellence and finish, but it is difficult for the non technical public to discriminate between good and bad in the matter of telephones and to resist the temptation of buying rubbish at 10s. instead of good apparatus at double that sum.

ABSOLUTE MEASUREMENT OF ELECTRICAL RESISTANCE.—An interesting lecture was recently delivered at the Royal Institution by Prof. J. V. Viriam Jones, F. R. S., on "The Absolute Measurement of Electrical Resistance." The lecturer possesses an unusually fluent style which turned what might otherwise have been to a popular audience, a somewhat dry subject into one of absorbing interest. Prof. Jones strongly advocated that the official standard of electrical resistance should be a specification in absolute measure rather than an actual piece of metallic wire; in other words, that this standard should be obtained directly by an electromagnetic method. He exhibited a model of the apparatus which he himself had used in his researches into this subject and stated that with the actual apparatus itself an error of less than one in 10,000 could easily be determined. As this error is the maximum permissible in our official standard of resistance there is strong grounds for Prof. Jones' claim that the absolute method is sufficient for practical purposes.

NEW BOARD OF TRADE RULES.—The Board of Trade has recently published and issued to central station engineers and others a revised set of rules and regulations relating to the safe working of electrical supply undertakings and have invited suggestions to be sent in by the end of the month. We are accustomed in this country to spend considerable money and trouble with a view to ensuring the safety of the public, nevertheless there is universal grumbling in connection with the new Board of Trade regulations, not that they contain anything particularly novel, but their issue has brought matters to a head. These rules will be discussed both by the electrical trade section of the London Chamber of Commerce and the Council of the Institution of Electrical Engineers, but it is to be hoped that the Board of Trade will do the same as they did in regard to their electric traction regulations, that is to say, call together a conference of the representatives of the interests concerned and discuss the regulations clause by clause across a table.

TELEPHONE SERVICE OF THE UNITED KINGDOM.—The Parliamentary Committee of Inquiry which has been sitting for some time past and investigating grievances and suggestions with regard to the telephone service of the United Kingdom, completed the hearing of evidence last week, and is now considering its report, which, if any attempt is made to digest and summarize the evidence and make specific recommendations based thereon, should certainly prove a lengthy and possibly a valuable document. The chief suggestion of any novelty which was made, was that of municipal telephony, but it cannot be said that its advocates cut a very fine figure, or brought forward the strongest arguments which might have been brought forward in its favor. Perhaps the net result of the inquiry will be to convince the telephoning public that the National Company is not quite so black as it has been painted; compared with other countries its charges are not so high, nor its service so bad as has been represented, and considering the way in which it has been hampered by the post-office in the matter of royalties and general restrictions and by the local authorities themselves in the matter of way leaves, it is not far short of a miracle that the telephone exchange system has managed to survive.

THE LONDON COUNTY COUNCIL AND TRANSFORMER SUB-STATIONS.—Notwithstanding the ruling of the Board of Trade that the existence of transformer sub stations under the pavements was *not* a grave public danger, as was alleged by the London County Council and the other local authorities of London, several of the local authorities, headed by the London County Council itself, continue to hamper the operations of electric light companies engaged in the distribution of current on the alternate-current transformer sub station system. The latest fight is between the London County Council and the House-to-House Company which is anxious to construct transformer sub-stations of the inside dimensions of 5 by 6 feet 6 inches by 7 feet deep, and which has been forbidden to do so by the London County Council. The company contends that as it has received the provisional permission of the Board of Trade it may legally proceed with the construction of these sub-stations. An appeal has, I believe, been made to the Board of Trade and it will be interesting to see whether the Board of Trade goes back upon its decision of a few months ago and decides at the instance of the London County Council that transformer sub-stations of large dimensions *are* a public danger. The same authority is hampering the operations of the County of London and Brush Provincial Companies which has some 76 transformer sub-stations in contemplation.

CENTRAL STATION ENGINE PRACTICE.—The discussion on Mr. Mark Robinson's paper on recent developments of the single-acting high-speed central station engine came to a conclusion on Thursday evening last; the Institution of Electrical Engineers then adjourning until the autumn. The debate was one of the best we have had this session, being confined to practical men with strong views. The discussion resolved itself into a duel between the advocates of double-acting and single-acting high-speed engines; the numerous gentlemen who are so ready to air their advocacy of the slow-speed horizontal engine in the columns of the engineering journals, not apparently caring to come out into the open and discuss the matter before a competent assembly. A very excellent speech was made by a representative of one of our leading firms of high-speed, double-acting engines. He made a strong point by referring to the fact that the admiralty had had such an unfortunate experience of the Willans engine that they had eliminated it entirely from Her Majesty's ships. Further emphasis was given to this by the remarks of a naval engineer, who stated that so far as his experience went the great advantage of the Willans engine was the interchangeability of its parts. In his reply, however Mr. Robinson succeeded in somewhat diminishing the force of this indictment by stating several instances of the gross carelessness of naval engineers. He said that he was afraid that his firm had offended the admiralty by hinting to that august government department that the Willans engine was not an hydraulic but a steam engine; a large proportion of the breakdowns of Willans engines on Her Majesty's ships being due to the fact that water which had condensed in long unused steam pipes had been allowed to find its way into the cylinders.

General News.

NEW INCORPORATIONS.

THE ANTHRACITE TELEPHONE & SUPPLY COMPANY, has been incorporated at Shamokin, Pa., with a capital stock of $10 000.

THE SMITHVILLE WATER & LIGHT COMPANY, Smithville, Tex., capital stock $400,000, has been incorporated by K. H. McDonald and others.

THE HAMMOND LIGHTING COMPANY, Chicago, Ill., capital stock $210,000, has been incorporated by Wm. B. Engel, C. F. Griffin and M. E. Barnhart.

THE BIG FOUR ELECTRIC COMPANY, Chicago, Ill., capital stock $200,000, has been incorporated by Wm. H. Brown, Louis K. Gibson and Henry D. Ames.

THE TRUMANSBURG ELECTRIC LIGHT COMPANY, Trumansburg, N. Y., capital stock $10,000, has been incorporated by C. C. Sears, A. S. Mosher and others.

THE ADAMS & BAGNALL ELECTRIC COMPANY, Cleveland, O., has been incorporated to manufacture electrical apparatus, railway motors, incandescent lamps, etc.

THE MAMMOTH SPRINGS ELECTRIC LIGHT COMPANY, Mammoth Springs, Ark., capital stock $100,000, has been incorporated by H. G. Kings and others.

THE POPULAR TELEPHONE COMPANY, Watsonville, Cal., capital stock $25,000, has been incorporated by C. A. Rice, W. H. Lamb, Joseph Schwartz and others.

THE WOODWARD WATER, HEAT & POWER COMPANY, Woodward, Oklahoma, capital stock $25,000, has been incorporated by A. G. Cunningham and John M. Pugh.

THE DALLAS STREET RAILWAY COMPANY, Dallas, Tex., capital stock $500,000, has been incorporated by F. P. Clark, Baltimore; G. L. Blackwood, Denison, and J. L. Salle.

THE DALLAS CITY STREET RAILWAY COMPANY, Dallas, Tex., capital stock $500,000, has been incorporated by Frank P. Clark, of Baltimore, J. L. Sale, of Dallas, and others.

THE MOUNDSVILLE, BENWOOD & WHEELING RAILWAY COMPANY, Moundsville, W. Va., capital stock $250,000, has been incorporated by J. W. Burchinal, M. F. Cox, and others.

THE BLUE EARTH VALLEY TELEPHONE EXCHANGE COMPANY, Blue Earth, Minn., capital stock $50,000, has been incorporated by Washington Z. Haight, Andrew C. Dunn and others.

THE SHELBY ELECTRIC RAILWAY COMPANY, Shelby, O., capital stock $10,000, has been incorporated by S. S. Bloom, Albert Moore, G. D. Geilelen, C. S. Holbrook, F. A. Abbott and J. W. Williams.

THE FRANKLIN COMPANY, of Pittsburg, Pa., has been formed by H. W. Mitchell and Chas. F. Patterson, of Pittsburg, and Wm. H. Dodds, of Allegheny, Pa. The capital stock is reported to be $1 000.

THE MARIETTA ELECTRIC COMPANY, Marietta, Ga., capital stock $10,000, has been incorporated by D. N. Anderson, G. F. Gober, A. S. Clay and others to generate electricity for light, heat and power.

THE INDIANAPOLIS, ANDERSON & MARION RAILWAY COMPANY, Indianapolis, Ind., capital stock $500,000, has been incorporated by M. J. Clodfaller, of Crawfordsville, V. C. Quick, of Alexandria, and others.

THE HAMMOND & BLUE ISLAND RAILWAY COMPANY OF INDIANA, Chicago, capital stock $80 000, has been incorporated. The promoters are Edw. S. Whitney, Fred. B. Fuller, Jas. T. Maher and Ralph Martin.

THE HILLSBORO STREET RAILWAY COMPANY, Hillsboro, Tex., capital stock $15,000, has been formed to operate street railway in Hillsboro. R. J. Ware, H. W. Carter and C. E. Carter, all of Hillsboro, are interested.

THE NORTHERN ELECTRIC COMPANY, Norwalk, O., capital stock $25,000, has been formed to generate electricity. Geo. P. Jones, Parks Foster, Mayme C. Foster, Burton P. Foster and John W. Foster are the incorporators.

THE SPRINGER ELECTRIC COMPANY, McCordsville, Ind., has been incorporated by T. L. Springer, S. Morrison and A. C. Morrison, for the purpose of manufacturing electrical apparatus and operating telephone exchanges.

THE PENN ELECTRIC LIGHT, HEAT & POWER COMPANY, capital stock $100,000, has been formed to generate electricity for light, heat and power, by John P. Bechtel, Chas. N. Frame and Milton H. Schnader, Reading, Pa.

THE PLYMOUTH WATER, LIGHT & POWER COMPANY, Plymouth, Wis., capital stock $50,000, has been formed to build water, light and power works. H. E. Dow, A. W. Schram and H. Wheeler, Jr., Plymouth, are the organizers.

THE REXFORD-WHITMORE-ELDRED IMPROVEMENT COMPANY, Seattle, Wash., capital stock $6,000, has been formed to operate electric light plants, etc. The promoters are Louis A. Rexford, Jesse K. Whitmore and Elon Eldred.

THE SAN JOSE LIGHTING COMPANY, San Jose, Cal., capital stock $250,000, has been formed to generate electricity for light, heat and power, gas, etc. Chas. F. Wilcox, Jos. R. Patton and Wm. H. Sumner, of San Jose, are interested.

THE BRIDGTON & HARRISON ELECTRIC COMPANY, Bridgton, Me., capital stock $10,000, has been formed to generate electricity. Geo. P. Locke, Norway; Chas. E. Gleason and Chas. A. Scribner, Bridgton, are the promotors.

THE PEOPLE'S LIGHT, HEAT & POWER COMPANY, Denver, Col., capital stock $100,000 has been formed to construct an electric light company. The promoters are Wm. H. Brevoort, Chas. F. Lacombe and Samuel S. Campbell.

THE CENTRAL CALIFORNIA ELECTRIC COMPANY, Jersey City and New York, has been formed by Warner Van Norden, William de la M. Van Norden, New York; H. T. Bronson, Rye, and Edward C. Boardman, Garden City, N. Y.

THE GLOBE ELECTRICAL COMPANY has been incorporated at Detroit, Mich., with a capital stock of $10,000, to manufacture and sell dynamos, motors, etc. The promotors are Will H. Palmer, Scott H. Morris and Friend Palmer, Detroit, Mich.

THE GEAUGA COUNTY TELEPHONE & ELECTRIC COMPANY, Huntsburg Centre, O., capital stock $2,000, has been incorporated by Geo. W. Pease and others to build and operate a telephone line from Huntsburg Centre to Chardon.

THE SUBURBAN ELECTRIC RAILWAY COMPANY, Chicago, Ill., capital stock $1,250,000, has been formed to operate a railway. Geo I. Talbot, Jas. W. Kenney, Oscar L. McMurray, Homer K. Galpin and J. S. McClashen are the promoters.

THE AUTOMATIC CIRCUIT BREAKER COMPANY, Newaygo, Mich., capital stock $10 000, has been formed to manufacture and sell electrical machinery, etc. The organizers are Chas. C. Kritzer, A. C. Runnels and Nancy Runnels, Newaygo, Mich.

THE SOUTH SHORE STREET RAILWAY COMPANY, of Erie, Pa, capital stock $100,000 has been organized by L. J. Chase, Buffalo, N. Y., and Frank McLaughlin and E. M. Ketcham, of North East, to build an electric railway in North East.

THE GROSS STREET RAILWAY COMPANY, Pittsburg, Pa., capital stock $6,000, has been formed to build an electric street railway. W. B. Rhodes and Joshua Rhodes, of Allegheny, and W. H. Latshaw, of Pittsburg, are the interested parties.

THE LEADVILLE ELECTRIC POWER & IRRIGATION COMPANY, Denver, Col., capital stock $500 000, has been formed to erect and operate an electric plant. John H. Poole, Roswell E. Rodell and Edward W. Rollins, Denver, Col., are interested.

THE HUMBOLT MANUFACTURING COMPANY, Arcata, Cal., capital stock $15,000, has been formed to generate electricity, build flour and feed mills, etc. C. A. Callstorm, J. Cullberg, Jr., Wm. Chaffey and J. M. Moore, of Arcata, are interested parties.

THE NEGLEY STREET RAILWAY COMPANY, Pittsburg, Pa., capital stock $6,000, has been formed to build an electric street railway. W. B. Rhodes and Joshua Rhodes, of Allegheny, and Wm. H. Latshaw, of Pittsburg, are the interested parties.

THE CHATHAM ELECTRIC LIGHT, HEAT & POWER COMPANY, Chatham, N. Y., has been organized to manufacture and use electricity by H. M. Francis and J. O. Carr, of Schenectady, and J. F. Farrell, of Albany. The capital stock is $10,000.

THE WILLIAMSBRIDGE GAS & ELECTRIC LIGHT COMPANY, Williamsbridge, N. Y., capital stock $30,000, has been formed to manufacture gas, and to generate electricity. C. H. Royce, W. S. Johnson and Franklyn Paddock, New York, are interested.

THE ALLEGHENY POWER COMPANY, Pittsburg, Pa., capital stock $1,000, has been formed to supply light, heat and power by means of electricity. H. W. Mitchell, Pittsburg; Wm. H Dodds, Allegheny, and Chas. F. Patterson, Allegheny, are interested.

THE FREEMANSBURG ELECTRIC COMPANY, Freemansburg, N. Y., capital stock $10,000, has been formed to manufacture and use electricity. The promoters are C. C Sears, J. H. Smith, O. C. Noble, all of Freemansburg, and C. S. Wixom, Covert, N. Y.

THE CARTHAGE ELECTRIC TELEPHONE COMPANY, Carthage, Mo., capital stock $5,000, has been formed to erect and maintain telephone lines. The promoters are Theo. J. Clark, E. C. Clark, Geo. W. Wheeler and E. R. Wheeler, Carthage, Mo.

THE MILWAUKEE ELECTRIC MANUFACTURING COMPANY, Milwaukee, Wis., capital stock $8 000, has been incorporated by J. E. McKivitt, M. W. Weisser and J. C. Schmitt for the purpose of manufacturing and dealing in electrical supplies and machinery.

THE CANALES TROLLEY COMPANY has been incorporated at Springfield, Ill. Capital stock $100,000: to own, manufacture, buy and operate inventions relating to trolleys and machinery. The promoters are Adam M. Ross, Frank W. Canales and T. Henry Pearse.

THE FLORIDA RAILWAY, HEAT, LIGHT & POWER COMPANY, Sanford, Fla., capital stock $400,000, incorporated by J. M. Saunders, A. Menser and others, has received a franchise to construct an electric line in Sanford and between that town and Longwood.

THE SEA BEACH CONSTRUCTION COMPANY, capital stock $100,000, has been formed to construct and equip electric street railways. The promoters are John W. Bowles, New York; T. Bridgewater Jones, Staten Island, N. Y., and J. Herbert Potts, Jersey City, N. J.

THE LANCASTER WATER, LIGHT & ICE COMPANY has been incorporated at Lancaster, Tex., by R. P. Henry, S. L. Rancrett, W. A. Strain, F. M. Hammond, W. L. White and others, to supply water and electric lights and manufacture ice. Capital stock $15,000.

THE GREENVILLE LIGHT COMPANY, Greenville, O., capital stock $5,000, has been formed to manufacture and supply light, heat and electricity for public and private use. Mr. John P. Martin, Chas. Darlington, E. M. Milton and M. A. Broadstone, of Xenia, O., are interested.

THE LITTLE FALLS STREET RAILWAY, Little Falls, N. Y., has been incorporated with a capital stock of $75,000, to build and operate an electric surface road. The organizers are W. H. Tylee, Worcester, Mass.; C. L. B. Tylee, J. L. Miller and F. H. Vrele, of Corning, N. Y.

THE WEST END ELECTRIC LIGHT & POWER COMPANY has been incorporated at West Hazleton, Pa., with a capital stock of $10 000, to supply light, heat and power. The promoters are Thos. H. Powell, of Hazleton; Walter McAvoy and Wilson S. Betterly, West Hazleton, Pa.

THE BATESVILLE & OLDENBURG RAILWAY & ELECTRIC COMPANY, Batesville, Ind., capital stock $50,000, has been incorporated. Kendal M. Hord, Bellamy S. Sitton, Ed. K. Adams and Jonas Joseph, Shelbyville, and John Hilderbrand, Batesville, Ind., are the interested parties.

THE CITIZENS' TELEPHONE COMPANY, Indianapolis, Ind., has been incorporated with $15,000 capital stock, by Andrew E. Reynolds, and Carl L. Rost, of Crawfordsville, and George W. Caldwell, of Columbus, for operating telephone lines in Marion, Bartholomew, Jackson and Johnson counties.

THE MISSOURI GAS COMPANY has been incorporated at Kansas City, Mo., with a $1,500,000 capital stock to supply gas, electric light, heat and power. The promoters are Irwin Reu and Henry C. Reu, Chicago, Ill.; C. J. White, J. C. James, J. M. Lowe and Robert M. Snyder, of Kansas City, Mo.

THE CRESCENT SILVER PLATE COMPANY, Chicago, Ill., capital stock $10,000, has been formed to do a general carriage, harness and hardware business; also to do plating, and manufacture electric and gas fixtures. The promoters are Walter J Mullen, Wm. K. Ziegfeld and Barnet Rubenstein.

THE NEW YORK & PHILADELPHIA TELEGRAPH & TELEPHONE COMPANY, capital stock $15,000, has been incorporated by E. P. Meaney, Newark, N. J.; M. Egleston, Elizabeth, N. J., and A. E. Holcombe, of New York, to erect telegraph and telephone wires from New York to Philadelphia.

THE TOPEKA TELEPHONE & ELECTRICAL COMPANY, Topeka, Kan., capital stock $100,000, has been formed to construct and maintain telephone lines and exchanges; deal in electrical goods, etc. A. K. Rodgers, S. J. Bear, Simeon Greenspan and A. P. Jetmore, Topeka, Kan., are interested.

THE PRESSLEY SINGLE TRACK ELECTRIC RAILWAY COMPANY, San Francisco, Cal., capital stock $500,000, has been formed to purchase, use and sell patents for electromagnetic safety railways, etc. L. C. Pressley, J. C. Rhoads, J. O Jephson, C. S. Wheaton and W. F. Oecling are interested.

THE BATTLE MOUNTAIN HEAT, LIGHT & POWER COMPANY, Victor, Col., capital stock $500,000, has been formed to manufacture and supply gas and to generate electricity for lighting purposes in that town. Jas. F. Burns, Jas. Doyle, R. M. Reardon and J. B. Cunningham, Victor, Col., are the interested parties.

THE GLOBE TELEPHONE COMPANY, of New York, has been incorporated in West Virginia with a minimum capital stock of $50,000, to buy, sell and lease patents, operate telephone lines, etc. The promoters are Geo. W. Williams, Portland, Ore.; Frank B. Carpenter, Chas. L. George and Ed. Bradley, New York City.

TELEGRAPH AND TELEPHONE.

STATESVILLE, N C.—E. C. Hein has obtained a franchise for a telephone exchange.

ELLSWORTH, KAN.—The Pohlman Electric Light Company is putting up telephones.

NORFOLK, VA.—The Southern Electric Service Company is petitioning for a franchise to construct underground conduits for a telephone system, etc.

HARTFORD, WIS.—The Badger State Telephone Company, of Hartford, will construct a line from Neosha to Woodland and Iron Ridge and other points.

MIDDLETOWN, N. Y.—The Orange County Telephone Company is asking the Common Council for permission to erect poles and string wires through the streets within the city limits

ELECTRIC LIGHT AND POWER.

LEXINGTON, MO.—On June 18 Lexington will vote for electric lights.

MADRID, IA.—The citizens have voted to issue bonds for a water and light plant.

BALTIMORE, MD.—A second-hand ¼-hp motor is wanted at 427 Hanover Street.

SUMMERVILLE, S C.—F. W. Wagner can be addressed regarding an electric light plant.

ALFRED, N. Y.—Steps are being taken looking to the establishment of an electric light plant.

LANARK, ILL.—A franchise has been granted H. Reid Staley to put in an electric light plant.

SAGINAW, MICH.—The Board of Public Works favors the placing of the wires underground.

[illegible] The ma[illegible] will give information concerning the erection [illegible]

[illegible] has authorized an issuance of $10,000 bonds for an electric light plant.

[illegible] interested in the construction of the proposed electric light plant

ASHLEY, ILL.—The citizens of Ashley are figuring on an electric light plant [illegible] the city.

[illegible] Gramm, village clerk, is inviting proposals for lighting the village by electricity.

[illegible] MO.—The [illegible] can give information concerning the erection of a lighting plant, either by gas or electricity.

[illegible] MICH.—The Mil[illegible] Electric Light Company will add a 100 hp boiler and 75-hp engine and desires prices on same.

SHIPPENSBURG PA.—The Electric Light, Heat & Power Company is in the market for two 30-kw direct-current 110-volt dynamos.

ROCKWELL CITY, IA.—An electric light company will probably ask for a franchise to put in an electric light plant at this place.

ELBERTON, GA.—Steps are being taken to organize a company to develop an electrical power plant. Calhoun Falls will probably be utilized.

SMITHLAND KY.—A movement is in progress to erect water works and electric light plant. A company is being organized for the purpose.

LEXINGTON, KY.—The City of Lexington will receive bids until June 26 for furnishing street lights, and will also consider bids for electric lighting plant.

JOHNSTOWN, PA.—The Johnstown Telephone Company is making arrangements to extend its line to South Fork, Ebensburg, Wilmore and other nearby towns.

LEXINGTON, KY.—K. T. Duncan is inviting bids until June 26 for lighting the streets with gas or electricity, or both, on a five or 10-year contract after Oct. 31, 1895.

MILES CITY, MONT.—Bonds are to be issued to purchase an electric light plant and waterworks that supplies the town and which is now owned by a private corporation.

SANTIAGO, CAL.—An electrical expert is figuring on the establishment for a plant to supply the city with electric power, which is to be secured from the waterfall on the Flume Line.

PHILADELPHIA, PA.—The Southern Electric Light & Power Company will erect an extensive power house at Gray's Ferry Road and Carpenter streets. Cost with machinery, $150,000.

BOSTON, MASS.—A six-story block to be erected at the corner of Elliott and Pleasant streets will be equipped with electric elevators. Architect Patrick A. Tracy is in charge of the work.

RAHWAY, N. J.—It will necessitate an outlay of over $10,000 by the Electric Light & Power Company to provide its plant with additional machinery required for lighting the streets.

ALTOONA, PA.—Proposals will be received by the Edison Electric Illuminating Company, of Altoona, Pa., up to 12 o'clock noon, July 1, 1895, for a new steam plant, steel stack and trestle.

MANHEIM, PA.—The Borough Council has voted to grant the Manheim Electric Light, Heat & Power Company rights and privileges to erect poles and string wires on the streets of the borough.

DENVER, COL.—The County Commissioners have decided to advertise for bids for the electric light plant at the County Hospital. Plans and specifications are on file at Room 3, County Court House.

JAMESTOWN, N. D.—John A. Masters has purchased the controlling stock in the Jamestown Electric Light Company and is now president and general manager. The company is in the market for a 35-hp engine.

EL PASO, TEX.—Sealed proposals will be received until Aug. 2 for lighting the streets of El Paso by electricity for a term of five years, from Sept. 1, 1895, not less than 50 lights to be furnished, and all lights to be of not less than 1,200 candle-power. B. F. Campbell is mayor, and W. T. Kitchens city clerk.

PETOSKY, MICH.—The Furniture City Electric Company, of Grand Rapids, Mich., has secured the contract for equipping the new Imperial Hotel at Petosky, for lights and bells, also the Macatawa Park Hotel and grounds at Macatawa Park, near Holland, Mich., for complete electric light plant and bells.

HOBOKEN, N. J.—Proposals and bids will be received by the Board of Freeholders of the County of Hudson, at 4 p. m., June 20, for the furnishing and erection of 183 combination gas and electric light fixtures for the new lunatic asylum at Snake Hill. Plans and specifications can be seen at office of the board, next to Court House, or at office of Architect H. Kreitler, 55 Montgomery Street, Jersey City.

THE ELECTRIC RAILWAY.

JACKSON, MICH.—The street car line is to be extended to Vandercook's Lake at a cost of $35,000.

GRAND HAVEN, MICH.—The new street railway is being rapidly pushed toward completion.

SKOWHEGAN, ME.—An electric road will be constructed between Skowhegan and Madison.

CHARLESTON, S. C.—Mr. Hoefgen is president of the Brooklyn syndicate which is to build a new electric road here.

GAINESVILLE, GA.—D. E. Evans and others are organizing a company to build an electric line in the city and suburbs.

CARTERSVILLE, MO.—The Fitch Electric Railway Company has received permission to build an electric road in this city.

PALM BEACH, FLA.—A company is to be organized to build an electric road along the east bank of Lake Worth to Palm Beach.

LITTLE ROCK, ARK.—J. H. Healey and others have asked for a franchise to construct an electric line along several of the city streets.

DALLAS, TEX.—It is announced that the Dallas & Oak Cliff Railway has completed arrangements to extend its road to Fort Worth.

WESTPORT, MO.—The Westport Council has granted a franchise to the Kansas City Electric Railway, giving it also the right to furnish heat and motive power.

PHILADELPHIA, PA.—The Council sub-committee on street railways has decided to postpone further consideration of the Cayuga Street railway trolley extension.

AUSTIN, TEX.—The Dam Boulevard Railway Company has secured permission to erect its poles and wires. It will secure water power from the Colorado River dam.

LITTLE ROCK, ARK.—W. S. McKain, P. W. Crawford and E. W. Milball are interested in the Boulevard Street Railway, which will be about three and one half miles long.

BAY CITY, MICH.—The Common Council has received a petition from the Inter-Urban Street Railway Company asking for a franchise to construct and operate a street railway.

TROY, N. Y.—Application has been made for permission to change the motive power on the White line branch of the Troy City Railway, between Cohoes, Green Island and Troy, to electricity.

CLAREMONT JUNCTION, N. H.—Steps are being taken looking to the establishment of an electric line of cars from Claremont Junction through West Claremont to Newport and Sunapee Lake.

WARREN, PA.—The North Trumbull Rapid Transit Company will construct a passenger and freight electric railway from Farmdale to Mesopotamia, 20 miles. Said company was recently organized.

LOUISVILLE, KY.—A company is being formed to build an electric road 35 miles long, from Louisville to Fairfield, running through Jefferson County. John H. Ward and B. McKinney are interested.

HARTFORD CITY, IND.—The matter of building an electric railway nine miles long to connect Hartford City and Montpelier is being agitated. J. P. McGeath, of Hartford City, can give information.

SPENCER, MASS.—The Richmond Construction Company intends to commence work Aug. 1 on the new street railway from Spencer to Warren. The completion of the road is not expected until next spring.

LOCKPORT, N. Y.—President Charles A. Johnson, of the Lockport City Railway Company; F. H. Reed, W. T. Thiers and E. M. Ashley are interested in the construction of an extension of the electric road to Olcott.

NEWARK, N. J.—At a meeting of the Bloomfield township committee an ordinance passed its first reading calling for a double track electric road from the city line to the present terminus of the horse car road on Bloomfield Avenue.

CINCINNATI, O.—R. J. H. Archible, John Rempy and others are among the incorporators of a new company which is going to construct an electric line from the end of the Norwood or Hyde Park lines to the Oakley race tracks. The capital stock is $10,000.

NIAGARA FALLS, N. Y.—An application of the Niagara & Lewiston road for authority to increase its capital stock from $100,000 to $1,400,000 was granted. The company will build an electric line overhanging the bank of the Niagara River from Niagara Falls to Lewiston.

BALTIMORE, MD.—The Canton, Sparrows Point & North Point Company has commenced the grading of its electric line in Canton. The route is to terminate at North Point on Chesapeake Bay and is about 12 miles long. F. W. Wood and W. B. Brooks, Jr., are interested.

PERSONAL NOTES.

MR. FRANK LONEY PERRY, assistant business manager of the *Western Electrician*, will be married June 27, at Chicago, to Miss Lucretia Faulkner. Mr. Perry is widely known from his connection with the trade press, and in his matrimonial departure will carry with him the best wishes of the entire electrical fraternity.

HENRY C. PARMLY, senior member of the real estate firm of Parmly Brothers, Chicago, and a member of the Board of Directors of the Standard Electric Company from its inception, died on Thursday of last week. Mr. Parmly leaves a widow and a 10-year-old daughter, Grace, and a brother, S. P. Parmly He was born in Painesville, O., in 1836 and educated in Ohio colleges. Though of a quiet, retiring disposition, yet he was a charming companion, a loyal friend, an upright, wholesome and progressive citizen.

MISCELLANEOUS NOTES.

THE WESTERN SOCIETY OF ENGINEERS will extend the courtesy of one of its rooms to Lehigh University on June 21, 22 and 23, in which to hold its local examinations for admission to the Freshman class. The examinations will be under the direction of Mr. H. F. J. Porter, western representative of the Bethlehem Iron Company.

THE "M. I. T." SOCIETY, OF NEW YORK, has been organized by those of the alumni and former students of the Massachusetts Institute of Technology, who live in and around New York City. At a recent meeting held for the purpose of effecting preliminary organization, Messrs. G. L. Heins, E. D. Brown, H. S. Chase and F. A. Pickernell were elected as the executive committee, and the committee on organization elected is composed of Messrs Chas. R. Richards, H. P. Barr, C. W. Eaton, E. H. Munford, F. A. Pickernell and A. Rice McKim the last-named gentleman being also elected secretary and treasurer. On account of the time taken up by business matters the paper on "Bracing of the Skeleton Type of High Buildings," which was to have been read by Mr. McKim, was held over until the next meeting.

Trade and Industrial Notes.

FRANK H STEWART & CO., of Philadelphia have removed their headquarters from 20 to 35 North Seventh Street

LARGE GENERATOR CONTRACT The West End Railway, of Boston, has recently placed an order with the General Electric Company, covering two 800-kw, two 1,300-kw and one 1,500-kw generators, all for direct-connection to the engines.

AN INDEX OF PUMPS and pump accessories is a rather unique idea which the Goulds Manufacturing Company, of Seneca Falls, N. Y., has put in practice in the shape of a small pamphlet containing a full list, alphabetically arranged, of all its various products.

MR. H. H. HARRISON has become identified with the interests of Mr. R. B. Corey, and can hereafter be found at the office of the latter, 39 Cortlandt Street, New York, where he will be glad at all times to see his many friends and tell them all about arc lamps, carbons, etc.

A LARGE ENGINE CONTRACT has been placed by the Edison Electric Illuminating Company, of Paterson, N. J., with the Ball & Wood Company, 15 Cortlandt Street, New York. The equipment will consist of two 700-hp, five 600-hp and one 300-hp vertical engines of the latest Ball & Wood type.

AN AUBREY BEARDSLEY DAMSEL in the embrace of peacock feathers, with a rescuing Lundell fan motor approaching from the background, is the frontispiece of a recent circular of the Central Electric Company, Chicago. The remaining pages point out the many other uses of the fan motor, of which a half dozen types are illustrated.

JAMES WOLFF, 320 Dearborn Street, Chicago, the popular and energetic western representative of the New York Insulated Wire Company, has returned from a successful business trip. Mr. Wolff considers the business outlook in the Western and Middle States very bright, and reports a gratifying increase in this season's business over the same period last year.

WAGNER TRANSFORMERS AND FAN MOTORS IN DEMAND. The Wagner Electric Manufacturing Company, of St. Louis, Mo., is now several weeks behind on orders for fan motors and is running full force in the transformer department on some large contracts recently secured. The company is well pleased with this season's business and considers the prospects for a large fall trade encouraging.

A NICE BUSINESS is reported by the Electric Appliance Company, Chicago, on Jaeger miniature lamps for which the company has just taken the general western agency. The Electric Appliance Company carries in stock a complete line of Jaeger goods, comprising mounted and unmounted series lamps, battery, dental and theatrical lamps, lamp bases, shades and holders, and is prepared to quote special figures on quantity orders.

THEATRE AND STAGE LIGHTING APPARATUS is the title of a handsome catalogue just issued by the Mayrhofer Electric Stage Lighting Company, 842 Broadway, New York. The extent to which electricity is now applied in the theatres may be realized by a glance through the pages of this pamphlet. Many forms of apparatus are illustrated and a description given of some novel electrical stage effects that may thereby be produced.

AT THE ANNUAL MEETING of the stockholders of the Phœnix Carbon Manufacturing Company, of St. Louis, held last week, the following Board of Directors was elected for the ensuing year: S. M. Dodd, S. B. Pike, Thos. H. West, J. C. Van Blarcom and James Campbell. The new board met after its election and appointed S. M. Dodd, president; S. B. Pike, vice-president; H. L. Page, secretary and treasurer, and S. G. Booker, superintendent.

J. H. VAIL, 39 Cortlandt Street, New York, is prepared to act as consulting and supervising engineer for the installation of electric light and railway plants, electric transmission of power and all other engineering work. Mr. Vail has been engaged by the Wilkesbarre (Pa.) Electric Light Company for the construction of a large electric light and power plant for the utilization of the product of a valuable culm bank recently purchased by the company.

STRONG GUARANTEES are made by the Emerson Electric Manufacturing Company, of St. Louis, Mo., in its new catalogue of fan motors. The company assumes all responsibility for repairs not due to carelessness or accident which may become necessary within three months from date of sale of a motor. Two new motors have been brought out this year by the Emerson Company a ceiling fan for alternating-current circuits and an induction desk fan motor which has neither commutator nor collector rings. These are made for 7,200 and 16,000 alternations. Instructions are given in this as in previous catalogues for the care of the Meston motors.

CHLORIDE OF SILVER DRY BATTERIES.—A handsome catalogue of electro-medical batteries has been issued by the Chloride of Silver Dry Cell Battery Company, of Baltimore, in which are described a number of physicians' outfits and accessories which have been brought to a high stage of development by the manufacturers. A special feature is the Willms rheostat, by the use of which the current strength may be regulated from maximum to minimum by imperceptible gradations. Another improvement consists in making the individual cells interchangeable, so that the owner can replace exhausted cells without having to send the entire battery to the factory.

NATURE MAY ABHOR A VACUUM, but the users of the Williames vacuum system of steam heating and the Webster feed water heaters seem to differ with her, judging from the rapidly increasing list of customers shown by Warren Webster & Co., Camden, N. J. Among the recent orders for Webster "vacuum" heaters and purifiers not previously mentioned are Philadelphia Construction Company, Philadelphia, 1,600 hp; Temple Electric Company, Temple, Tex., 150 hp; Wilkesbarre & Wyoming Valley Traction Company, Wilkesbarre, Pa., 1,200 hp; Kittanning Electric Light & Power Company, Kittanning, Pa., 250 hp; Freeland Electric Light & Power Company, Freeland, Pa., 320 hp.

TRIPLEX POWER PUMPS.—The following recent sales of triplex power pumps are reported by the Goulds Manufacturing Company, of Seneca Falls, N. Y.: Freydenburg Falls Paper Company, Plattsburg, N. Y., one 12 by 12 inch pressure pump to be used with grinders; Jay Paper Company, Jay, Me., one 7 by 8 inch pump to be used for pumping stuff; Lewiston Foundry & Machine Company, Lewiston, Pa., two 1¼ by 2 inch pump for boiler feeding; Tide Water Oil Company, Bayonne, N. J., three 4 by 6 inch pumps, two to be used for pumping oil and one for pumping water; one 1⅞ by 6 inch and one 2½ by 6 inch, to be used for pumping ammonia; Standard Oil Company, Olean, N. Y., two 8 by 12 inch pumps for water supply; P. H. Potter, Springfield, Mass., one 4 by 6 inch pump for boiler feeding; Worcester Engineering Company, Worcester, Mass., one 12 by 12 inch pump for water works system at Millbury, Mass.

THERE ARE BATTERIES AND BATTERIES, and the Law Battery Company, of 39 Cortlandt Street, New York, explains at length in an attractive new catalogue, the difference between the two classes. Two strong claims made for the Law battery are low internal resistance and high E. M. F. The negative element of the "double cylinder" type has about 145 square inches of surface and the jar holds two and one half pints of solution. Attention is called in the catalogue to the fact that in telephone work a battery which deteriorates rapidly is a nuisance, entailing frequent adjustments of the transmitter and other obvious annoyances. It is claimed that the Law battery gives a practically uniform current throughout its life, thus obviating the troubles mentioned. Four styles of batteries are described. A strong testimonial to the quality of the sal-ammoniac handled by the Law Company is presented in the shape of a certificate of analysis from a well-known chemist. The catalogue also describes medical outfits in which the Law battery is extensively used.

Business Notices.

ELECTRIC LEAGUE.—Meets every Thursday evening, 100 West 24th Street, New York. Electrical engineers and electricians cordially invited.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 11, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

540,620. ELECTRIC CIRCUIT; W. W. Alexander, Kansas City, Mo. App. filed March 24, 1890. The combination of a relay provided with contacts, armature, sounder and a switch and a signal controller and a battery for operating the mechanism.

540,641. RAILWAY SIGNAL; W. Daves, Jersey City, N. J. App. filed Dec. 29 1894; 540,642, filed Feb. 14, 1895. The combination of circuits arranged to be automatically cut out of circuit by the trains, running upon the tracks.

540,653. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS; O. A. Enholm, New York, N. Y. App. filed Nov. 3, 1891. The combination of a main feeder and return rail, and distributing stations located at suitable points along the road with the make or break apparatus located therein.

540,664. ELECTRIC RAILWAY; S. Hoeninger, Milwaukee, Wis. App. filed Aug. 15, 1894. An electric railway having suspended yokes centrally provided with insulated hangers, spring controlled insulators pivoted thereto and a trolley wire joined to the pivotal insulators.

540,668 REGULATION OF ALTERNATING GENERATORS; R. M Hunter, Philadelphia, Pa. App. filed June 21, 1894. The combination of a generator, line circuits, a separate continuous current leading to the field magnets of the generator and a regulating device arranged in the continuous circuit.

540,685. ELECTRIC BRAKE; W. B. Potter, Schenectady, N. Y. App filed March 9, 1895. In an electric braking apparatus a controlling switch, a reversing switch, a brake switch, interlocking mechanism between the switches, and means arranged to vary the effect of the interlock in accordance with the position of the reversing switch.

540,687. COVERING FOR ELECTRIC WIRES; F. S. Randall, Philadelphia, Pa. App. filed Jan. 2, 1894. A covering which consists of silver drawn longitudinally until the fibres have been rendered parallel, evenly applied parallel with the conductor.

540,691. APPARATUS FOR LINING TUBES; W. T. Ruete, New York, N. Y. App. filed Feb. 26, 1895. The combination of a supporting rod to rest a pipe which is to be lined, a carrying rod for conducting the strips into the tube and one or more guides for curving the said stripe before they enter the tube.

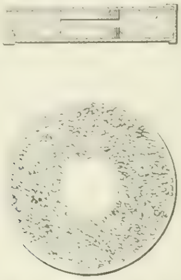
540,742. ILLUMINATED SIGN OR DISPLAY; P. F. Keelyn, Milwaukee, Wis. App filed Jan. 18 1895. An illuminated sign consisting of a series of letters built up from elements thereof, each element comprising a separate incandescent electric lamp of exactly the same length as that of the other lamps, also having the same size filament, and connected to wires at each end.

540,761. TELEPHONE; W. W. Scott, Buffalo, N. Y. App. filed March 4, 1895. A voice conveyor comprising a tube with double walls having an elongated, confined, tortuous passage extending around the inner tube in a zigzag or spiral manner, one end of the said passage opening outwardly, and the other into the passage through the instrument.

540,772. PHOTO-TELEGRAPH; C. Willoughby, San Francisco, Cal App. filed Nov. 3, 1894. The combination of a checked diagram or chart, numerals to [illegible] letters to indicate the horizontal columns [illegible] to be used in combination with the [illegible] indicate the character of line to be drawn.

[illegible] TRANSMITTER; D. Drawbaugh, Eberly's Mill, Pa. App. [illegible] filed Feb. 21, 1895. These two patents relate to [illegible] body of carbon interposed between the electrodes and [illegible] holder having an opening of a size to fit the said electrodes [illegible] in operative position.

[illegible] ELECTRIC ARC LAMP; S. P. Parmly, Chicago Ill. App. filed Oct. 26, 1891. A pair of pencils adapted to be presented to one another end to end [illegible] adjusted toward one another as they are consumed by an arc [illegible] between them formed each with an elliptical or oval figure in cross-section.

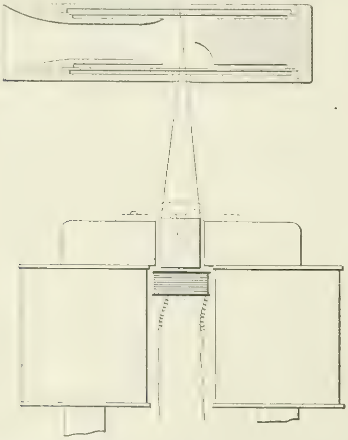


No. 540,961.—Telephone Electrode.

540,859. ELECTRIC RAILWAY SIGNAL; B. H. Gedge, Anderson, Ind. App. filed May 20, 1892. The combination of lines or rails separated at desired intervals by forming divisions and there connected to an electromagnet, and other intervals between the said insulation, and another line of electric conductors separated near the electromagnets and capable of being put into circuit by the circuit closers, and locomotives provided with electric signal devices to complete the circuit between the conductors.

540,883. TROLLEY; W. E. Steinbach, Philadelphia, Pa. App. filed April 6, 1895. A trolley having transversely extending slots in the frame, roller adapted to engage the trolley wire, and sliding shafts carrying the rollers mounted in the said slots, and a movable arm adapted to bear against the shafts for separating the rollers.

540,899. TELEGRAPHIC APPARATUS; L. Boudet and P. Lacombe, Lumel, France. App. filed Oct. 20, 1894. The combination of a suitable dial, a plurality of hands carried by shafts concentric with one another, a toothed wheel secured to each of the shafts and a vibrating mechanism actuated by the rotation of the toothed wheel located adjacent to each of such wheels for making and breaking the circuit when vibrated.



No. 540,969.—Telephone.

540,900. CONDUIT ELECTRIC RAILWAY; D. Brooks, Jr., Philadelphia, Pa. App. filed June 9, 1892. The combination of a conduit, a sectional conductor and a continuous conductor with intervening insulating strips, upwardly projecting guards on the sides of the sectional conductor, a receiver having a chain adapted to contact with the sectional conductor.

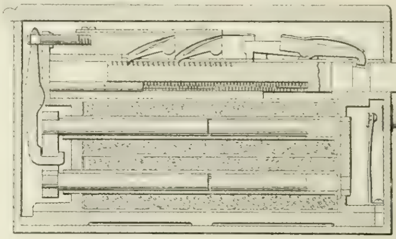
540,901. CONDUIT ELECTRIC CONDUCTOR; D. Brooks, Jr., Philadelphia, Pa. App. filed Feb. 27, 1892. A conductor formed of two conductors having an insulating material between them, one being continuous, and the other consisting of separated sections, both conductors being connected by fusible material.

540,949. ELECTRICAL PUSH BUTTON; E. A. Clark, Cleveland, O. App. filed Jan. 24, 1895. A push button formed of a casing having an inwardly projecting rim, a flaring metallic cap engaged by the rim, contact points held in the path of the cap, and a spring extending into the cap for automatically separating the cap from the contact points.

540,960. CARBON HOLDER FOR TELEPHONES; D. Drawbaugh, Eberly's Mill, Pa. App. filed Feb. 21, 1895. A carbon holder consisting of an annulus constructed wholly of sponge encircling the electrodes, and a body of granular carbon interposed between the electrodes and held in place by the annulus.

540,961. TELEPHONE ELECTRODE; D. Drawbaugh, Eberly's Mill, Pa. App. filed Feb. 21, 1895. A telephone electrode comprising two diaphragms, a disc-like annulus filling the space between the said diaphragms, carbon buttons carried by the diaphragms of a size to fit the opening in the annulus, and a body of granular carbons interposed between the said buttons.

540,969. TELEPHONE; S. D. Field, Stockbridge, Mass. App. filed Dec 5, 1894. A telephone having two independent circuit windings in inductive relation to each other, one of said windings being in mechanical connection with the diaphragm and forming a closed circuit complete in itself, and the other being adapted for connection in a main circuit.



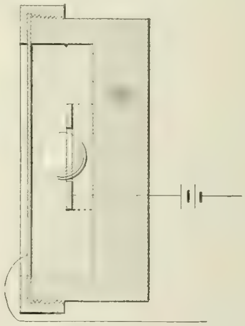
No. 541,024.—Electromagnetic Combination Lock.

540,974. MULTIPLEX TELEGRAPHY; D. B. Grandy, St. Louis, Mo. App. filed Dec. 17, 1894. The combination of a line, a single armature, a neutral relay having two mechanically separated electromagnets differentially wound and placed in different planes, resistance coils having iron cores and condensers, one of the said electromagnets being connected to the main line, and the other connected in shunt circuits with the said condensers around the said resistance coils.

541,019. ELECTRIC WIRE LOCK AND SUPPORT; D. W. Smith, St. Louis, Mo. App. filed Sept. 10, 1894. An improved wire loop comprising a body of material having a transverse recess at a point about midway of its length, and grooves formed in each side of it curved downward and together extending continuously from one end to the opposite end, and being overhung by a lug or projection.

541,020. CONDUIT ELECTRIC RAILWAY; D. W. Smith, St. Louis, Mo. App. filed Sept. 10, 1894. The combination of a loop formed integral with and in the length of the conductor at the crossings of the conduit, the loop comprising vertically bent portions, horizontally bent portions and a circular loop all bent from the length of the conductor.

541,024. ELECTROMAGNETIC COMBINATION LOCK; E. and H. C. Stockwell, Stamford, Conn. App. filed Aug. 6, 1894. The combination of suitable bolt-operating mechanism, two detents or dogs controlling the said mechanism, a time lock connected with one of the said detents for disengaging it, and an electrically operated lock connected with the other detent for disengaging it, whereby the bolt-operating mechanism cannot operate until both detents are disengaged.



No. 541,036.—Telephone Transmitter.

541,036. TELEPHONE TRANSMITTER; C. Clamond, Paris, France. App. filed March 20, 1895. The combination of a movable electrode and sound receiving diaphragm, an adjacent receptacle, having a bridge within it, a paste contained within the said receptacle and a loosely supported ball encompassed by said paste and maintained in relation to the movable electrode.

541,037. Filed March 20, 1895. This patent is substantially the same as the above one.

541,044. TROLLEY WHEEL AND YOKE; W. H. Fritz, Dayton, O. App. filed March 12, 1895. A trolley yoke consisting of a single piece and having journal openings extending approximately one half of each side from the centre to the circumference, bosses on the outer side and partially surrounding the journal openings, openings in the said bosses adapted to receive pins, and a trolley wheel, a shaft for said wheel having openings in its ends and adapted to be mounted in the journal openings in the yoke, and means for securing the said shaft therein.

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THE OUTPUT OF POLYPHASED MACHINERY.

In another column we print a letter from Mr. R. D. Mershon, correcting a wrong impression conveyed in an editorial comment on the article from his pen, contained in our last issue. As will be seen, the deductions made in the article referred to were based upon a constant copper and iron loss, and therefore the increased output in polyphased machinery, under the conditions named, is an absolute instead of relative one, as suggested by us. The article in question is an important contribution to the subject of polyphased machinery, not only from the practical weight of its conclusions, but also from the value of the analytical method employed in demonstrating them.

TESTING OF ALTERNATORS.

Dr. Behn-Eschenberg, of the Oerlikon Works, describes in another column a method of testing alternating-current dynamos, which is claimed to give direct values suitable for an exact comparison of the various factors entering into the efficiency of alternators. The method appears to be simple, and as to its theoretical exactitudes, the assurance of Dr. Eschenberg is, of course, sufficient. The principles of the method are in line with those involved in Mr. Kapp's tests for transformers, described in the Digest of several weeks ago, and these two contributions to the practical side of alternating work go far toward putting this branch on a plane with direct current practice with respect to ease of determining the necessary efficiency data.

THE THEORY OF UNITS.

Prof. Fessenden in this issue answers the objections raised in our columns by Mr. Townsend Wolcott, apropos of two previous articles from the pen of the former, and we gladly offer the use of our columns to others for the discussion of the issue which is now so clearly established. Fortunately, the proposed change in the value of our present units does not affect the main points of the theory offered, as otherwise we fear that it would meet with little favor. One notable advantage which this theory does offer is a rational basis for the dimensional expression of the ohm and henry, which thereby is freed from the reproach of posing in the false character of a velocity and a length, respectively. As tending to remove the difficulty which has existed in the minds of students and others as to these and other points, it promises to perform a good service, and, therefore, deserves careful attention.

AMERICAN BELL AND WESTERN UNION.

Some comment was caused during the past week by the retirement from the directorate of the Philadelphia Bell Telephone Company of all but one of several representatives of the Western Union Telegraph Company. As the contract will soon expire between the American Bell and the latter company which confines each to a definite sphere of activity, much interest as to their prospective policy naturally exists, and it was thought by some that the action referred to presaged an invasion of each into the present field of the other. As far as we can ascertain, however, there is no ground for such a construction upon the result of the election, it appearing to be simply the case of a minority dispossessed in the usual way from purely business considerations. It is, of course, quite possible that in due time these two giant corporations may lock horns, in which case it would seem that the general public has nothing to lose and much to gain. On the face it would seem that the American Bell has the stronger position, as it would merely have to open offices in its exchanges to enter the telegraph business, while the Western Union would be handicapped in the long-distance telephone field [illegible] connections. As both of the corporations are [illegible] tious of their purpose, should the struggle come [illegible] it will be a battle royal, and one from which the public is likely to obtain a goodly share of the spoils.

RESUSCITATION FROM ELECTRIC SHOCK.

As our readers are aware, we have earnestly advocated the necessity of electricians acquainting themselves with the methods to be pursued in case of suspended animation from electric shock, and in our columns this week we print a striking confirmation of the wisdom of this advice. The case of Mr. Grover, at Rochester, is a parallel to the one mentioned by D'Arsonval which led our attention to the subject, and the evidence is now overwhelming that one apparently dead from electric shock may be resuscitated. In the present instance the men who applied the instructions of Dr. Goelet, as contained in the poster distributed to central stations by The Electrical World, deserve particular credit for not ceasing their labors with the patient, notwithstanding that no signs of life became apparent for over half an hour. They doubtless feel that they have an infinite reward in having saved a useful life, and the electricians of the world are indebted to their faith for what ought to be considered the final test of a method which should be mentioned among the boons to humanity. In sad contrast to the Rochester case are those reported elsewhere from Harrisburg, Pa. We feel thoroughly convinced that had the proper means of resuscitation been here applied, at least one of the lives, and very probably both, would have been saved. In conclusion we think we may say that after the demonstration at Rochester, the managers of electric plants should feel that a responsibility rests with them in the matter of providing for the necessary aid in case of electric shock, for further deaths from this cause through the absence of that aid can reasonably be considered in the light of a sacrifice of human life.

POLYPHASED CURRENTS.

For the benefit of those of our readers who wish to read a simple, non-mathematical explanation of the principles of polyphased currents, we print in another column an article giving the main outlines of the subject in terms that require no previous knowledge on their part. We would here emphasize the fact that polyphased currents in themselves possess no peculiarity, but are simply two or more ordinary alternating currents differing in phase—that is, while having the same mean value, yet not reaching a given identical value at the same instant of time. In fact, polyphased currents may be considered as simple alternating currents developed in two or three distinct machines according as they are two-phased or three-phased; the only thing to be borne in mind is that the several currents must be considered to bear a definite phase relation to each other, which idea may be fixed by considering the separate alternators to have their armatures rigidly fixed on the same shaft, and that when the winding of the one is in one part of its field the winding of the other will be in a relatively different position with respect to the first field. The fact that there may be only three instead of four exterior conductors in a two-phased system or three instead of six in a three-phased system does not alter the conditions named, for the currents in the connections made with these conductors are precisely the same in character as if the even numbers of wires leading from separate alternators were used. The distinctive properties of polyphased systems are developed in the external receptive devices; in a four-pole, two-phased motor, for example, when one pair of poles has a maximum strength the other pair has a minimum strength; on the other hand, the first pair has then a minimum inductive effect on the closed-circuit armature, while the second set has a maximum current-producing effect on the coils of the armature. The result of this is that the strong current produced by the second set flows in the armature under the poles of the first set, thus producing a torque exactly as in a continuous-current motor. We should add that the application here made of the word *armature* is arbitrary; a more rational nomenclature would designate it the revolving secondary, the other element of the motor in this case being called the stationary primary.

Death of Henry W. Frye.

Mr. Henry W. Frye, until recently an associate editor of The Electrical World, died near Folsom, N. M., on June 20, of consumption. Last fall Mr. Frye contracted a severe cold, which developed into pneumonia, and upon his recovery from the latter disease it became sadly apparent that his lungs were affected. At the beginning of the year, upon the advice of his physician he reluctantly gave up the editorial work to which he was so attached, and went to New Mexico, and it was fondly hoped by his friends that the dry climate of that region would rapidly recuperate his health. Unfortunately the weather there during the past season has been extremely unfavorable for an invalid and this, coupled with over-exertion in riding while residing on a ranch, led to the sad end.

Henry Wakefield Frye was born at Belfast, Me., April 21, 1868, and was, therefore, but a little over 26 at the time of his death. Part of his early life was passed at Halifax, N. S., where, for many years, his father was United States Consul. After graduating from Colby University, of Maine, he followed the electrical course of Dr. Duncan at Johns Hopkins University until his acceptance in April, 1892, of a position on the editorial staff of The Electrical World.

The death of Mr. Frye is a regretable loss to electrical journalism, for aside from his technical qualifications and the possession of a graceful literary style, he had in a high degree that sense of editorial truth and honor which Dana has pronounced so essential to the usefulness of the newspaper press, and which qualities are even more desirable in technical journalism. Ever conscious of the duty imposed by this responsibility, no labor was too arduous in the verification of facts, and no care too great in the preparation of editorial matter, that it might give rise to no wrongful interpretations on the part of readers oftentimes too busy to more than cursorily examine it. With him carelessness in these respects involved a breach of faith toward the reader, and even a slight error took on the aspect of an inexcusable offense.

In his personal relations Mr. Frye was warmly sympathetic, while a geniality of manner and frank sincerity of expression added to the appreciation in which he was held by those who had the pleasure of his acquaintance. Though somewhat retiring in disposition, this, as is often the case, was rather to be ascribed to the presence of the qualities already mentioned than denoting any lack of sociability. Possessed of an elevated character and with a keen sense of moral duty in all of his actions and thoughts, his loss is to be deplored outside of the circle of his friends, for in him the world lost a real force on the side of its nobler aspirations.

A New Use for Accumulator Grids.

The return of the hot weather reminds us, says the London *Electrician*, of an instance of the novel use to which an ingenious mind can put a secondary battery plate. Not a hundred miles from Farringdon Street there was to be seen last summer the grid of a secondary-battery plate of well-known type. As in ordinary practice, it lay in a glass cell; it also had an acid electrolyte, but the vessel was a cylindrical bowl and the electrolyte dilute "lemon squash." The use to which the grid was put was to keep in position the metal syphons used, a few of the meshes of the grid being cut away to admit the end of the syphon, and the corners of the grid were turned down, to keep it well clear of the bottom. It would be interesting to know how the owner of the business came into possession of the plate; also the effect of the liquid (which had to pass through the meshes of the grid) upon the internal economies of its consumers.

American vs. English Electro-Therapeutics.

Referring to two recent pamphlets on electro therapeutics, one by an English and the other by an American author, the London *Electrical Review* characterizes the former as an apology for the existence of scientific truths, professionally slighted and neglected, and the other as a bald statement of work done and advance made in the practical working of these same truths, professionally accepted. What a comment, it adds, on the conservatism of the medical profession in England!

The National Independent Telephone Association of the United States.

A meeting of the recently formed Association of Telephone Manufacturers was held at Pittsburg on Monday, June 24, for the purpose of forming a permanent organization for the protection of the interests of the independent telephone manufacturing companies of the country.

J. E. Keelyn, president of the Western Telephone Construction Company, of Chicago, the prime mover in the organization idea, presided. After several addresses, committees were appointed to look over the various plans presented by the delegates. The committees reported at the afternoon's session, at which the permanent organization, under the name National Independent Telephone Company of the United States, was effected.

On Tuesday the following directors were chosen: J. E. Keelyn, Chicago; J. R. Johnson, Baltimore; S. J. Tunbridge, Utica; Paul W. Bossart, Minneapolis; E. S. Wallace, New York; P. C. Burns, Kokomo; J. G. Imsen, Pittsburg; A. F. Boardman, Boston; E. A. Katlin, Richmond; P. L. Spooner, Madison; E. B. Seeley, Philadelphia; Thos. McCoubray, New York; M. Kuhn, Philadelphia; J. D. Randall, Memphis; Frederick Harrington, Cleveland. The executive committee consists of J. E. Keelyn, J. R. Johnson and S. J Tunbridge. A constitution and by-laws were adopted and a plan of campaign determined upon. The meeting closed with enthusiasm in the prospects of success. About forty notices of membership were received. The next meeting will be at Niagara Falls, on Sept. 1.

Resuscitation from Electric Shock.

On Thursday evening of last week Mr. Frank Grover, foreman of the Rochester, N. Y., Gas & Electric Company, while standing near a 3,000-volt alternator, suddenly gave a loud cry and fell to the ground. Several of the men in the power house immediately ran to his assistance, and when they arrived on the spot he was unconscious and apparently dead. Very fortunately, Mr. Geo. A. Redman, manager of the company, had posted in the station copies of the instructions for resuscitation from electric shock, written by Dr. A. H. Goelet, and distributed to electric stations in poster form by THE ELECTRICAL WORLD, and several of the employees who had familiarized themselves with the details, immediately proceeded to apply the method, a doctor not arriving until a half-hour later. After laboring for three quarters of an hour signs of returning life were noticed, after which respiration returned slowly; the manipulations were kept up an hour, at the end of which time the patient was sufficiently recovered to be removed to his home.

The next day Mr. Grover was very weak from his terrible experience, his body was sore and his heart weak, but on the succeeding day he was able to move about out-doors. In relating his experience he said that he could not tell how the accident happened. All he remembers is that he was standing near one of the dynamos, and the next moment he lost consciousness; then he knew nothing until he awoke and found the doctor and the men working over him. When he returned to consciousness he did not have the slightest idea what had happened, and was intensely surprised when they told him that he had been subjected to a shock from 2,899 volts. He did not think that he leaned against the dynamo, as he had been an electrician too many years to do so foolhardy a thing, and concludes that he must have moved his arm in such a manner that it swept the brushes, thus coming in direct contact with the circuit.

Fatalities that Might Have Been Averted.

A correspondent in Harrisburg, Pa., sends us an account of two fatalities from electric shock which recently occurred there. An employee of a street railway while making some repairs, took hold of the trolley wire with one hand and grasped a span wire with the other, whereupon he received a violent shock and expired in a few minutes. It appears that the span wire was insulated only about three feet, the remainder being bare iron wire with the terminal wound around an iron pole

The second accident occurred to a man who attempted to adjust an arc light. He had been warned not to touch the lamp, but as he had been successful once before in making it burn under similar circumstances, he attempted it again and received a shock which resulted in instant death. Our correspondent expresses the opinion that the life of the former, and, perhaps, of the latter, might have been saved had an attempt at resuscitation been made according to the directions given by Dr. Goelet in THE ELECTRICAL WORLD of Sept. 8, 1894.

Dimensional Formulæ and the Theory of Units.

BY R. A FESSENDEN.

From Mr. Wolcott's article criticising my notes of May 4 and 18, on "Dimensional Formulæ," it would appear that we are at difference in very fundamental points. Mr. Wolcott holds:

1. That "the dimensions of the unit of any quantity have nothing to do with its physical nature, or even with its physical properties, if such it has, which are independent of those by which the unit is defined in the particular system." "Dimensional formulæ are largely optional."
2. That "the determination of the change of the magnitude of a derived unit, which results from changing the magnitude of one or more of the fundamental units, and allied uses, are the only legitimate uses to which dimensional formulæ can be put."
3. That the use of dimensional formulæ to "discover the ultimate constitution of matter and to solve other like questions regarding the fundamental physical properties of things," is not a correct one.
4. That we can have two different expressions for the dimensions of unit energy, each of which is correct.

My views on the subject, however, are:

That the dimensional formula of a quantity is a full and sufficient definition of the nature of that quantity, so far as it is possible for human knowledge to go, and that, consequently, *there is one and only one correct dimensional formula for any given quantity, and that if by any method we arrive at two different formulæ, one of them is incorrect.*

Consequently, I regard dimensional formulæ as a legitimate form of mathematical analysis.

I believe that the difference of opinion between Mr. Wolcott and myself is due to the fact that he has not perceived that I have, in my article, developed a new system of dimensions. On my part, I confess that I should have explained this more fully, but I was dealing with results rather than methods. The present system, in which we use only three fundamental units, *i. e.*, those of length, mass and time, is only capable of being correctly applied to gravitational phenomena. When it steps outside this it goes wrong, and is entirely incompetent to explain phenomena, or to be used correctly. So far I agree entirely with Mr. Wolcott, and the statements quoted above as embodying his views, are shared completely by the writer, so far as the C. G. S. system is concerned.

The C. G. S. system is based upon the entirely erroneous idea that (to quote from Clerk Maxwell's "Electricity and Magnetism," vol. 2, page 263) "every electromagnetic quantity may be defined with reference to the fundamental units of length, mass and time." That this idea was erroneous has been perceived, thanks, I believe, to the work of Prof. Rücker, and in the last edition of Everett's C. G. S. units, we find the modified statement, "*Nearly* all the quantities with which physical science deals can be expressed in terms of three fundamental units."

From Professor Rücker's work, we see that the number of fundamental units must be increased to five, *i. e.*, $L.$, $M.$, $T.$, μ and k.

I have, however, shown in my article of May 18, that the number of fundamental units must be still further increased to ten, when we come to treat of gravitated attraction and inertia separately.

These are:

1. L = dimensions of length.
2. T = dimensions of time.
3. q = dimensions of quantity of electricity.
4. b = dimensions of quantity of magnetism.
5. k = dimensions of specific inductive capacity.
6. μ = dimensions of permeability.
7. g = dimensions of quantity of gravity.
8. i = dimensions of quantity of inertia.
9. f = dimensions of property of medium, determining gravitation.
10. h = dimensions of property of medium, determining inertia.

This system gives us a means of expressing completely all the phenomena of nature fully, and in such a manner that we can use it as a means of investigation. When we know how electricity and gravity are related, then we can reduce these fundamental units from ten to three. These remaining three will be length, time and force. By force I do not mean electric force, or any particular force, such as gravitational force, but some function of the ether, by virtue of which one portion of the ether tends to move another. What its ultimate nature may be does not at present concern us, and it is possible that it never will.

It [illegible] noted that the quantities here symbolized by *g*, *f* [illegible], are given as [illegible], *l* and *m* in my note of May 18. I have made the change in order to avoid conflict with the symbols recommended by the committee on notation of the last Congress.

It will be noted that the "fundamental" unit *M* has disappeared. The relations between electricity, magnetism, gravitation and inertia may be derived from the equations,

1 2 3. [illegible] = [illegible] $= gg/L \cdot f$ [illegible] $L^2 h$ (= *F*.)

4. [illegible] $b\,k^{\frac{1}{2}}$ [illegible]

5. $k^{\frac{1}{2}}$ [illegible] T/L

6. $qb = FLT$

7. $f^{\frac{1}{2}} h^{\frac{1}{2}}$ [illegible] T/L

8. $k/\mu^{\frac{1}{2}} = Z.$

Only one dimensional formula is possible for any one quantity.

Since by merely changing the dimensions of our units of length, time and force, we can make the numerical value of any quantity anything we please, except zero, it is evident that the numerical values are not of any importance in qualitative work, and that, so far as the nature of a phenomenon is concerned, the dimensional formulæ give us a sufficient means of investigation.

This method is a powerful one, in spite of its great simplicity. Take, for instance, equations *A*, *B* and *C*, of my article of May 18. Suppose one knowing nothing of electricity were asked what was the effect of a quantity of electricity on a quantity of magnetism. The symbols *q* and *b* appear together in equation *C*, and in equation 6 above, their product being equal to force multiplied by length divided by time. The right-hand side of the equation does not represent any one thing, but if we bring the *T* over to the left we have the right-hand side equal to work. Therefore, he would deduce the facts that if we have a quantity of magnetism, and a varying quantity of electricity, we have work, and that if we have a varying quantity of magnetism and a quantity of electricity, we again have work. The permeability or specific inductive capacity of the medium has no effect in either case. These results are Faraday's and Weber's laws.

Again, suppose that we wish to know if a moving quantity of matter exercises any other force on another moving quantity of matter, except that of gravitation. Multiplying the right-hand member of 6 by the right-hand member of 5, and similarly the left-hand members, we find that when we introduce the coefficients, *k* and μ, we have work and velocity, and since there is nothing else on that side of the equation, it must be the work which is propagated with the velocity. Taking the analogous equations concerning gravitation and inertia, we see that if gravitation is propagated with a finite velocity, then there will be an additional force.

One important fact is seen from the equations for *q* and *b*; that is, that though from the fact that the velocity of an electromagnetic disturbance is the same as that of light, it is almost certain that light is such a disturbance, it by no means follows that light is a wave motion. The supposition that this electromagnetic disturbance is a wave motion is based upon a similarity of form in certain sets of equations, but it is quite possible, though not probable, that other kinds of disturbance may give similar equations.

Having thus explained the method I have used, I would show how it answers Mr. Wolcott's objections. The latter asks, "Does Professor Fessenden seriously maintain that there are, or even that there ought to be, only 10^7 C. G. S. units in the ohm?"

To this I would reply, that that is my position. The equations which I have given in my article of May 18 show us, beyond any possibility of contradiction, that no matter what the true nature of electricity and magnetism may turn out to be, that the ohm has nothing to do with a velocity, and that it is really equal to work × time. In absolute units, therefore, it must be measured in erg-seconds, and as the second is also the practical unit of time, and there are 10^7 ergs in a joule, there are 10^7 = C. G. S. units in the ohm. No future discoveries as to the real nature of electricity can vitiate this conclusion.

In regard to Mr. Wolcott's difficulty concerning the two inconsistent expressions for work, I would say that the left-hand member of the equation, given by him, is not complete. The dimensions for gravitational attraction are not $M\,M/L^2$, but should be written $M\,M/L^2\,c$, where *c* is a constant depending on the medium. There is thus no inconsistency.

Mr. Wolcott's remarks upon my equations *A* and *B* (article of May 4) are based upon a misprint. Through an accident for which the writer is responsible, this article did not receive final revision before going to press, and the letter *b* was omitted from the right-hand member of the equation. If this be supplied, the method of obtaining the results will be seen.

The inconsistencies shown in the astronomical system given in Everett, and referred to by Mr. Wolcott, are due to the fact that the dimensions of one quantity have been omitted. Mass does not equal acceleration × distance; the right-hand term must also contain *c*. If this be supplied, the system, and with it its inconsistencies, disappear. In every case where inconsistencies appear, they will be found to arise from the fact that the equations have not been written out fully.

The system in which electrical and magnetic force have the same dimensions as other forces, given in my note of May 18, leads to the following definitions:

The resistance of a wire is the work done in forcing unit quantity of electricity through the wire, multiplied by the time taken in doing it. The unit of resistance is the erg-second, and the ohm = 1 joule-second.

The potential across the ends of a wire is the work done in carrying unit quantity of electricity from one end to the other. The absolute unit is the erg. The volt = 1 joule.

The current in a wire is the rate of flow of electricity in the wire. The absolute unit is the reciprocal of one second. The ampere = the absolute unit.

The capacity of a condenser is the reciprocal of the work necessary to charge it with two units of quantity. The absolute unit is the erg^{-1}. The Farad = joule^{-1}.

The inductance of a circuit is the energy stored up in the circuit magnetically, by the passage of a current, multiplied by the square of the rate of flow. The absolute unit is the erg (second)^2, and the Henry is 1 joule-(second)^2.

It will be noticed that, while the practical units all remain the same as at present, the absolute units are changed. Instead of using 10^9, 10^8, and 10^7 as multiplying factors, we have now only one factor, *i. e.*, 10^7. This is a great gain in simplicity.

Mr. Heaviside has proposed to eliminate 4π from the circuital equations. It has been objected that it will reappear elsewhere. This is true, but it reappears in a place where it will not cause much trouble. So long as we have to use such things as Schwartzians to calculate the capacity of two parallel plates, the average electrician will be apt to let that branch of the science alone, in spite of the ample fulfillment of Lord Rayleigh's prediction that alternating currents would educate electricians to become mathematicians. If we must have a skeleton, it is better to keep it in the closet, among the electrostatic units.

If we follow Mr. Heaviside we get a new ampere and henry, each approximately 12 times the old; a new farad, 1-12 the old; a new volt three times as great, and a new ampere one third as great. Now, I believe nearly all these are in the right direction. The ohm is too small, our henry about right, our farad too large, our volt too small, while the new ampere would be just about the current taken by a single incandescent lamp. Taking this, therefore, in conjunction with the elimination of 4π, and the use of one multiplying factor, it would appear as if it would be a good thing if we could commence the twentieth century with these changes.

Curious English Laws.

Among the new proposed regulations in England there is a clause that no arc lamp shall be used in places where there is any danger of the presence of explosive dust or gas; according to this an arc light would not be allowed in any building where gas is used because wherever there is gas there is always a danger of the presence of an explosive gas. Our English contemporary, the *Electrician* stated that to be consistent there ought also to be a law that no building should have more than one gas jet, on the ground that the gas from one might be escaping and producing an explosive mixture which would be ignited by the other light. The parental English Board of Trade might do well to engage some assistance in framing their laws.

Carbide and Acetylene.

Our London contemporary, the *Electrician*, states that Mr. Wedding has found great differences between the acetylene yield of various samples of calcium carbide. One sample, from Pintsch's, gave 64.5 litres per kilogram; another gave 115.7; one from the Neuhausen works gave 96.8; one made by himself gave 254.3; while the theoretical is 348.

Lord Kelvin.

The July number of the *Pall Mall Gazette* contains an appreciative article on Lord Kelvin by Mr. Arthur Warren, from which we reproduce the accompanying portraits and the following paragraphs, relating more particularly to the personal history and traits of the great scientist.

After referring to the fact that Lord Kelvin has been for more than a half century the Professor of Natural History at the University of Glasgow, it is added that the University of Glasgow is assuredly Lord Kelvin's home; for he was but eight years old when he went to live there with his father, Dr. James Thomson, who had been appointed Professor of Mathematics. The elder Thomson was also a remarkable man. He was born on a little farm near Ballynahinch, in County Down, Ireland, where his family had dwelt for several generations, although their line was Scotch. James Thomson had, even as a lad, a huge hunger for knowledge. When he was between eleven and twelve years of age he learned, without the aid of a teacher and with the assistance of a few books, the principles of the sun-dial, and he taught himself to make dials for any latitude. Also, from old volumes which he somehow happened to unearth in his native village, he taught himself the elements of mathematics. His passion for this study seemed to be of such an extraordinary nature that his father permitted him to attend a small classical and mathematical school, in which, while still quite a youth, he became an assistant teacher. Teaching in this little school in the summers, he studied during the winters at the University of Glasgow and at the end of his fifth year as a student there he received an appointment at Belfast, being afterward promoted to the position above mentioned.

LORD KELVIN.

We learn from this article that Lord Kelvin received his early education from his father, only going to school during the year previous to entry into the University of Glasgow. It was at the unusually early age of eleven years that he entered that university, and after taking the courses there he went to St. Peter's College, Cambridge, graduating in 1845 as Second Wrangler and First Smith's Prizeman. He was then immediately elected a Fellow of his College. Already as a student he had distinguished himself by his application to scientific pursuits and his interest in literature, and had been elected President of the Cambridge University Musical Society. After leaving Cambridge he went to Paris, where he worked for a while in the laboratory of the great physicist, Henri Victor Regnault. In 1846, being then only 22 years of age, he was appointed to the position which he still holds—the Professorship of Natural Philosophy at Glasgow University.

Lord Kelvin as a lad was an amazing prodigy, but he differed from nearly all juvenile prodigies that one reads of in his love of fun and boyish sports. He was as active physically as he was mentally, and he set himself up with a splendid stock of health. No doubt his elders thought him precocious. Imagine, if you can, the amazement of men grown gray in scientific work when they read in one of their favorite periodicals a series of learned papers which upset many old and well-nursed theories and substituted some surprising new ones which proved to be correct, and which were propounded by a youth of eighteen? Who was this William Thomson, whose contributions to the *Cambridge and Dublin Mathematical Journal* drew the attention of the scientific world? There was something more than juvenile audacity in his articles; there was knowledge—there was discovery.

Writing of the numerous and varied contributions to science and scientific literature of Lord Kelvin, Mr. Warren refers to his extraordinary capacity for turning from one task to another, as if he found inspiration in the change; yet all of his work is elaborate and painstaking to the last degree. Investigation must needs be accompanied by unbreakable precision, and this quality Lord Kelvin has to an astonishing degree.

He has an irrepressible habit of making notes, not because he distrusts his memory, but because he delights in working out complicated mathematical problems. Wherever he goes he carries in a coat-tail pocket a "little green book," in which, when not otherwise occupied, and not merely that his memory may be subsequently refreshed but that he may perhaps elucidate some theory which has engaged his mind, he jots down pages of mathematical demonstration which would be the despair of most men who are accounted clever in these lines. Thus, on railway journeys, or while driving in his carriage, or when waiting, perhaps, for some friend to make ready to accompany him on a drive or a walk, he will whip out the "little green book" and work with assiduous content. It is literally true that he is never idle except when he is asleep. But he is not a one-sided man. At a dinner, or a conversazione, he will be found readily engaging in any good talk that may be going on, and will amaze the listener by the extent of his information, and charm him no less by the wonderful clearness of his discourse than by the simple geniality of his manner.

The home of Lord Kelvin is described as a pleasant residence within the precincts of Glasgow University. It commands on three sides the most extensive views. The study, a good-sized room on the ground floor, has its walls covered from top to bottom with shelves filled with scientific books. Over the fireplace are hung some very rare and interesting engravings and photographs of Darwin and Joule and Faraday, and the cable-laying steamships the *Hooper* and the *Great Eastern*. Not only here, but throughout the house, there are evidences of Lord Kelvin's ingenuity. He has a simple, original, yet very effective ventilating system throughout the dwelling, and another original system for heating. His house, too, was the first one in the world to be completely lighted by electricity. He obtained the current from machines in the University laboratory, and he carried it into every nook and corner of the house—into closets, cupboards, attics and cellars, as well as into the halls and sitting rooms.

LADY KELVIN.

Lord Kelvin is a most enthusiastic yachtsman, or was so when he could find time to indulge in his favorite recreation. It is characteristic of him that the older he grows the busier he becomes. For twenty years he went yachting every summer. Being a skillful navigator as well as a mathematician, a scientist, and an expert mechanic, he very naturally kept himself as busy aboard his yacht [illegible] when ashore. But now he finds that he has not time to indulge himself in the pleasures of the sea, so he has sold his schooner, the *Lalla Rookh*, and whenever he can take what he [illegible], but what is only an opportunity for doing another kind of work, he goes to his country place, Netherhall, near Largs, in Argyleshire. Lord and Lady Kelvin made their wedding journey in the *Lalla Rookh*. Lady Kelvin is a charming woman, and a most devoted and wise companion and helper of her husband in all his labors. She is as much of an enthusiast for the sea as he is, and in the yachting days she used to accompany him on his cruises. So devoted to the sea was Lord Kelvin in these days, that he has, in the course of a cruise of seven months, spent but a single night on shore.

A painful accident befell Lord Kelvin more than thirty years ago, while at the favorite Scottish game of "curling," and left him permanently lame. Notwithstanding this, his physical activity is as remarkable as his mental energy. Mr. Warren gives an account of two specimen days which he had seen him live through. One Monday morning he returned to Glasgow from Edinburgh, where he had been staying for two or three days. He had no sooner reached home than he was at work in his study, attending to his correspondence with the aid of his secretary. After lunch he was absorbed in the intricate details of a plan for lighting a town by electricity. After that he joined Lady Kelvin in the drawing-room, and received friends for an hour or two. Then came dinner, which was followed till bedtime with elaborate calculations about the laws governing the formation of crystals. Lord Kelvin retires late and rises early. The next morning Mr. Warren met him before nine, and accompanied him to his lecture-room at the University, where he devoted an hour to expounding Kepler's laws before a crowded class. After that they drove to James White's, where Lord Kelvin made his final tests with his new electric meter; and from White's they returned to the University, where his lordship delivered, until one o'clock, a lecture on the Higher Mathematics. In the afternoon there was a consultation with electric experts, and the evening was similar to the previous one. The next day the untiring man took train for London, in order to preside over a meeting of the Royal Society.

Lord Kelvin is pronounced by the writer to be one of the most kindly-natured men he has ever known. His manner is very gentle and pleasant and winning, but for all that his utterance is decisive. As a teacher he is simply delightful, and is at the farthest removed from the grim professor. It is pronounced a great treat to hear him lecture, either before his University class, or before the Royal Society, or any other learned body. He speaks in a low conversational tone which is clear enough withal, and pleasantly Scotch in its accents, and a smile plays over his face as he delivers some difficult scientific truth. When he cracks a very hard philosophical nut he pauses for an instant, looks at his audience, gives a merry little laugh, as much as to say, "This is the simplest of pastimes, yet you appear to think, and the world thinks so too, that it is a difficult, even an insoluble problem. Now see how easy it is!" Then with a few words he clears the atmosphere, and his audience sees at once how simple it is to do a thing that one knows how to do. He talks very quickly at these demonstrations, as if there would never be time enough for him to say all that he has to say. Knowledge rolls from his lips in a swift flood. There is nothing rhetorical, there is no "talking for effect," and yet Lord Kelvin has hardly uttered a dozen words before you can see that he is master of his facts. He knows many things, and he knows them thoroughly. It is diverting to watch him turn swiftly on his heel, snatch up a piece of chalk, and demonstrate on the blackboard the very thing which he wishes to convey to his hearers. He seems almost to jump from his desk to the board, and then with a few white lines and cabalistic figures he flashes the laws of the universe at you. He has a way of putting things so that an attentive mind cannot forget them.

On a morning, says Mr. Warren, you will see him—a white-haired, white-bearded man of 70—walking across the University grounds toward the laboratory; in spite of his lameness he walks so quickly that his professor's gown streams out behind him. If you address him you will be charmed by the simple, natural courtesy of his response, and by the light of kindliness in his clear eyes. As he lifts his mortarboard cap you will note the height and fullness of his fine dome-shaped head, and you will feel instinctively, even if you are not aware of his identity, that you are standing in the presence of a great man, and a great-hearted one.

The Testing of Alternating-Current Dynamos.

BY H. BEHN ESCHENBURG.

As is well known, that quantity which most surely determines the value and efficiency of an alternating-current dynamo is the fall of potential, *i. e.*, the difference in the potentials at the binding posts of the dynamo, 1°, when no current flows through the armature, and 2°, when the armature windings generate a current which has a definite difference of phase with the binding post potential, the revolutions and the current in the magnetizing field being constant in both cases. In other words, the fall of potential is the difference in the potentials (with constant excitation and revolutions) at no load and at a certain definite load. This fall of potential is determined essentially 1°, by the induction of the "current-carrying" armature windings on themselves; 2°, by the copper resistance of these windings; and 3°, by the reaction of the Foucault currents induced by the armature currents, principally in the massive iron field magnets.

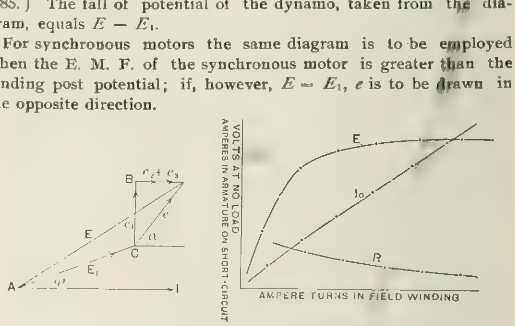
These determining factors of the fall of potential may be represented as electromotive forces, which, in definite phase, combine with the E. M. F. of the dynamo to form the resultant binding post potential.

We thus obtain three E. M. Fs. in the armature windings, proportional to the currents in the armature, which we place in a polar diagram (Fig. 1) according to their effective values and their phases (*i. e.*, their directions) and designate by e_1, e_2 and e_3.

In the same diagram, we let I represent the armature current (*i. e.*, the load current of the dynamo); E the E. M. F. of the dynamo, which is equal to the binding post potential at no load; and E_1, the binding post potential when loaded. The direction of the different quantities is determined by the angle of the phase difference which they have relatively to the current I. There will now naturally be a phase difference of $\frac{\pi}{2}$ between the E. M. F. e_1 of the self-induction and the current; and between the E. M. Fs. e_1 and e_3 and that of the current a phase difference of o. We assume further that for the chosen load of the dynamo, the phase difference between the binding post potential and the current is ϕ, where ϕ is defined by making the delivery in watts of the dynamo $W = E_1 \, I \cos \phi$.

For lighting distribution with transformers, ϕ is about 10° and $\cos \phi$ practically equal to 1; and for power distribution with nonsynchronous motors ϕ may be taken as about 35° and $\cos \phi$ about 0.85.) The fall of potential of the dynamo, taken from the diagram, equals $E - E_1$.

For synchronous motors the same diagram is to be employed when the E. M. F. of the synchronous motor is greater than the binding post potential; if, however, $E = E_1$, e is to be drawn in the opposite direction.


B
$e_2 + e_3$
e_1
e
a
E
C
E_1
A
ϕ
I
VOLTS AT NO LOAD
AMPERES IN ARMATURE ON SHORT-CIRCUIT
E
I_0
R
AMPERE TURNS IN FIELD WINDING

FIGS. 1 AND 2.

The resultant e of the three E. M. Fs. e_1, e_2 and e_3, in a phase a relative to I, represents the total counter electromotive force of the "current-carrying" armature. By this E. M. F. e and the current I, and apparent resistance of the armature windings is defined as

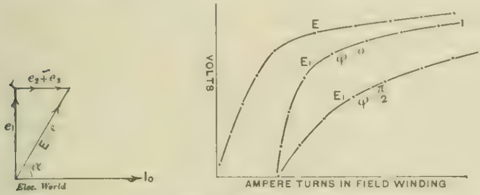
$$R = \frac{e}{I}.$$

A chief problem in the testing of alternating-current dynamos is to ascertain and calculate in advance this resistance R and e, as when they are known, all quantities important for operating may be taken directly from the diagram Fig 1.

For this purpose I have for some time taken the following course, which I most heartily recommend to my colleagues. In the first place, there is drawn in the ordinary manner a characteristic of the E. M. F. of the dynamo when no current flows in the armature (compare Fig. 2, curve E). The abscissæ are the number of ampere-turns of the magnetizing continuous current (that is, the strength of the exciting current), and the ordinates are the induced E. M. Fs. E of the dynamo, at a fixed number of revolutions. A second characteristic I_0 is taken after the armature windings have been short-circuited by an ammeter across their terminals. The abscissæ are again the number of ampere-turns of the field, and the ordinates are the current strengths of the short-circuited armature in amperes (designated by I_0). This curve I_0 as a rule differs but slightly from a straight line; with strong fields it is a little convex.

For the case of the short-circuited armature, the diagram, Fig. 1, is to be changed so that $E_1 = o$, $E = e$, and we then immediately obtain in Fig. 3, $e = E$ and $R = \frac{E}{I_0}$ for every value of the abscissæ.

This value of R we place as ordinates in Fig. 2 and so form a third characteristic R of the apparent resistance for every value of the field strength.



FIGS. 3 AND 4.

For any value of the load current I, with a fixed field excitation, $e = R\,I$ is given directly, and E_1, and ϕ may be calculated from the diagram. With a given field current, either E, ϕ and I are to be assumed as given and E_1 is to be determined in advance, or E, E_1 and I are given or observed and ϕ is to be determined from them. The following formulæ result from the oblique-angled triangle A, B, C of the diagram:

$$\cos(a - \phi) = \frac{E^2 - E_1^2 - e^2}{2\,E_1\,e};$$

$$E_1 = E - e\cos(a - \phi) - \tfrac{1}{2}\,\frac{[e\sin(a - \phi)]^2}{E}.$$

(The counter E. M. F. e should naturally be considerably smaller than E in practical cases.)

Finally, in order to ascertain the difference of phase a between e and I_0 or I, we must observe not only the current I_0 with short-circuited armature, but also the watts consumed, $E\,I_0\cos a$, either directly by means of a wattmeter, or by measuring the expenditure of energy necessary to drive the short-circuited dynamo; this last may be done by observing the watts used by a continuous-current motor employed to drive the alternator. With good dynamo machines, a is greater than 80°, and for approximate measurements may be put equal to $\frac{\pi}{2}$. This means that the copper losses and the losses through Foucault currents should be very small compared with the losses in potential. The component e_2 of the E. M. F. e, is easily determined by means of resistance measurements, for if r be the armature resistance, $e_2 = I\,r$.

The component e_3 increases approximately with the square of the number of revolutions, and so can be separated from e_3. As a check, a can be calculated when measurements with the dynamo loaded have given observed values of E_1, E, I and ϕ; for instance, when $\phi = o$ or $\phi = \frac{\pi}{2}$ with wholly inductionless or purely inductive load, respectively, or when ϕ is determined by means of a wattmeter.

(It is to be remarked, that for small values of ϕ, for instance, with transformers, the diagram will give much more accurate determinations than a wattmeter, for from the diagrams in ϕ and from the wattmeter $\cos\phi$ is read.)

If, as an approximation we make $a = 90°$, the formulæ for ϕ and E, will become simplified, as follows:

$$\sin\phi = \frac{E^2 - E_1^2 - e^2}{2\,E_1\,e};$$

$$E_1 = E - e\sin\phi - \frac{e^2\cos^2\phi}{2\,E};$$

and for the limiting cases of inductionless and purely inductive load:

$$\phi = 0\ ;\ E_1^2 = E^2 - e^2.$$
$$\phi = 90°;\ E_1 = E - e.$$

The two characteristics E and I_0 may be taken in a very short time with a voltmeter, a continuous-current ammeter, a revolution counter and an alternating-current ammeter. The driving of the dynamo requires in this case only 10 to 20 per cent. of the normal load; *i. e.*, the energy loss of the loaded dynamo.

The short-circuit current I_0 during the short time which is necessary for the observation, may be raised, without hesitation, to two or three times the normal current. When taking the short-circuit curve I_0, the number of revolutions are of small importance, for with a fixed field magnetization, the short-circuit current will naturally remain constant at all speeds.

In the curve diagram, Fig. 4, are drawn the special characteristic curves of the binding post potential E_1, calculated from Figs. 1 and 2, which correspond to the dynamo load when carrying a current I in the two limiting cases $\phi = o$ and $\phi = 90°$, for all field excitations and $a = \frac{\pi}{2}$. These are the curves 1 and 2, between which, for all possible values of ϕ, must be the binding post potentials of the dynamo with the current I.

Besides the quantity R, determining the efficiency of the dynamo, this method gives a clear picture of the leakage conditions of the machine. The ampere-turns of the "current-carrying" armature windings must act inductively on the same magnetic circuit; the lines of force which are induced by one of these windings without cutting the turns of the other, are designated as scattered lines.

We will assume that 100 × S_1 per cent. of the total lines induced by the field winding and 100 × S_2 per cent. of the total lines of the armature winding are scattered and so lost for useful inductive working.

Let the number of turns of the field be w_1, and of the armature w_2, in which both numbers are to be reduced to the same magnetic circuit. This reduction is easily accomplished by the help of a schematic drawing, in which the magnetic circuit, that is, the closed courses of the magnetic lines of force in the dynamo, are drawn as linear conducting circuits, in analogy to the diagram for branching electric currents, and the ampere-turns of the armature and the field, at the places where the windings are cut by the circuit of the lines of force, are designated as magnetomotive forces, analogously to electromotive forces. The number of lines of force, in analogy to a current strength is calculated for every part of the circuit according to Kirchhoff's rules for divided currents. For the short circuit, equality must obtain between the magnetomotive forces of the armature current and the field current, as far as the ampere-turns which occasion the scattered induction and those which induce the E. M. Fs. e_2 and e_3. These equal ones are the magnetomotive forces which induce the E. M. Fs. E and e_1.

We thus obtain the important condition:

$$(1 - S_1)\,i_0\,w_1 = \frac{1.4\,(1 + S_2)\,I_0\,w_2}{\sin a}$$

in which i_0 is the continuous field current, and the factor 1.4 in the right member the amplitude of the mean value of I_0.

If the field system possess a single magnetizing coil, w_1, as is easily seen, must be multiplied by half the number of poles; and if the armature system consist of N phase divisions, w_2, in the right hand member, is to be multiplied by $\frac{N}{2}$, and w_2 signifies the number of turns of one phase division.

From this equation, which besides the number of turns presupposes only the observation of the curve I_0, we obtain for every excitation of field, the value of the loss of potential in per cent.; that is, the value of the ratio of the counter E. M. F. e to the E. M. F. E_1 of the dynamo with a load current I:

$$\frac{e}{E} = \frac{I}{I_0}\ ;\text{ or, also, }\frac{e}{E} = \frac{I\,w_2}{i_0\,w_1}\cdot\frac{1.4\,(1 + S_2)}{(1 - S_1)\sin a}.$$

That is to say, e has the same ratio to E as the load current has to the short-circuit current, with constant excitation; or as the number of ampere-turns of the armature to those of the field, multiplied by a factor approximately equal to 1.4. This factor is:

$$\frac{1.4\,(1 + S_2)}{(1 - S_1)\,\sin a} = \frac{i_0\,w_1}{I_0\,w_2}.$$

The leakage value S_1 is, on the other hand, easy to calculate when the principal dimensions are known, so that the preceding formula will give the value of S_2, which is difficult to calculate. The total magnetic resistance ρ of the magnetic circuit of the field and armature windings is calculated in the usual manner from the [illegible] resistances of the air gaps and the iron parts at the [illegible].

If we designate the total number of lines induced by the ampere turns of the field by $\mathfrak{N}$, and the number of alternations of the dynamo by n, the well-known equations obtain:

$$E = \frac{S \cdot w_2 \cdot 2 \,[illegible]\, 4\,[illegible]}{1.4 \times 10^8 \quad 10} i_e w_1 = \mathfrak{N} \rho (1 + S_1).$$

Also,
$$1 + S_1 = \frac{5.6\, i_e w_1 w_2 n}{E \rho 10^8}.$$

On the other hand, in the case of the short circuit:

$$I_k R = E, \text{ and } R = \frac{8 w_2^2 n (1 + S_2)}{\rho (1 + S_1)(1 - S_1) \sin \alpha .\, 10^8}.$$

This last equation shows us the constructive meaning of the apparent resistance R of the dynamo. R increases proportionally to n, and with the square of the number of turns.

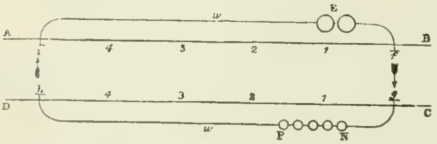
By means of this sketch I believe that I have shown a very convenient method, which I have myself tested in a number of practical cases, giving direct values which make possible an exact and unobjectionable comparison and discussion of alternators. Knowing the characteristics for no load and for short circuit, the limits of the loading of every dynamo for a prescribed binding post potential can be determined beforehand; that is, the values of the current strength and of the shifting of phase between the current and the binding post potential.

Three months ago I sent a theoretical and more complete discussion of this method in manuscript, to the Berlin *Elektrotechnische Zeitschrift.*

Mode of Crossing Broad Rivers or Other Bodies of Water Without Wires.

The recent experiments of Mr. W. H. Preece, in England, on telegraphing without wires, recall the work of Morse in the same direction, an account of which is contained under the above caption in Alfred Vail's "American Electromagnetic Telegraph," published in 1845. In a letter to the Secretary of the Treasury, and by him submitted to the House of Representatives, Dec. 23, 1844, Morse referred to the subject as follows:

"In the autumn of 1842, at the request of the American Institute, I undertook to give the public in New York a demonstration of the practicability of my telegraph, by connecting Governor's Island with Castle Garden, a distance of a mile; and for this purpose I laid my wires, properly insulated, beneath the water. I had scarcely begun to operate and had received but two or three characters, when my intentions were frustrated by the accidental destruction of a part of my conductors by a vessel, which drew them up on her anchor, and cut them off. In the moments of mortification, I immediately devised a plan for avoiding such an accident in future, by so arranging my wires along the banks of the river as to cause the water itself to conduct the electricity across. The experiment, however, was deferred till I arrived in Washington; and on Dec. 16, 1842, I tested my arrangement across the canal, and with success. The simple fact was then ascertained that electricity could be made to cross a river without other conductors than the water itself; but it was not until the last autumn that I had the leisure to make a series of experiments to ascertain the law of its passage.



Arrangement of Circuits.

"The accompanying diagram will serve to explain the experiment. A, B, C, D, are the banks of the river; N, P, are the battery; E, is the electromagnet; w, w, are the wires along the banks, connecting with the copper plates, f, g, h, i, which are placed in the water. When this arrangement is complete, the electricity, generated by the battery, passes from the positive pole, P, to the plate, h, across the river through the water to plate i, and thence around the coil of the magnet, E, to plate f, across the river again to plate g, and thence to the other pole of the battery, N. The numbers 1, 2, 3, 4, indicate the distance along the bank measured by the number of times of the distance across the river. The distance across the canal is 80 feet."

A table is included giving the deflection of a galvanometer with different battery power and size of plates, and the experiments are declared to show that "electricity crosses the river, and in quantity in proportion to the size of the plates in the water. The distance of the plates on the same side of the river from each other also effects the result. Having ascertained the general fact, I was desirous of discovering the best practical distance at which to place my copper plates, and not having the leisure myself, I requested my friend, Prof. Gale, to make the experiments for me. I subjoin his letter and the results."

The letter from Prof. Gale dated New York, Nov. 5, 1844, is as follows:

"I send you herewith a copy of a series of results, obtained with four different sized plates, as conductors to be used in crossing rivers. The batteries used were six cups of your smallest size, and one liquid used for the same throughout. I made several other series of experiments, but these I most rely on for uniformity and accuracy. You will see, from inspecting the table, that the distance along the shores should be three times greater than that from shore to shore across the stream; at least, that four times the distance does not give any increase of power. I intend to repeat all these experiments under more favorable circumstances, and will communicate to you the results."

The tables referred to give deflections of a galvanometer with plates of different sizes and for different distances along the bank.

Morse says in conclusion, that "as the result of these experiments, it would seem there may be situations in which the arrangements I have made for passing electricity across the rivers may be useful, although experience alone can determine whether lofty spars on which the wires may be suspended, erected in the rivers, may not be deemed the most practical. The experiments made were for but a short distance; in which, however, the principle was fully proved to be correct. It has been applied under the direction of my able assistants, Messrs. Vail and Rogers, across the Susquehanna River, at Havre-de-Grace, with complete success—a distance of nearly a mile."

One More Evidence of Returning Prosperity.

It is not alone in increased wages and in the growing volume of business that we notice the turn of the tide. There are other indications that are equally convincing. A manufacturing firm which had the misfortune some months ago to be caught in the financial panic, but which had also the strength and courage to fight its way through, has just sent The Electrical World a check for $100, but dated January 24, 1895. The check was accompanied by the following explanatory note:

"We enclose herewith our check for $100. You will notice that this check is dated way back into antiquity. It also bears with it quite a history. When the check was made out to your order last January, with the intention of making payment on account of our advertisement, this company was right in the midst of those stormy days that many corporations encounter on some occasions in their career. It occurred to the writer that he might better hold the check over for a day or two and await developments which were pending at that time. After the lapse of a few days he found out that the crisis had come, and the fight was on, and it was a good thing that the check had not been forwarded. However, it is sent you herewith, and the writer is pleased to add that the company has successfully stormed the fort."

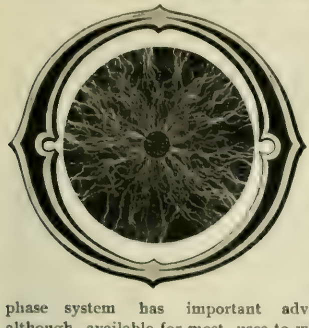
We congratulate our friends upon the return of brighter days, and trust that the publication of their experience will have the effect of encouraging others who have not fully recovered from the effects of the recent financial storm.

Progress Abroad.

The progress of the electrical industry in Europe is well indicated by the output of the large Swiss factory at Oerlikon. The number of dynamos made by this firm up to the end of May is 3,318, many of which are very large machines; the number of transformers is 1,843; more than half of these dynamos and transformers were made during the last two years; during that time 69 traveling cranes were constructed, representing a total lifting power of 1,600,000 pounds.

The Westinghouse Electric & Manufacturing Company's New Plant—II.

POWER PLANT AND TWO-PHASE SYSTEM OF CURRENT DISTRIBUTION.



Of all the branches of electricity, that dealing with polyphased currents offers by far the greatest interest at the present time, and this is true whether we consider the immense field offered for the utilization of the polyphased principle, or the beautiful flexibility and simplicity of its application.

As compared with either the direct or simple alternating current, the polyphase system has important advantages. Direct currents, although available for most uses to which electricity may be put, have a limited range in the transmission of energy because of the comparatively low voltage necessitated by the use of a commutator. The simple alternating current, by reason of the fact that it can be easily and efficiently transformed from a high to a low voltage, or vice versa, furnishes the ideal means for transmitting power over long distances. Unfortunately, however, while the power thus transmitted is available for lighting, a difficulty is offered to its utilization for power purposes from the fact that the so-called single-phase motor will not start with load and will not run at varying speed.

Polyphase currents combine the advantages lacking in both the others; they can be used for long-distance transmission, since they can be easily converted by transformers up to any desired voltage, the same as the simple alternating current; and they are available for the operation of self-starting motors requiring large starting torque or variations in speed. Where a direct current is necessary for electrolytic work, etc., it may be obtained from a polyphase circuit by means of rotary transformers. Thus directly, or through the use of transformers, polyphase currents meet every known requirement of electrical energy. The only objection that can be urged against their universal adoption is, that they require more than two wires for conveying the energy.

As a simple exposition of the principles of polyphase currents may have an interest to some of our readers, and enable them to follow more satisfactorily the account of their practical application herein given, we print in another column an article in which the subject is briefly treated in an elementary manner, and with especial reference to induction motors.

The Westinghouse Company holds a series of 29 American patents on the polyphase system of alternating currents, issued between May 1, 1888, and Dec. 8, 1891, to Nikola Tesla. The first large installation of apparatus operated under this system was made at the World's Fair. Since that time many other installations have been made, chief of which is the Niagara plant, now the centre of so much interest, inquiry and investigation.

Power Plant.—The Westinghouse Company is convinced that the most economical method of distributing power through mills, factories, etc., is by the use of electricity, and as it also believes in the superiority of polyphase currents for work of this kind, it was so arranged that all the machinery in its new factory should be operated in accordance with this latest practice.

The power plant at East Pittsburg is a fine example of the latest developments in steam and electrical engineering, as well as of the most modern and economical methods of power generation and distribution. The plant is almost identical with one that might be used for the supply of high-potential long-distance transmission circuits. As all the energy generated at this plant is used within a few hundred yards of the station, the potential is restricted to only a few hundred volts.

On account of the nearness of the points of distribution, polyphase currents have no advantages over the direct current in the way of transmission and distribution, but their superiority is quickly apparent when the simplicity and ease of handling the generators and motors is considered. A comparison, for example, of the direct and polyphase generators in the power house illustrates the point in question. Though the direct-current machines are of the most improved type, their commutators of necessity have daily required a certain amount of attention, while the polyphase machines have needed hardly a half hour's care since they began operating some five or six months ago. Again, the motors require no starting box or controller when starting, as they are entirely self contained, and it is only necessary to throw the short-circuit switch after they have gotten under way, in order to have them take up and carry their regular loads. The absence of commutators and starting boxes obviously make the polyphase motors in every way preferable to direct-current machines for use by the average workman.

One of the novel features in the operation of the East Pittsburg plant is the coupling of direct-connected alternators in multiple. Though in some few cases, both in this country and abroad, belt-driven machines have been run in parallel, the present installation is one of the first instances where high-speed engines directly

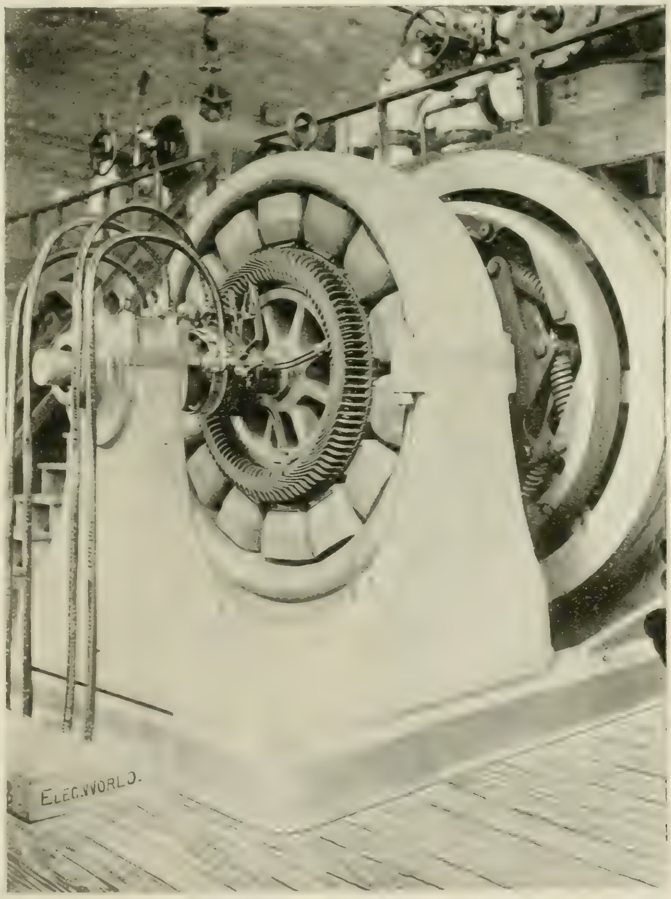


Fig. 1.—500-hp Direct-Connected Two-Phase Generator.

coupled to slow speed alternating-current machines have been so operated. For central station work this feature is one of much importance, as heretofore alternating-current practice has tended almost entirely to the operation of generators separately. Though many electrical engineers have for some time advocated the multiple arcing of alternators, there has thus far been a marked conservatism on the part of the central station manager in regard to such methods. A glance at the very satisfactory way in which the polyphase machines at East Pittsburg are operating would demonstrate to the most sceptical that the running of alternators in multiple is in every way a commercial success. In a few weeks, we shall, no doubt, have further proof, on a large scale, of the practicability of paralleling alternators, as the huge generators at Niagara Falls are to be operated on this plan.

Power House.—The power house is a fine example of modern design and adaptation to requirements; it is 206 feet in length by 76 feet wide, and open to the ridge of the trussed roof 62 feet above the floor. The building is of brick, resting on 16-foot stone foundations laid in concrete. All beams, girders, etc., are iron, and the roof of slate, so the building is completely fireproof.

Boiler Room.—At present there are installed five batteries each of 500 horse-power, Pierpoint vertical water tube boilers, located along one side of the boiler house as shown in Fig. 3. Directly opposite, there is provided space for a similar installation, for which there is already beginning to be a need. Fig. 2 gives a cross-section through the boiler house and shows very completely the plan of construction of the boilers. From this it will be noticed that the boilers have three upper drums connecting by means of tubes to three lower drums. The rear drum communicates with the forward ones by means of a steam connection, the other drums being all connected together by water tubes. The principle of the Pierpoint boiler is that when the feed-water is admitted to the lower rear or mud drum, it is warmed sufficiently in its ascent to the upper rear drum to deposit its sediment and impurities in the former. From there the water is distributed to the tubes and other drums where the steam is generated.

The boilers each occupy a space 18 feet 10 inches square and 22 feet 7¾ inches in height. There are 321 three and a half inch

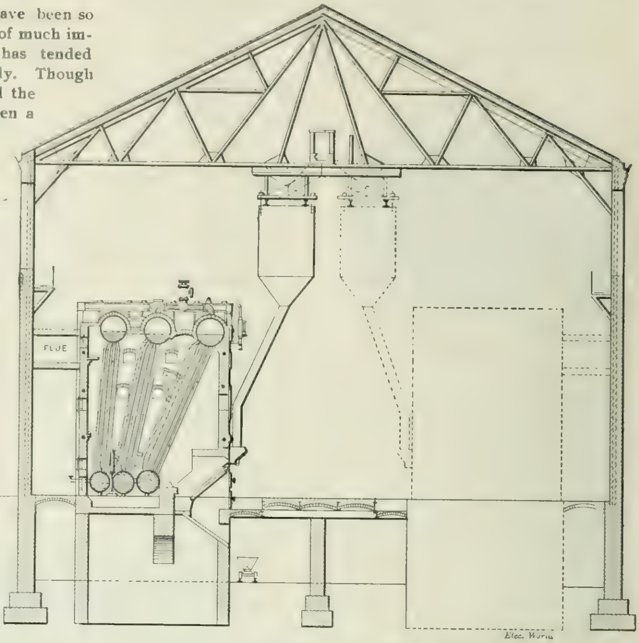


Fig. 2.—Cross-Section of Power House.

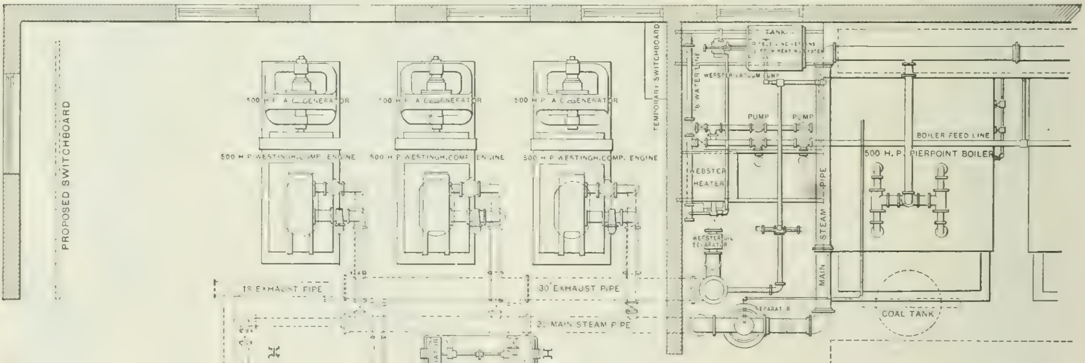


Fig. 3.—Ground Plan

tubes connecting the various drums. The three bottom drums are 30 inches in diameter, the two forward top drums 42 inches in diameter, and the rear one 36 inches in diameter.

Steam is generated at 130 pounds pressure, and is delivered through wrought-iron feeders equipped with Pratt & Cady valves, to a 20-inch main which runs along the west wall of the boiler house. The main passes into a 20-inch Stratton steam separator of the type shown in Fig. 9, which was supplied by the Goubert Manufacturing Company of New York, and is perhaps the largest separator ever made for low-pressure steam; the pipe then dips below the floor and passes up on the other side of the fire wall to the distributing pipes supplying the engines. The mains and steam pipes are all supported by roller bearings.

The boilers are each fired by two Roney automatic stokers, (Fig. 8), fed with coal from cylindrical iron tanks suspended, as shown in Fig. 7, from the roof trusses. The stokers are all driven by a single Westinghouse standard five-horse-power engine, as shown in Fig. 7. The grates of the stoker form a series of steps, to which the coal is fed from the dead plate by a pusher having a vibratory motion; each step of the grates is given a rocking motion, the grate surface thus alternately forming a series of steps and an inclined plane with the grates partly overlapping like the shingles of a roof. In this manner the fuel is worked down and at the same time broken up. The rocking motion is from 7 to 10 strokes per minute.

The ashes from the grate bars drop into large hoppers below the boilers and are thence delivered to cars on a track in the tunnel below the floor of the boiler house. These arrangements will be clearly understood from Fig. 3. At the end of the tunnel is an elevator for lifting the cars to the surface, where they are run to the dump and the ashes used for filling in.

Smoke connection from the boilers to the stack is made through a 72 by 40-inch brick flue running the length of the building, back of the boilers. The smoke-pipe is of iron and was erected by Riter & Connoly of Pittsburg. It is of the self-sustaining type, 198 feet in height with a 10-foot core, brick lined to the top, the whole supported on a brick base. As soon as additional boilers are installed, there will be erected a companion chimney.

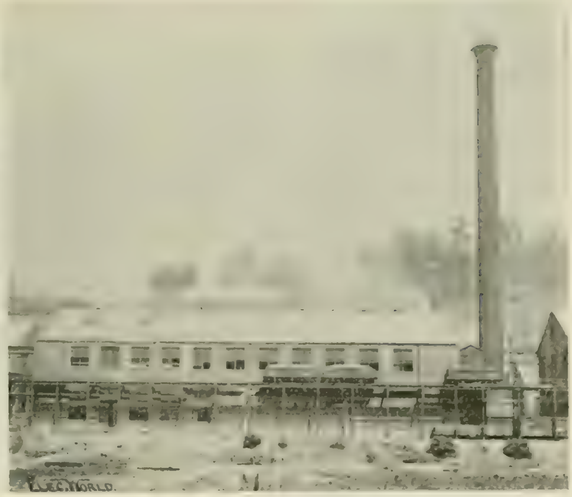
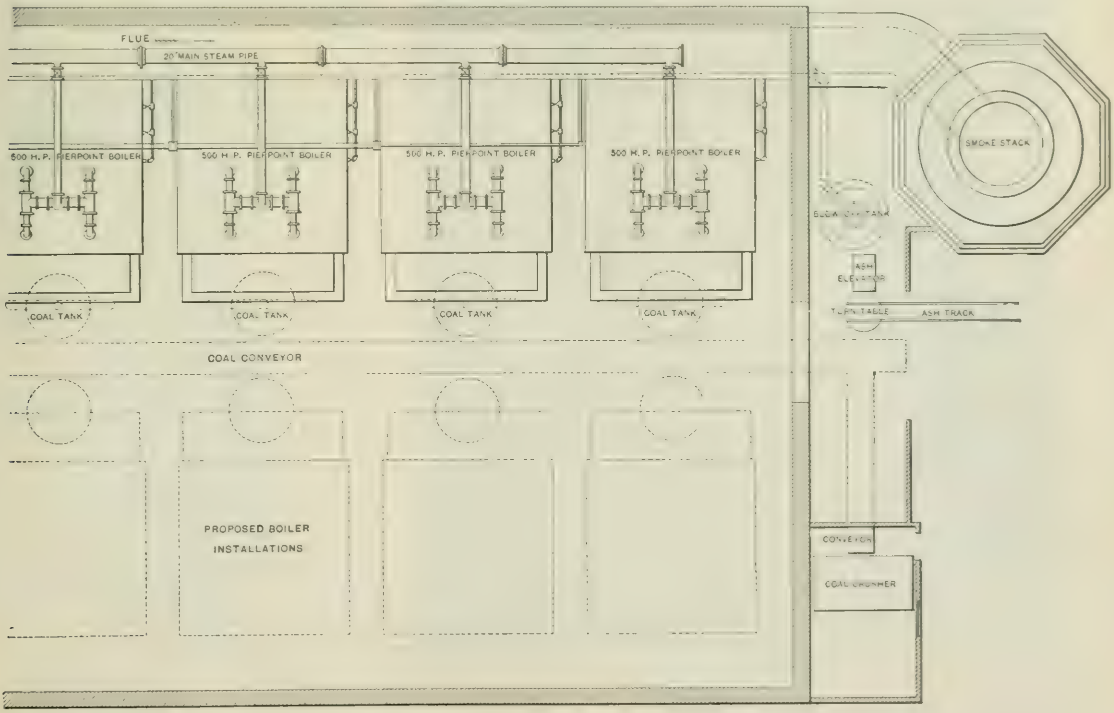


Fig. 4.—Power House.

Coal is brought to the power house by means of an elevated railway track (Fig. 4), from which it is dropped through a chute into bins located at the east end of the power house. On its way to the bins the coal passes through a crusher if necessary. From the bins the fuel is hoisted 60 feet by means of a chain bucket elevator, which empties it into a conveyor that carries it to the tanks feeding the stokers. The capacity of each of these tanks is 8 tons, and the total capacity of the bins about 150 tons. A 15-hp electric motor drives the conveyor and a 20-hp motor operates the lift and runs the crusher when required. The coal apparatus was all installed by Heyl & Patterson of Pittsburg.

It is so arranged that feed water for the boilers may be fed under



of Power House.

reservoir pressure directly to the boilers, or run into the feed-water heater, from which it is forced into the boilers against pressure by means of 12 by 7 by 18-inch duplex double-acting pumps, manufactured by The Wilson & Snyder Manufacturing Company of Pittsburg. They are of the outside packed type and each of the two pumps installed is of sufficient capacity to supply all the boilers, thus insuring continuity of service under all conditions. The pumps are each fitted with a counter and there is also a water meter connected to the supply pipe so that all water furnished the boilers is accurately measured.

Part of the exhaust steam from the engine is used for supplying a Warren-Webster vacuum heater, which raises the temperature of the feed water to 200-210 degrees Fahr. Exhaust steam is also used for heating the buildings and the condensed water from the radiators and heaters is returned to an elevated tank near the eaves of the boiler house by means of a Warren-Webster vacuum pump, which maintains from 10 to 15 inches vacuum on the heating system, thus relieving any back pressure on the engines. From the elevated tank the water flows by gravity into the feed-water heater, where the level is maintained by a float. When the returns of the heating system are insufficient to supply the demands, the float automatically admits cold water. The above system of vacuum heating, known as the Williams system, was installed by Warren, Webster & Company, of Camden, N. J.

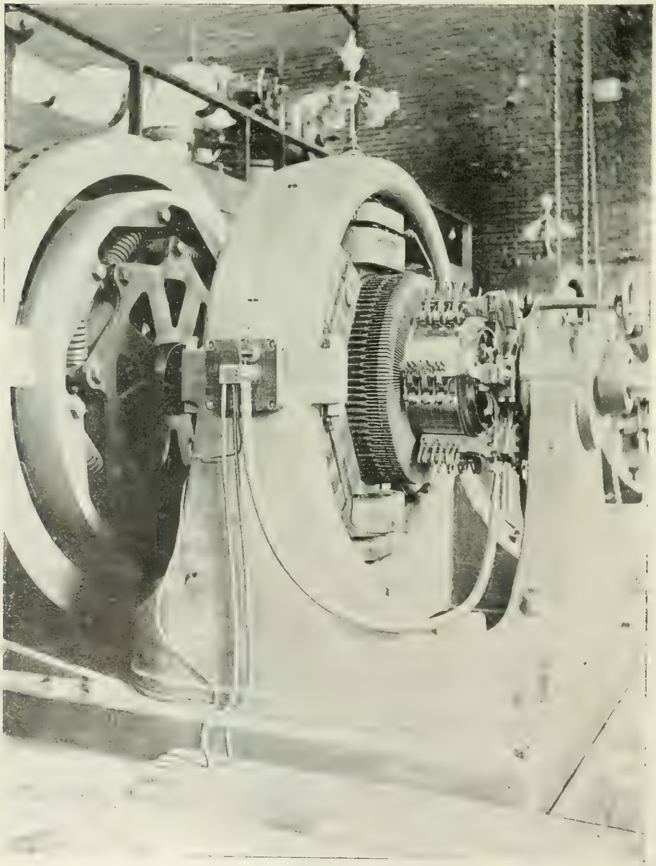


Fig. 6.—500-hp Direct-Connected D. C. Generator.

There is also being put in the boiler house a 20 by 12 by 16 inch Snow underwriters' high-pressure fire pump, which is to obtain its supply of water either from the city mains or from a large reservoir recently sunk just outside the power house. Furthermore, there are in the boiler room several Westinghouse air pumps for maintaining air pressure used in the manufacturing departments, and also two Webster grease separators, as well as other minor but necessary apparatus.

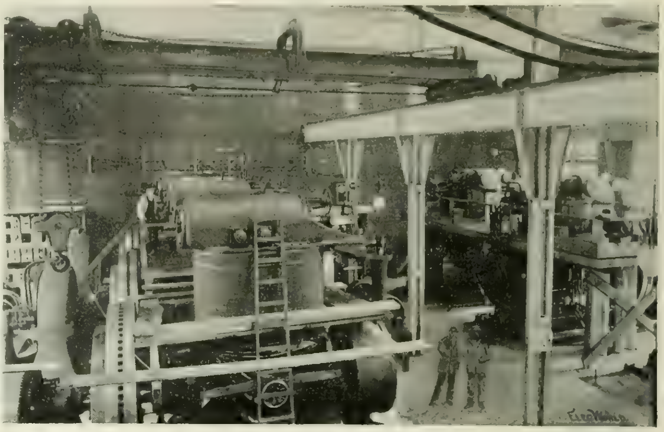


Fig. 5.—Interior of Dynamo Room.

Engines.—The five engines already in operation are of the regulation Westinghouse compound type illustrated in Fig. 10. As shown in the power house floor plan, the high and low pressure cylinders are arranged side by side, and are of 23 and 40 inches diameter respectively, having a 20-inch stroke. When running at regulation speed of 215 revolutions per minute, with 125 pounds steam pressure, they develop their full rated capacity of 500 horse-power.

The distinguishing features of this type of engine are almost too well known to need repetition. They are distinctively a "high speed" and not a "high speeded" engine, which makes them particularly adapted for direct connection to electrical generators. They are equipped with what are known as momentum governors, which instantly respond to the slightest changes in load and maintain an engine speed that is constant from second to second and not merely an average speed per minute, a point of great importance where sudden changes in load are constantly occurring. The engines are made single acting in order to better withstand the wear and tear which the modern high-speed engines are called upon to endure. By reason of their being upright, they occupy a comparatively small space, and all working parts are incased and kept bathed in oil.

Dynamo Room.—The dynamo room at the west end of the building is 76 by 70 feet, and completely separated from the boiler room by an 8-inch fire wall; a glance at the floor plan will show the general arrangement of the apparatus here installed. The equipment consists of three 500-horse power two-phase generators and two 500-horse-power direct-current machines, each connected to a 500-horse-power Westinghouse compound engine of the type illustrated in Fig. 10. These machines are already in operation, and there is being erected an additional 500-horse-power, direct-current generator, direct-connected to a 500-horse-power steeple-compound Westinghouse engine of a new type. As seen from Fig. 3 the three machines of each class are arranged on either side of the room. Each of the generators rests on a bedplate in common with its engine, to which it is direct connected by means of a flexible coupling. The space occupied by the steeple engine and its dynamo is only 17 feet by 8 feet 6 inches; the other five double units occupy a space 22 feet by 8 feet 6 inches. There is also installed a revolving transformer, or two-phase motor, used for driving a direct-current arc-lighting machine, and also for supplying the exciting current for the fields of the polyphase generators. An overhead crane affords a quick and convenient method of handling apparatus to be installed or repaired.

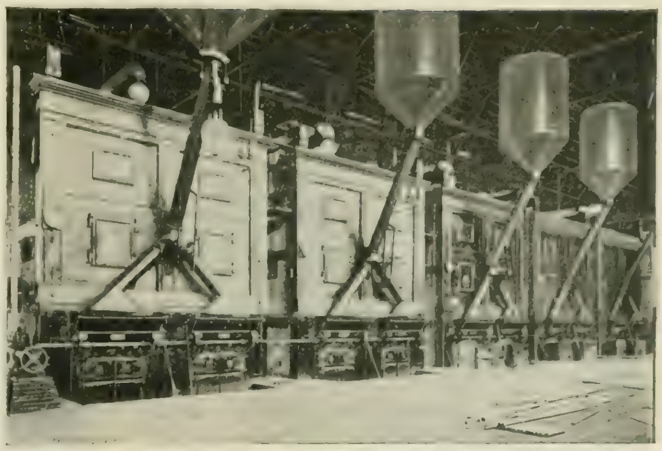


FIG. 7.—BOILER ROOM.

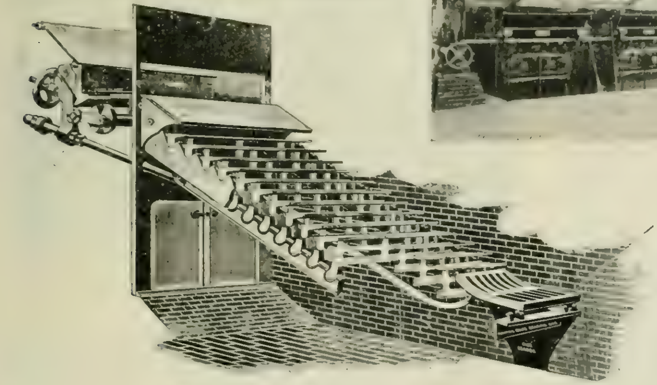


FIG. 8.—RONEY STOKER.

Direct-Current Generators.—The generators (Fig. 6) are all of the Westinghouse standard type; that is, they have a slotted, ventilated armature and a cast-iron yoke with inwardly projecting pole-pieces of laminated steel. The general dimensions are 7 feet 10 inches by 8 feet 8 inches and 8 feet 3 inches in height. The armature winding consists of bars of copper threaded through slots in the core and so connected as to give a two circuit winding, which at all times insures equal distribution of current throughout the coils. The armature is 46 inches in diameter, keyed and pressed on to a 7-inch shaft, which is 104⅛ inches in length and 48⅛ inches between journals. The commutator, 26 inches in diameter with a 10½ inch face, is of the best grade copper, properly tempered, and built up with Canadian mica. The current is collected by means of a six-arm brush-holder carrying three carbon brushes per arm. The bearings have a spherical seat, so that they are at all times self-aligning. Below the bearings are large reservoirs for oil, which is carried up to the shaft by means of brass rings, thus affording automatic lubrication. The pole-pieces are built up of sheet steel punchings riveted together; thus constructed they are sent to the foundry and there have the yoke cast solidly about them. This method of construction insures perfect mechanical

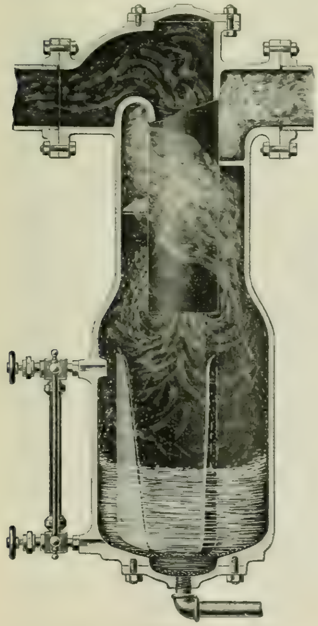


FIG. 9.—STRATTON SEPARATOR.

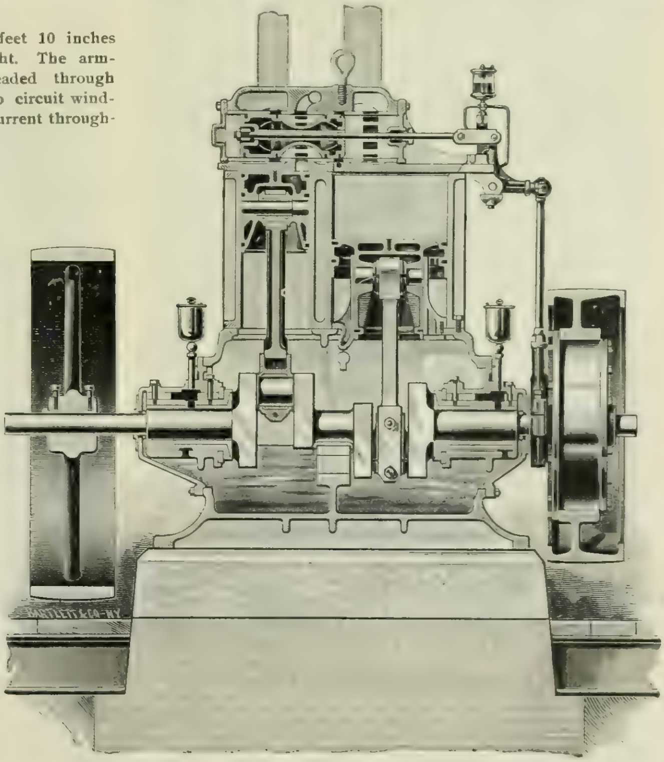


FIG. 10.—500-HP WESTINGHOUSE COMPOUND ENGINE.

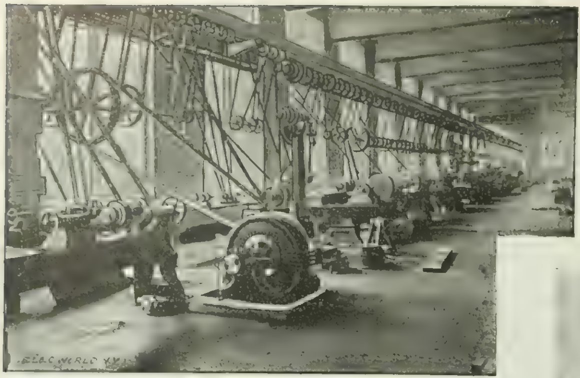


Fig. 11.—Two-Phase Motor Driving Line of Shafting.

contact between laminated and cast-iron parts, and affords the most efficient form of pole-piece. The lower half of the field yoke and the bearing supports are cast in one solid piece, thereby securing rigidity and strength. The field winding is, of course, compound, the series coils being copper strips of three-quarter inches cross-section. The machines develop 750 amperes at 500 volts when running at normal speed, which is 215 revolutions per minute. The points of commutation are constant under all loads, and the machines will carry, for short periods, as high as 75 per cent. overload without damage or undue sparking. The generators have an efficiency of about 95 per cent.

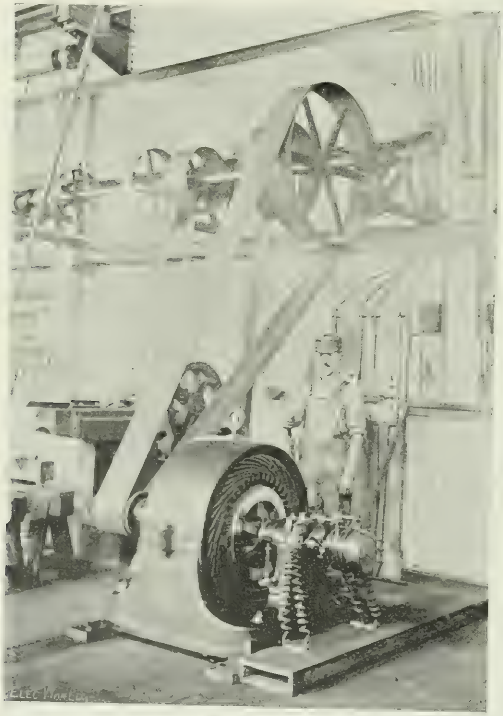


Fig. 14.—60-hp Two-Phase Motor in Section C.

Polyphase Generators.—These machines, (Fig. 1), are of the same general form and dimensions as the direct-current generators. They have 14 laminated steel pole-pieces, built up and cast into the yoke in the same manner as described above. The exciting coils have but a single winding, as regulation is secured through a rotary transformer which supplies the total field current. The armature is very similar to the direct-current hub or spider, the whole design providing for thorough ventilation during operation. The periphery contains some 92 slots, in which the bar winding used is held in position by strips of rigid insulating material secured by grooves inside of the slots. The type of winding used affords excellent ventilation, avoids the necessity of any binding wires on the surface of the armature, is symmetrical in form, and particularly attractive in appearance. It is of the continuous type, and the four connections are brought out at points 90 degrees from each other, to four collecting rings, where the current is collected by means of copper brushes. The collecting rings are 5½ inches in diameter, with a 1½-inch face. There are four brush-holder arms, two per circuit, which carry two brushes to each arm in order to insure efficient contact. The polyphase machines run at the same speed as the direct generators—215 revolutions per minute. They generate current of 3,000 alternations at a potential of 240 volts. Their normal output is 400 amperes on each of the two circuits, and at this load the machines have an efficiency of about 95 per cent. These generators are usually run in multiple, operating as perfectly and satisfactorily as any direct-current machines.

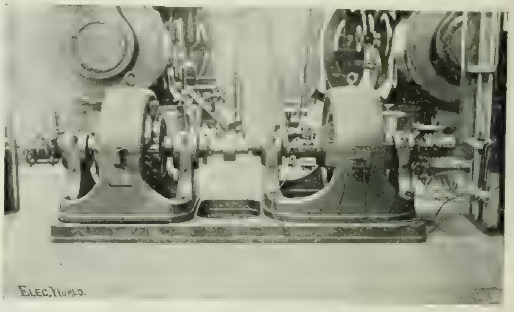


Fig. 12.—Rotary Transformer Direct-Connected to D. C. Arc Generator.

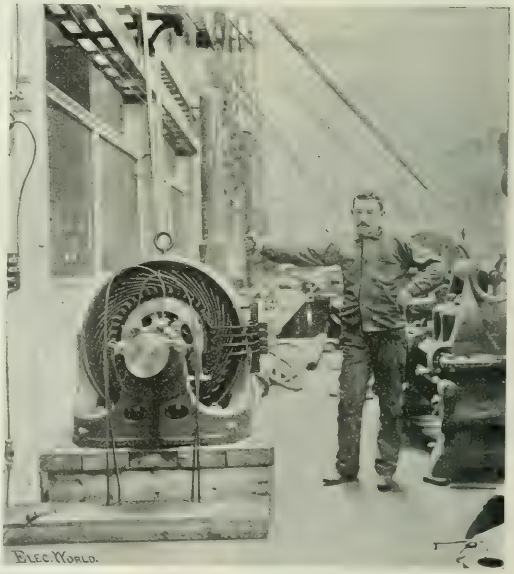


Fig. 13.—40-hp Two-Phase Motor in Section B.

Switchboards.—At present there are installed two temporary switchboards, which will be replaced by handsome Italian marble incombustible boards, one for the direct current and one for the polyphase system. These boards will be of a new and improved type, a single marble slab over five feet long, two feet wide and one and three-quarter inches thick, taking the place of a number of smaller units. The apparatus will be mounted directly on the face of the marbles, which will be supported by iron bracings against the wall. Each board will consist of one load, five generator and five feeder panels. The load panel will be equipped with wattmeters and voltmeters for measuring the total output of the machines in multiple. Each of the dynamo panels will contain signal lamps, main switches, voltmeter and ammeter switches, ammeters, rheostats, and synchronoscopes or phase indicators on the polyphase board for throwing in multiple. The feeder panels will be equipped with lamps, ammeters, fuses or circuit breakers, switches, etc.

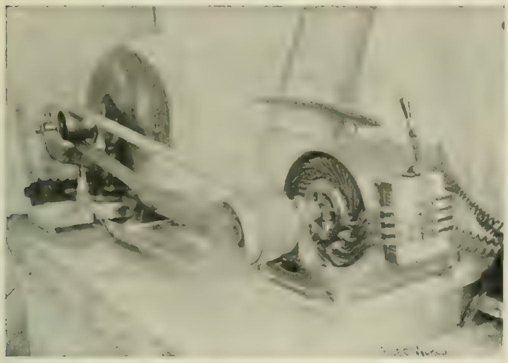


FIG. 15.—5-HP TWO-PHASE MOTOR RUNNING HOT BLAST FAN.

Distributing System.—Up to the point at which the current leaves the switchboard for supplying the transmission circuits, the installation is identical with that which would be used for long-distance work. If the energy were to be used, for example, at Johnstown, Pa., 75 miles distant, it would only be necessary to connect in converters and transform the potential from 240 to perhaps 10,000 or 15,000 volts, a potential which is perfectly feasible and in use in parts of this country and in Europe.

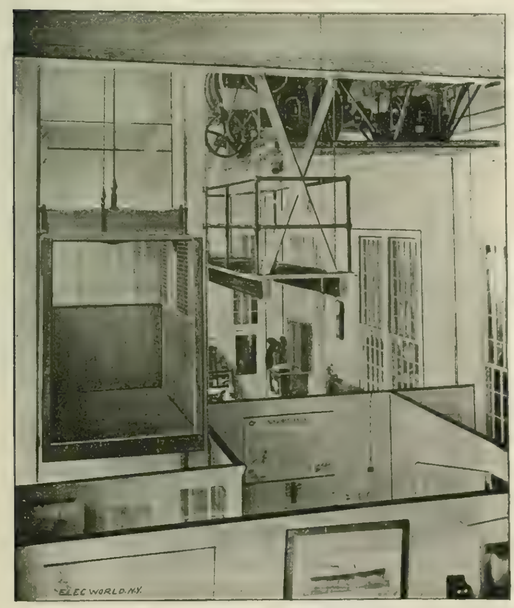


FIG. 17.—TWO-PHASE MOTOR OPERATING ELEVATOR.

In the Westinghouse plant the current is distributed through copper cables covered with simple water-proof insulation. These are carried on heavy iron brackets, with special malleable-iron feed-wire insulators manufactured by the Ohio Brass Company. To the main building there are run 18 conductors, arranged as in Fig. 19. The eight cables nearest the support marked 1-3, 1-3, 2-4, 2-4 in the diagram, are each of 500,000 circular mils cross-section and are used for conveying polyphase current used in power work. The wires are arranged as numbered in order to avoid mutual and self-inductive affects, wires 1 and 2 conveying one of the two currents, and 3 and 4 the other one, which differs 90 degrees in phase from the first. The four outside wires marked "+ and +, and —," are also of 500,000 circular mils cross-section and are used for direct currents, supplying the testing departments. Of the lower six cables the four inside ones are marked 1-3, 2-4, and convey polyphase currents used for lighting. These cables are of 500,000 circular mils cross-section. The two outside cables marked "plus" and "minus" are of 250,000 circular mils cross-section and convey direct current used for the operation of some small stationary motors and for various other purposes. Energy is conveyed to the carpenter shop by four 250,000 circular mils cables, transmitting polyphase currents. The punch shop is supplied with similar energy through eight 210,000 circular mils cables and the warehouse by four 500,000 circular mils cables. At the various motors four connections are made to the mains, through two double joint switches and fuses, as shown in Fig. 15.

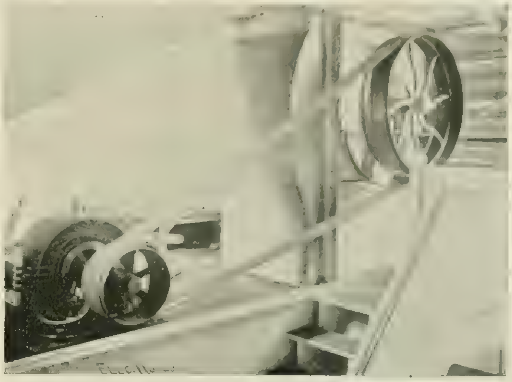


FIG. 16.—40-HP TWO-PHASE MOTOR DRIVING VENTILATING FAN.

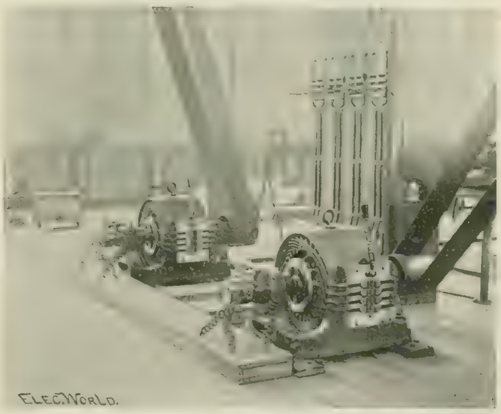


FIG. 18.—TWO 30-HP TWO-PHASE MOTORS DRIVING LINES OF SHAFTING IN SECTION D.

As a rule the Tesla motors are belted, as shown in Figs. 11, 12, 13 and 18, to short lengths of shafting from which the machinery is driven. A detailed description of the latest forms of the Westinghouse polyphase motors will be given in the next issue. The location of the motors and their horse power is given in the appended table:

220-VOLT, POLYPHASE MOTORS.

	Horse Power.									Total
	10.	15.	20.	25.	30.	40.	60.	75.	Motors.	H. P.
Machine Shop	2	1	4	1	9	8	1	..	26	790
Detail Department	2	..	4	..	..	..	..	..	6	100
Blacksmith Shop	1	2	3	..	..	1	..	..	7	140
Punch Shop	2	..	2	..	1	..	..	..	5	90
Brass Foundry	2	..	1	..	..	..	..	..	3	40
Carpenter Shop	1	..	2	..	1	..	..	1	4	155
Paint Shop	2	1	2	..	..	..	..	..	6	85
Totals	12	4	18	1	11	9	1	1	57	1400

500-VOLT DIRECT CURRENT MULTIPOLAR MOTORS.

	Horse Power.			
	3½	5	7½	10
Two 30 ton Shaw Cranes, 67 ft. span	2	..	2	2
Two 10-ton Sellers Cranes, 32 ft. span	2	2	2	..
Two 10 ton " " " "	..	6	..	..
Two 10-ton Gale & Towne Cranes, 22 ft. span	2	2	2	..
Totals	6	10	6	2

Throughout the factory there are 17 electric, freight and passenger elevators which were at first operated by direct current; these are rapidly being replaced by multiphase motors. The elevators are all belt driven as shown in Fig. 17, but there is no objection to their being direct connected whenever so desired. The motors vary from 20 to 30 horse power capacity. Fig. 20 gives a view of the bridge end of one of the two 30-ton Shaw standard single trolley electric cranes in the main shop, which were supplied by Manning, Maxwell & Moore, of New York. These cranes are equipped with the electric and mechanical brakes and operated by Westinghouse motors especially designed and built for them. The span is 67 feet and each of the cranes has a travel the full length of the shop.

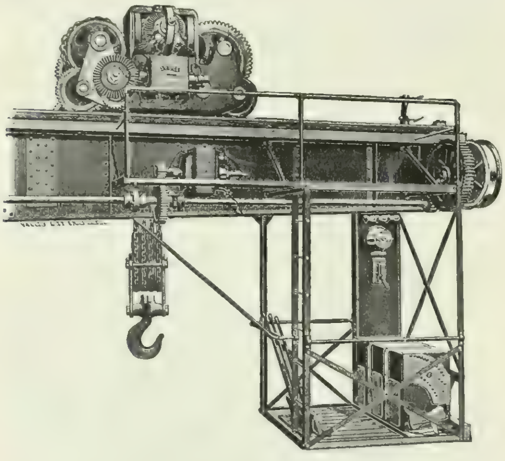


Fig. 20.—Bridge End of 30-Ton Crane.

Electric Omnibuses.

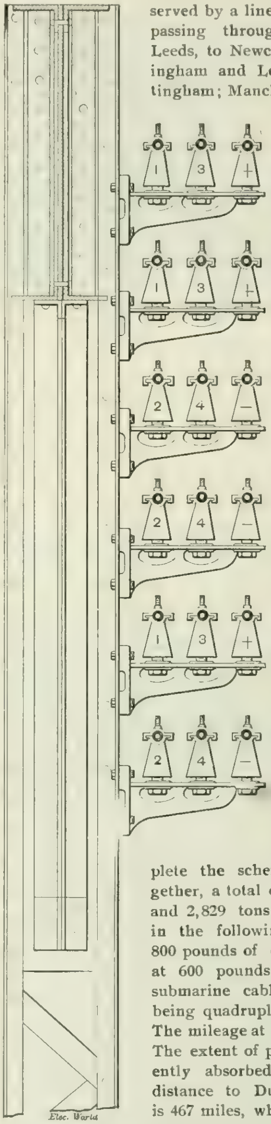
It is reported that two lines of omnibuses, to be electrically propelled, will shortly start running between Hammersmith and Liverpool Street stations, London—one line running north of the park by Notting Hill, Bayswater and Oxford Street; the other on the south by Kensington and Piccadilly.

Needed More Light.

The Electric Lighting Committee of Belfast, Ireland, at its last meeting considered an application from the gas company for the supply of electric current to the gas works. Some amusement was caused by the application, which was referred to the city engineer for report.

Telephone Trunk Lines in England.

The first and most important stage in the establishment of a telephone system for the United Kingdom in conjunction with the post office was, we learn from the London *Electrical Engineer*, recently completed, and London for the first time put into telephonic communication with Edinburgh, Glasgow, Belfast and Dublin. The most easterly wire from London runs to Ipswich, by way of Chelmsford and Colchester, and the most southernly to Brighton, two wires being used in each case. The Midlands are served by a line of from sixteen to four wires, passing through Nottingham, Sheffield and Leeds, to Newcastle, and feeding Derby, Birmingham and Leicester from Sheffield and Nottingham; Manchester and Liverpool, on the one side, and Hull on the other, from Leeds; and Hexham and Morpeth from Newcastle. At Birmingham the line is taken southwest to Newport, Cardiff and Swansea, and, by another network, to Bristol, Exeter and Plymouth. At Leeds, the communication strikes off to the northwest, and passes through Carlisle to Glasgow and Edinburgh, for Scotland, and to Portpatrick, where a submarine cable across St. Patrick's Channel is laid to Donaghadee, and touch is gained with Belfast and Dublin. These lines are already completed and in working order; but there is still in progress a system direct from London to Birmingham, leading on to Derby, where it will branch to Liverpool and Manchester, passing through Cottonopolis to a point where it will join the Leeds-Carlisle communication. The direct service from London to Bristol, Southampton and Portsmouth will be secured by six wires running to Salisbury, where they will separate, four turning to the Bristol Channel and two to the Solent. A couple of wires from Newcastle to Sunderland, and two more from the same centre to Darlington and Stockton, will complete the scheme of the department. Altogether, a total of 10,375 miles will be covered, and 2,829 tons of copper will be consumed, in the following proportions: 2,719 miles, at 800 pounds of copper per mile per wire; 4,914, at 600 pounds; 2,646, at 400 pounds; and the submarine cable, 24 miles in length which, being quadruple, gives a total of 96 miles. The mileage at present completed is 7,595 miles. The extent of private undertakings to be presently absorbed is about 28,000 miles. The distance to Dublin, as traversed by the wire, is 467 miles, which is a notable increase on the 334 miles followed by the railway from Euston *via* Holyhead. The longest circuit over which the postoffice authorities have spoken by linking the largest possible number of wires is 1,270 miles, and the result of the experiment is considered by them to be quite satisfactory.



Elec. World

Fig. 19.—Pole Line Construction.

Amount of Light Per Capita in Paris.

The amount of artificial lighting in Paris in 1855 is said to have been 3,765 candle-hours per year per capita, which was increased to 11,302 in the year 1889.

Polyphase Currents and Motors.

Much confusion has been created in the minds of beginners by the habit of some writers of using current in the singular when writing of polyphase currents. This, of course, is a manifest error, the presence of the word *phase* in itself carrying a contradiction. As will be illustrated later on, a polyphase system is one in which two or more simple alternating currents are employed, but which do not simultaneously pass through an identical value, as, for example, the maximum value. That is, one of the two simple alternating currents of a two-phase system passes through its maximum value a quarter period after the other, while in the three-phase system the three simple alternating currents have phase differences of a third of a period.

In every alternating-current circuit the potential is first positive and then negative; that is, the current in one half-period flows in one direction and in the other half-period in the opposite direction. This change of value of the potential, or electromotive force, of the simple alternating current is usually graphically represented by some such wave line as shown in Fig. 1. At any instant the value of the E. M. F. is determined by selecting a point on its wave corresponding to the proper time, as indicated on the zero line, and referring the point to the scale at the left. The part of the curve above the zero line is usually taken to indicate positive potential, and that below the zero line as negative potential. It should here be remarked, however, that the zero line shown in the diagrams is one chosen for convenience, as the true zero line would be one tangent to the lower portion of the curve. Reference to the diagram will show that an alternation occupies half the time of a cycle, and that a cycle or period is the total change that takes place in the E. M. F., from zero to maximum in one direction, back to zero and to maximum in the opposite direction and to zero again. With a bipolar machine one cycle is completed with each revolution of the armature, and with a four-pole machine, two cycles per revolution, etc. The fluctuations in E. M. F. go on continually and very rapidly in every alternating-current circuit and distinguish it from a direct-current circuit, in which the voltage is constant and the flow of current continuously in one direction. In simple alternating-current circuits it has been customary to use about 16,000 alternations or 8,000 periods per minute, in which case, a complete period occupies only about 1/133 part of a second; lately, however, practice has tended to reduce the frequency as low as 3,500, and in some cases even to 1,500 per minute.

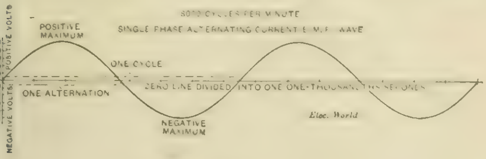


FIG. 1.

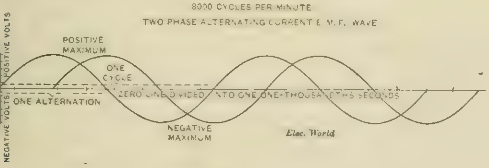


FIG. 2.

Polyphase currents consist of two or more simple alternating currents definitely and accurately related to one another as to time. Fig. 2 represents the E. M. F. waves of two-phase currents. It will be noticed that the waves are one fourth of a cycle, *i. e.*, 90 degrees apart, the maximum of one wave occurring during the zero value of the other wave, and vice versa. In the two-phase circuit the E. M. F. waves always maintain this relation to one another. If the E. M. Fs. are applied to separate circuits and kept entirely independent, they would produce two simple alternating currents, one always a little behind the other. We may suppose these currents to be produced by two alternators having the same number of pole-pieces, the same number of teeth on their armatures, and with their shafts rigidly connected together, so that when the armature teeth of one machine are opposite its pole centres, the teeth of the other armature are midway between the poles of its field. If the currents of these machines were kept separated, two wires being used for each phase, we would have the four-wire two-phase system.

Fig. 3 represents the three-phase system. It will be noticed that there are three waves regularly placed with respect to one another, one third of a cycle apart; that is, three-phase currents may be considered as being generated by three machines whose shafts are so connected that their armature teeth are respectively behind one another by two thirds the distance between their pole centres. If the leads from these machines were kept separated we would have a six-wire system, but each pair of wires can be so connected with each of the other two pairs, that three wires serve for three currents, which, as stated before, have phase differences of one third of a cycle. In practice it is not necessary to use separate generators to secure polyphase currents, as it will be readily seen that the teeth and coils of a single armature could be so arranged with respect to its pole-pieces as to give the required effects.

To look at the matter from a little different standpoint, we may consider the similarity between a direct current and a polyphase generator. As is well known, whether a machine shall give a direct or alternating current depends, not on the number of pole-pieces nor the form of armature winding employed, but solely on whether the armature windings are connected to a commutator or to collecting rings. Every dynamo armature has generated in its windings an alternating current, which may be rectified by means of a commutator, or used as an alternating current through the interposition of collecting rings. This is exemplified in rotary transformers, which have collecting rings on one end of the armature and a commutator on the other. When driven as a generator, these machines will supply either direct or alternating currents, as preferred, or direct currents may be sent in at the commutator end and alternating current taken off the rings, or vice versa. Such machines are in actual operation, supplying both direct and alternating currents, at Rochester, N. Y.

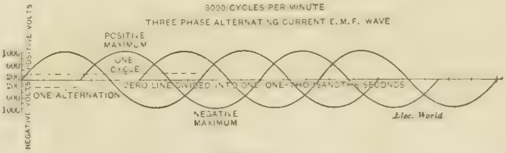


FIG. 3.

Suppose we take a simple two-pole direct-current dynamo and put a pair of ordinary collecting rings on its armature, in addition to the commutator. If these rings be connected to opposite commutator bars, then the current derived from them will be an alternating current. Two more rings may be added to the armature and connected to two other commutator bars at 90 degrees from the first. These last two rings will also give an alternating current similar to that of the first two, except that its maximum value will occur at the time of zero value of the current from the first pair of rings. Thus it will be seen that we attain two-phase currents, and all the while the *armature* currents are exactly the same as those in the machine when used for direct current.

The general impression prevails that there is something particularly mysterious and intricate about the action of a polyphase motor, and that it is entirely different in action from the ordinary direct-current motor. But it will be recognized that the machine just described can, of course, be reversed and run as a motor, the currents in the armature, and the reaction between the armature and field being the same, whether the armature is supplied by direct current or by polyphase alternating currents. This motor, when supplied with alternating current, is a synchronous type of motor, in which it is essential that the speed of rotation of the armature should correspond to the rate of alternation of the current; this follows from the fact that the currents in the armature must correspond with those which would flow in the direct-current machine, in order that the poles produced by the armature currents may be maintained in fixed position with relation to the field poles. If the armature speed is a little less than synchronous speed, it is clear that the poles produced by the armature will not maintain a constant position, but will rotate at a speed depending upon the relation between the speed of the armature and the rate of alternations. The reaction of a revolving pole of this sort upon a fixed and constant field will tend to produce rotation, sometimes in one direction and sometimes in the other direction, the result being that the [illegible] will come to rest, or cannot be started in motion. If, however, the field pole itself were to revolve and keep just ahead of the pole produced in the armature, then there would be constant reaction and pull, or torque, in one direction. This is accomplished by a different type of field, in which the currents are induced by the armature itself, very similar to the currents in the secondary of an ordinary converter. The armature induces the currents in the field, which in turn produce poles which are displaced in position from those in the armature, and reaction between the poles takes place, producing motion similar to that in the direct-current motor.

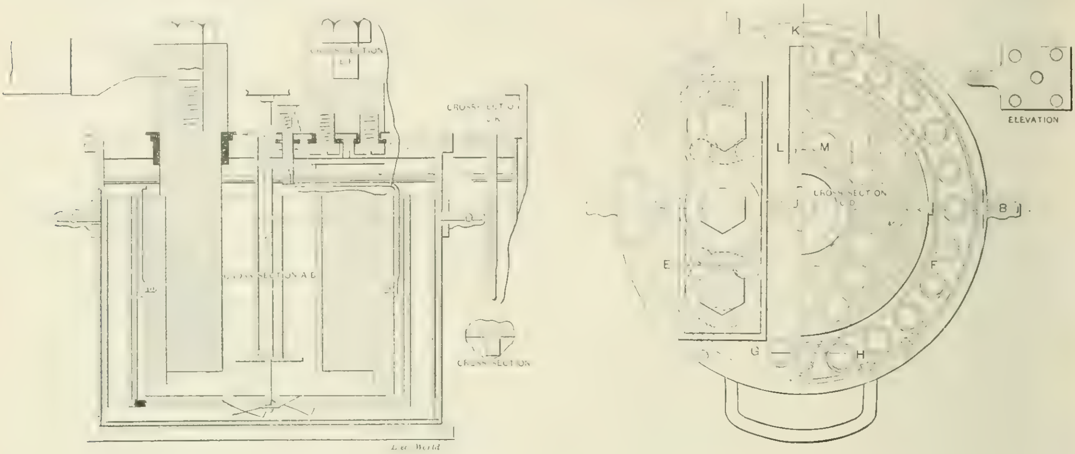
The two-phase synchronous alternating-current motor is therefore essentially the same as an ordinary direct-current motor, except that the alternating currents which are required in the armature are supplied directly instead of being produced from a direct current by a commutator. In the non-synchronous type of motor the field poles are not produced by a separate direct current but by an induced current, and these field poles are not fixed in position, but are transferred from point to point in the field, and maintain such a position as to give the proper reaction and torque between the armature and the field.

A further modification of the alternating-current motor, which seems a very radical one in form, but is really a very slight one in theory, is that in which currents are supplied to the outer or fixed element instead of the rotating element. The outer part is here really the armature. For simplicity and to avoid confusion the words "armature" and "field" have been discarded at the Westinghouse works, and "primary" is applied to the element to which currents are supplied, either "stationary" or "revolving" as the case may be, and "secondary" is applied to the element in which currents are induced, and this may also be either "revolving" or "stationary," depending upon the type of construction.

This relation between the two kinds of apparatus is very clearly exemplified in the types now being produced by the Westinghouse Company. It is very interesting also to see how the types of alternating and direct-current generators are similar in general form, and in many cases the construction is almost identical, with the exception of the substitution of collecting rings for commutator.

Standard Resistances for Strong Currents.

The new standard resistances of the Berlin Reichanstaldt for measuring large currents by the voltage at the terminals of a known resistance, are described by Dr. Feussner in the *Elektrotechnische Zeitschrift*, from which we reproduce the accompanying illustration. The first resistance has a value of 100 microhms, and can be used for currents up to several hundred amperes, and for a short time up to 1,000; the second resistance has a value of 10 microhms and is intended for currents up to 10,000 amperes. Instead of the usual bands of metal, these resistances are made of a casting of manganine in the form of a short hollow cylinder, having about the same width as its diameter, and having a thick wall, which appears from the illustration to be about equal to a little less than one third of its outside diameter; numerous holes are drilled through it, parallel to the axis, so as to increase the resistance to the desired amount, and to serve for the circulation of the oil in the bath in which the cylinders are placed. The connectors are made of large copper bars inserted in two holes, parallel to the axis and diametrically opposite to each other, the current therefore flowing through the two halves of the manganine ring in multiple; these terminals are carefully soldered with silver. The connections for the voltmeter are made of manganine strips screwed to the cylinder near where the copper leads enter it, and are soldered with tin. Great care is taken to have the leads sufficiently large; those in the small apparatus are made of round copper bars 15 mm (about ⅝ in.) in diameter, and in the large one about 50 mm (about 2 in.) in diameter, being a little less where they pass through the casting. It is not stated why the leads are not formed of manganine in the form of large blocks cast as a part of the original casting, to which the copper is then fastened; this would avoid all thermo-electric effects in that portion of the resistance which is used in the measurement.



Standard Resistances.

Leakage Currents and Metallic Sodium.

Our readers are aware through our columns of the recent discussion in England as to the formation of metallic sodium by leakage electric currents, and from what follows it will be seen that in Boston a similar case has been observed. At the request of the Boston Fire Underwriters' Union, Messrs. Forbes and Glidden of that city recently made an examination of a substance found in the casing about the electric mains in the basement of the Pray building, and we give below an abstract of their report.

The substance discovered was in reality impure metallic sodium mixed with partially disintegrated wood, the metallic sodium being the product of an electrolytic decomposition of impure sodium hydrate. This sodium hydrate came from the cement mortar used in laying the brick wall of the basement, upon which the wires were supported. Some of the hydrate may have possibly worked its way through the wall from the cement used in the foundation of the paved street (Washington Street), immediately adjacent.

The electric current which caused the electrolytic action was due to a leak inside the casing from one of the mains to another, the leak having been produced by the action of the sodium hydrate on the insulating covering of the wires. This covering was what is known as "Weather-proof," consisting of a cotton braiding covered with tar, which material is readily attacked by sodium hydrate and its insulating properties destroyed. The general arrangement of the wires in the front of the Pray Building is shown in the accompanying sketch.

The three street mains enter at the point *A*, and pass through the safety catches *C*, and meters *M*, to the wooden casing which starts at *D*. From this point the wires are run on porcelain knobs inside the wooden casing, behind the water pipe *P*, turning upward at *E*, and leaving the wall at *G*. Inside the casing the wires were partially covered by an insulating tubing consisting of tarred paper.

The deposit of sodium was found at the point marked *S* on the sketch and extended over an area represented approximately by the shaded portion. The wood at this point was badly eaten and discolored by the caustic action of the sodium, and for some distance around, especially along the top of the casing, was soft and wet.

For several months before the sodium was found, a slight smoke had been noticed to issue occasionally from the casing. When the front of the casing was removed, the wires, tubing and woodwork about the point *S* were covered with a thick liquid, which had dried in places to a white substance resembling discolored salt and which was slippery to the touch and strongly corrosive. The metallic sodium was smoking and when moistened and struck with any hard material gave off flashes of fire.

The following tests were made shortly after the discovery of the deposit, upon which the explanation given above is based. The substance was determined to be mainly metallic sodium by its appearance and characteristic reactions, and by its color in the Bunsen flame. The sample upon which the test was made was about half wood partially disintegrated, adhering to which was a mass composed of white sodium hydrate on the outside, with the metallic sodium in the centre.

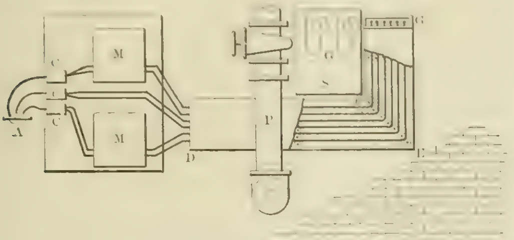


DIAGRAM OF WIRES ENTERING PRAY BUILDING.

Samples were taken from the surface of the wall at numerous points along the front of the basement, each of which gave a strong alkaline reaction. The moisture on the wall was also strongly alkaline.

The insulation on the wires about the point *S* was found to be practically destroyed. The upper two wires (negative) were in the worst condition; the middle two (neutral) were nearly as bad; while the lower two (positive) had not been so much affected.

The outer covering of tar, especially on the negative and neutral wires, had been dissolved by the action of the caustic, leaving the braiding bare and saturated with the sodium hydrate, which had dried white in places.

Opinions Regarding the Berliner Opinion.

The following views of managers of opposition or independent telephone companies as to the probable effect of the recent decision in the Berliner case will show how the subject is viewed by these gentlemen:

"The article and the editorial in THE ELECTRICAL WORLD explaining the opinion of the United States Circuit Court of Appeals in the Berliner case is evidence to us that you have the interest of your telephone subscribers to heart, and that you will continue to look out for them in the future as you have in the past.

"FLORIDA TELEPHONE & CONSTRUCTION COMPANY,
"James D. Randall, President, Memphis, Tenn."

"The question is entirely a simple one so far as concerns the Standard Telephone Company. We are in the telephone business, and have all the orders in hand and as many in sight as we can possibly handle, so that our hands are full taking care of practical business.

"STANDARD TELEPHONE COMPANY,
"Thurlow Weed Barnes, President, New York."

"I write to thank you sincerely for what you have published in THE ELECTRICAL WORLD relating to the opinion in the Berliner telephone patent case. Until I had read this I was at a loss to obtain intelligent information bearing upon the subject. We propose to go right on with the business and are meeting with wonderful success. Our plant has been removed to Madison, Wis., where we are meeting with success beyond our expectation.

"S. S. KILVINGTON, M.D., Minneapolis, Minn."

"It seems to be the current impression that while the Bell Company is looked upon as usurping the rights it is enjoying by appropriating privileges that in reality belong to the public, the public at large, particularly those who have capital to invest in this line of industry, are afraid of the power wielded behind the throne by the Bell Company. After having fully gone over the history concerning the telephone situation it would appear to the average person that it is impossible to get and sustain a decision in even the higher courts adversely to the interests of this company.

"THE NOWOTNY ELECTRIC COMPANY,
"John S. Nowotny, General Manager, Cincinnati, O."

"THE ELECTRICAL WORLD's digest of the opinion in the Berliner case, giving some interesting data, reached here ahead of any other information on the subject, and for this we feel you should be particularly complimented. The WORLD is the only electrical paper, as far as I know, that has put before its readers and the general public a digest of the situation up to the present time. In other words, you seem to have got about three or four days ahead of the others. There is to be an exhibition here in the Bullitt Building, commencing Thursday, June 27, of our telephone and the Gould-Smith switchboard. A complete working switchboard showing entire system will be in operation. We have, we believe, the only non-infringing system, and certainly we have got something that will be new to the public as well as the readers of the electrical papers.

"UNITED STATES TELEPHONE CONSTRUCTION CO.,
"A. H. Chadbourne, Gen. Mgr., Philadelphia."

"The decision in the Berliner case will probably have the present effect of keeping some uninformed persons, and others naturally timid, from aiding in the development of the independent telephone field, thus working an injury to themselves, the trade and to the public, and the carrying out to such extent of the probable designs of the Bell Company. But that the Bell will be able ultimately to maintain a monopoly of the telephone business through that monumental piece of patent jugglery—the so-called 'Berliner patent of '91'— we cannot believe. 'Our friends the enemy' claim that this patent covers all forms of microphone transmission. They are working a stiff bluff—if we may be pardoned the expression—perhaps thinking there is nothing to lose by claiming too much. They appear to base this claim on the 'constant-contact, variable-pressure' combination. The Berliner, Edison, Bell and Hunnings patents of '77 either did or did not involve this principle. If they did not then, they do not now. If they did then involve this principle, why should a so-called patent issued some 14 years later prevent the public from enjoying the benefits to be derived from these expired patents?

"THE RAWSON ELECTRIC CO.,
"T. M. Brush, Secretary and Treasurer, Elyria, O."

Output of Polyphase Machinery.

To the Editor of The Electrical World:

SIR:—In your editorial of June 15, commenting upon my paper, dealing with the output of polyphase machinery, you make a statement which might lead to the impression that the heating effect in an armature, and the consequent limitation in its output, had not been taken into account in the treatment of the subject. By referring to the paper in question it will be seen that the basis of comparison of output under the several conditions considered is that of identical copper and iron losses, which is equivalent to a comparison on the basis of equal rise in temperature. The armature iron loss of the polyphase generator is the same as that of the direct-current generator, and the armature iron loss of the rotary transformer is assumed the same as that of the direct-current generator, although in reality it is less, and for this reason the result obtained for the output of the rotary transformer is slightly low. This difference in iron loss was touched upon at the close of the paper, but was not brought into the discussion because it was thought that the complication thus introduced would not compensate for the slight difference in the result. In reality the iron and friction losses might be neglected in the case of the rotary transformer on the assumption that the power required for them is supplied to the *pulley* of the machine. For the copper loss due to that part of the armature current which supplies power for the iron and friction losses is small, and is partially, in some cases wholly, offset by the decreased iron loss referred to above. For this reason equation (8) of the paper is sufficiently accurate for all practical purposes although curve *B* was plotted from equation (7). If, as it seems, the paper was not sufficiently explicit upon these points, I take this opportunity of remedying the oversight.

Pittsburg, Pa. RALPH D. MERSHON.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

NOTE.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors, or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 927 Chestnut Street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French, or German languages. It will be to the advantage of all concerned if editors of non-electrical journals or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Theory of the Dynamo.—"L'Eclairage Elec.," June 1, contains a long article by Mr. Hanappe on "A Theoretical and Experimental Study of a Bipolar Dynamo for Di-phase Currents." His object is to apply known principles of the theory of the dynamo to finding a method of calculation sufficiently accurate, for practical purposes, for determining without experiments the external characteristics of a generator, the angles of lead for different outputs and the variation of the loss of flux; he deals largely with the calculations concerning the flux; his formulæ do not appear to be too complicated for practical application. He shows that the old method of calculating dynamos does not give results which agree with those obtained in practice, except for the voltage on open circuit, whereas his method gives approximate values which accord with those found in practice.

Alternators.—A brief abstract of a recent Royal Society paper by Dr. Hopkinson and Mr. Wilson is published in the Lond. "Elec.," June 7; it is reprinted in THE ELECTRICAL WORLD, June 22, p. 711.

Single-Phase Alternating-Current Motors.—An Institution paper by Mr. Eborall is reprinted in the Lond. "Elec. Rev." beginning with the issue of June 7; he reviews what has been done and attained in this field; it is an interesting summary but does not appear to contain much that has not already been published.

Connecting Alternators in Parallel.—A system is illustrated and described by Mr. Vietze in the "Zeit. fuer Elek.," June 1, for three-phase machines, by means of which the voltage and phase difference of the machines to be coupled are measured with a simple apparatus.

Dynamo Without Iron.—An illustrated description of the machine of Prof. Pietzker taken from the German (referred to several times in these columns), is published in "L'Elec.," June 8; this machine is of no practical interest.

LIGHTS AND LIGHTING.

Train Lighting.—In Mr Weeks' serial in the Lond. "Elec. Eng.," June 7, he describes the present plant used on the Great Northern Railway, accompanied by numerous good illustrations. All the machinery is placed in the baggage car, the dynamo being driven from the axle of the car by means of a countershaft; there are 22 cells of accumulators in each car, and there are 11 cars to a train, each train being provided with 552 cp of light; eight trains are now running regularly and the maintenance per year per train is about $750; the initial cost of the outfit is about $182 per car, the average candle-power is 50 and the cost of supplying the light is 0.052 cent per candle-power-hour; the lighting is said to be successful.

An article of a general character giving but little detailed information is published in "L'Elec.," June 8.

Differential Chain Lamp for Continuous or Alternating Currents.—An illustrated description of the Kremenezky-Mayer lamp is published in the "Zeit. f. Elek.," June 1.

Thermo-Regulated Apparatus in Practice.—Mr. Bartholomew, in the "Elec. Eng.," June 19, gives his experience in trying to make a commercial arc lamp, operated by a thermo device in place of the magnet; after spendng three years of time and $20,000 he has come to the conclusion that the thermo-regulated apparatus is commercially impracticable; heat, cold, dust, steam, smoke, miscellaneous fumes, etc., interfere with its operation; he believes that a thermal device cannot replace a magnetic one when responsiveness is requisite.

POWER AND HEAT.

Hydro-Thermoelectric System.—The article by Mr. Gooch (see Digest, June 1) is abstracted in "L'Eclairage Elec.," May 25; he points out the advantages of this system for various purposes; most of these have already been stated in these columns. An installation of 45 kw will be sufficient for welding pieces 25 cm (he probably means mm) in diameter in 40 seconds; in spite of the cost of the energy the cost of welds made by this method contrasts favorably with that of the usual method; he points out the advantages of being able to localize the heat by insulating those parts which are not to be heated; this feature may also be used to advantage in forging, tempering or hardening, in the latter especially when only a portion is to be hardened; he describes its application to wire drawing, drop forging, tempering, cleaning of castings, brazing and electrochemical operations; for tempering, a solution of carbonate of potash in glycerine is used in preference, as the heating is more rapid, more delicate and more easy to control; for the subsequent chilling the same bath is used the current being merely broken; for superficial hardening he suggests the application to the bearings of car axles which are hardened to a depth of about 0.5 mm, also to the edges of axles, hatchets and similar instruments; the electrolyte for this is a solution of carbonate of potash in water, and the voltage should be relatively high for making the operation more rapid. Pieces of conducting metals may also be heated without contact with either of the electrodes, by merely suspending them in the liquid and bringing them near to the negative pole; this is used for small metallic objects. The application of the method in the process of tinning sheet iron has not yet been fully developed; the process is used largely for brazing, especially in the manufacture of bicycles, on account of rapidity; for this the glycerine bath is used and the positive electrode should be changed according to the soldering metal which is used; in this last application the reducing action of the hydrogen forms an important part; in the treatment of minerals the most refractory can be easily melted; all metal can be worked by this process.

Electric Crane at the Port of Havre.—The "Mem. Soc. Ing. Civ." for April contains a very long paper by Mr. Delachanal accompanied by a number of good illustrations; he gives an account, at considerable length, of the comparative tests made with different electric systems each of which is described, the results of the tests being given in detail. Among the conclusions which he arrives at from these tests are the following: when the motors are connected in series (he apparently means series-wound motors) and are provided with a rheostat they are well adapted to the work and have a smooth motion enabling them to be substituted with advantage for local steam engines; motors in multiple (he apparently means shunt-wound motors) are neither as easily applied nor is their action sufficiently smooth to replace steam engines; the large current impulse at starting and the sparking when stopped requires that they be kept revolving continuously; the compound-wound machines approach both of the others without having the advantages of either and they are therefore not to be recommended; the expenditure of energy for producing the same tractive effect is about 40 per cent. greater in series than in the shunt motors. The general results of the investigations are that the cranes themselves are not modified appreciably by the substitution of electric power, but the cost of operation is less if the number of cranes is sufficiently great; the dangers accompanying isolated boilers then no longer exist, those due to freezing are avoided, the whole apparatus is more easily moved and no time is lost in starting the individual fires.

Tri-Phase Transmission Plant.—A brief description of a plant of the Fives-Lille Company is briefly described in "L'Elec.," June 8; the current is transformed up at the sending station by means of transformers; there are a few small motors on the lighting circuits; very little information is given.

Water Power Plant in Japan.—According to "Elec. Friend" (Japan) for April a plant is projected for supplying the city of Osaka with 30,000 hp generated by water power.

Transmission of Power.—Several papers on electrical transmission of power read at the convention of the New England Cotton Manufacturers' Association, are abstracted in the "West. Elec.," June 15. In one by Mr. Rice on "Water Power Development and Its Cost," he gives some data regarding several electrical installations; in a projected plant at Thornton Shoals, Ga., it is expected to develop 14,000 hp and transmit it to Atlanta, a distance of 7.5 miles; the power plant will contain 13 units of 1,000 hp each and two of 500; the entire cost is estimated at $46 per horse-power delivered at the switchboards in the power house; the operating expenses per year are estimated at $4.20 per horse-power. In another proposed plant of 36,000 hp the assumed cost will be $73.97 per horse power and the estimated cost of operation will be $6.09. In another 20,000 hp plant the estimated cost is $46 62 per horse-power, the cost of operation being $4 09 per horse power. In a paper by Messrs. Stone and Webster on "Electric Driving of Textile Establishments" they discuss the subject but give nothing new. In a paper by Mr. Eccles on "Operating by Electricity from a Distance," he gives some details of the operation of the three-phase plant at Taftville. A paper by Mr. Paine on "Electrical Driving of Textile Establishments," a long abstract of which is given, treats the subject in a general way and is intended apparently for non-electrical engineers.

Electric Mine Hauling Plant.—A description by Mr. Sprague of the plant at the Berwind-White Company's colliery, Pennsylvania, is published in the "Eng. & Min Jour.," June 1.

Proposed Power Bridge at Buffalo.—A brief account of the non-electrical features of the projected power plant of Mr. Mather is given in the "West. Elec ," June 15.

Electric Clutch.—The MacDonald clutch is described and illustrated in the "West. Elec.," June 15.

TRACTION.

Belt-line Power Station in Baltimore.—A brief paper by Dr. Duncan, read at the convention of Railway Telegraph Superintendents, is reprinted in the "Elec. Age," June 22 (this is the power house which is to supply the current for the large locomotives). It consists practically of two separate plants, one for power and one for lighting; for power there are four 10-pole generators, compound wound, of 500-kw capacity, at 700 volts, making a total capacity of about 3,000 amperes for traction purposes; the incandescent lighting is done by means of alternating currents, and there are in addition eight arc light machines for 50 lights each. The overhead conductor for the locomotives is described and illustrated; it is an iron trough composed of two bars shaped like the letter Z and supported so as to leave a slot one inch wide between them; a trolley shoe weighing about 25 pounds passes through this slot and slides on the horizontal surfaces of the conductor bars; it is made of brass and is over two feet in length; the overhead structure is suspended by means of two sets of insulators which thus affords a double insulation and it is necessary for both insulators at a point of suspension to be defective, in order to cause a leak; the data for the locomotive is also given.

Trolley Currents and Automatic Signals.—In a brief paper by Mr. Thayer, read at the convention of the Association of Railway Telegraph Superintendents, is reprinted in the "Elec. Age," June 22; he describes a curious occurrence in Chicago on one of the trunk lines in which a block semaphore signal remained in the safety position when a rail was removed, and it was shown to be due to stray currents from neighboring trolley lines; in another case the signal would go to the danger point on the approach of a trolley car and resume the clear position after the car had passed, the trolley current being apparently of opposite polarity to the signal current; examination showed that currents whose potential varied from a half to five volts and in some cases 15 volts, were found to flow in the tracks; he states that one tenth of a volt is sufficient to hold a signal to safety when it is once up and that therefore even a small leak from a neighboring trolley line is objectionable; the only absolute remedy is the double trolley.

Transportation at the Paris Exposition.—The "St. Ry. Gaz.," June 15, publishes a map of a portion of Paris showing the location of the electric belt line which encircles the exhibition grounds, the plans of which road, it appears, have been adopted; it will be about 2.5 miles long, partly on grade and partly elevated; it is expected that electric lines leading to the exhibition will be constructed in the city.

Philadelphia.—The "St. Ry. Gaz.," June 15, begins an illustrated description of the Electric Traction Company's plant in Philadelphia.

Accumulator Traction.—A portion of the article abstracted in the Digest, June 1, is reprinted with some of the illustrations in the "West. Elec.," June 22.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Statistics for Japan.—The "Elec. Friend" (Japan) for April contains an article by Mr. Katogi, in which he gives the following statistics for the end of 1894: number of electric light companies 23, number of 8-cp incandescent lamps 106,160, number of 1,200-cp arc lamps 370; the amount of electric power used was 1,023 hp; at the end of 1892 the number of isolated plants was 51, the number of incandescent lamps of different candle-powers 20,553 and the number of arc lamps 163.

Alternating-Current Practice.—Lond. "Lightning," May 30, contains an interview with Mr. Mordey on "Press, Practices and Principles," chiefly on alternators and alternator current practice.

Three-Wire System.—"El'ty," June 19, contains an article intended to show that this system is no longer necessary, as it is claimed that other and better methods exist; these are described, although not very clearly and in some respects incorrectly. The first system is that used in Vienna and was described by Crompton in a paper read before the Institution of Electrical Engineers (London), Vol. 17, No. 72 and 73 (several years ago), the title being "Central Stations Lighting. Transformers vs. Accumulators" (those desiring a description had better consult this original description); it appears from the present abstract that the system consists in charging a number of different local groups of accumulators in series, each group being then used as an independent source of current for lighting by the usual constant potential system, the regulation of the voltage appears to be accomplished, (as is usual in accumulator systems,) by a number of cells at the end of each group, which cells are switched in and out of circuit in order to keep the voltage constant; in charging they are presumably cut out of circuit as soon as they have received their full charge; the description at present referred to, states that "in each accumulator one terminal is permanently connected to one of the discharge mains and to one of the charging mains" which evidently is incorrect as that would short circuit "each accumulator"; "the other terminal attached to the other mains can be shifted from cell to cell according to the electromotive force required in the corresponding lamp circuit." A description of another well-known system is quoted, in which a single dynamo is used to charge two groups of accumulators in series, which discharge into a three-wire system, the neutral wire being connected to their middle point.

Gas Engine Plant.—A brief, illustrated description of the plant of the Midland Railway Company, at Leicester, Eng., is published in the "West. Elec.," June 22; it is said to be the largest of its kind in England.

Steamship Plant.—A brief, illustrated description of the plant on the steamer *Northwest*, plying on the Great Lakes, is published in the "West. Elec.," June 15.

WIRES, WIRING AND CONDUITS.

Effects of Lightning Discharges on Underground Cables.—In an illustrated article by Dr. Preller, in the Lond. "Elec.," June 7, he describes the way in which the cables are laid through the St. Gothard tunnel and the way in which they are protected against lightning; he describes in detail the recent damage due to lightning and gives several explanations of the phenomenon. The tunnel is about ten miles long; at first the cables were laid in an iron channel eight feet above the rails, but this rapidly deteriorated owing to the action of the gases and water in the tunnel, and they have therefore been transferred to a trench below the tracks; the telegraph and telephone cables were protected with lightning arresters at the terminal stations of the tunnel, the telegraph cables being connected to overhead lines at the ends of the tunnel; the telephone cable is protected at both ends and is a self-contained metallic circuit in the tunnel, completely insulated from the earth, being nowhere connected to overhead wires; in the telegraph cable a fault occurred near the middle of the line and in the other quite near both ends. In the opinion of the makers of the cables there was a simultaneous discharge at both ends, with electricity of the same sign, the two waves meeting midway in the tunnel where the cable was unable to resist the maximum potentials; according to another view an oscillatory and high-tension discharge occurred at one end and its still higher tension midway in the cable coincided with a weak joint in the insulation; but neither of these explain why the arresters failed to act. Mr. Preller thinks the phenomenon was due to a weak discharge and the absence of impedance coils in combination with the lightning arresters; he believes that if the discharge had passed through the cable to the northern end the self-induction of the telegraph apparatus would probably have forced it harmlessly to earth; as to the telephone cable he believes it could be due to either a side discharge, to induction or to an indirect discharge at both ends of the cable; it by no means follows that there was a weak point in the insulation; it confirms Dr. Fleming's observations; he cites experiments by Zielinski as confirmatory evidence; from the results of more than 150 experiments with nine different arresters he prepared a table showing the mean efficiencies obtained, that is, the percentage of the discharge which was forced to earth under varying self-induction of the impedance coils; from this it is seen that even a small self-induction of 0.094 henrys sufficed in all cases to obtain an efficiency of 100 per cent., that is to force the full discharge to earth. His experiments also showed that the efficiency of the arresters was not appreciably affected by the earth-plate resistance even when this was increased to 100 ohms, that the result was probably the same whether the arrester was placed in the main or in a shunt circuit, and that the efficiency of the nine different forms varied only within very narrow limits. The company has replaced all the original lightning arresters by tinfoil safety fuses melting at ¾ to 1 ampere, and by lightning arresters composed of carbon blocks separated by a mica plate 0.3 mm thick ; he believes it to be a question whether impedance coils so placed in front of the lightning arresters as to obstruct the flow of the ordinary current as little as possible would not be preferable to safety fuses; he shows tolerably conclusively that the side-flash phenomenon is not imaginary; that with resistance values such as are generally met with in practice, a very small impedance coil effectually shunts the discharge to earth.

Multiple Cables Insulated with Ropes.—The Clouth system is illustrated and described in the "Elek. Anz.," May 19; several wires run as one cable are insulated from each other by being wound partially with ropes peculiarly knotted so as to keep the wires apart.

Conductor Materials.—Mr. Perrine's serial is continued in "Elec. Eng'ing" for June; he reprints some interesting tables deduced by a [illegible] cts of the addition of one tenth per cent. of various metals to the copper; also tables showing the strength and conductivity of various alloys used for wires for overhead spans; he points out that while the strength and ductility are quite great the general introduction demands a far greater conductivity, strength and ductility than any of those so far investigated; the resistance of pure iron wire is given by the best authorities as 5.95 times that of an equivalent copper wire; this corresponds to 56.03 ohms per mil-foot at 0 degrees C., 4121.6 pounds per mile-ohm or 9,480 in C. G. S. units of resistance per cu. cm. He gives the results of the tests of Mr. Hamilton of some galvanized Swedish iron showing that the best galvanized iron wire used in this country has a conductivity of 96.6 per cent. for larger sizes and 97.3 per cent. for smaller sizes, as compared with that of pure iron, while the breaking strain is approximately 45,500 pounds per sq. in. of iron; an iron wire having 98 per cent. is used in England and has a weight of 4,480 pounds per mile-ohm with a tensile strength of 50,000 pounds per sq. in.; the softest qualities of Bessemer or open-hearth steel do not give better results than 5,000 and 6,000 pounds per mile-ohm with a breaking strength not much over 60,000 pounds, while cast steel of 150,000 and 200,000 pounds breaking strength has a resistance of 16 times that of copper, and weighs approximately 12,000 pounds per mile-ohm; soft steels of 5,000 pounds per mile-ohm are considerably less expensive and their strength and uniformity renders them preferable to common puddle iron which has about the same specific resistance and it is therefore customary to use such steel wire for short telegraph lines in preference to those having a better conductivity.

Danger in Flexible Cord.—In a brief article by Mr. Haskins in the "West. Elec.," June 22, he points out the dangers in the use of flexible cord, which are chiefly that very often a poor, cheap quality is used and that on account of the convenience, it is too often used in place of fixed wires.

Interior Conduit.—A long, illustrated description of the process of manufacturing, and the factory, is published in the "Elec. Eng.," June 19. The tubes are made of sheathing paper which is cut into strips and wound spirally in four layers, on a mandrel, forming a tube, the overlapping part being pasted; after drying for a week it is vulcanized by being immersed for about an hour in the curing compound the basis of which is a bi-product of petroleum called petrolite, which is kept at the boiling point; it is then immersed in another vat containing a mixture (not described) which renders it alkali proof; finally it is rodded to make the bore smooth. That which is to be iron armored is passed into an iron pipe heated up to 300 degrees by steam, the tube being first immersed in a tank of hot insulating mixture; the brass-armored tubes are covered with a strip of brass the ends of which are folded together making a longitudinal lock seam which is claimed to be waterproof.

Telegraph Line Construction.—A paper by Mr. Parker read at the convention of the Association of Railway Telegraph Superintendents, is reprinted in "Elec. Age," June 27; he points out a number of difficulties encountered chiefly in mountainous regions and recommends that the best civil engineers be engaged for the construction of such lines.

ELECTRO-PHYSICS AND MAGNETISM.

Phase Shifting in Electrolysis with Alternating Currents.—The "Elek. Zeit.," June 6, contains a short article by Mr. Peukert. Froelich and Steinmetz have shown that in the alternating-current arc the phase shifting between the voltage and the current is only apparent and not real; in the present article the author endeavors to find experimentally whether the same is true in a voltameter through which an alternating current flows. A voltameter and an inductionless resistance were placed in series; an alternating current of 96 periods was sent through them, the voltage and current curves being measured and plotted; the latter, which are given, show that there is neither a change in form nor a difference in phase due to the voltameter. The experiment was made with acidulated water and platinum electrodes and was repeated with electrodes of platinum wire and with others of carbon, all of which gave the same result. It, therefore, follows that the energy consumed in a voltameter used with alternating currents is equal to the product of the current and the voltage; this was also proved by direct measurement; a result of practical importance is that resistances made of liquids may be used with alternating currents as inductionless resistances. The experiments were repeated with a voltaic arc and showed that while there is no phase shifting, the voltage curve departs very decidedly from the sine form; it rises abruptly then falls very slowly during the greater part of the period and then very rapidly.

Hall Phenomenon.—"L'Eclairage Elec.," June 1, contains an article of some length by Prof. van Aubel, in which he gives a discussion on the subject, rich in references, and describes experiments made by himself. Among his conclusions are the following: the electrolysis of nitrate of bismuth (nitrate acide de bismuth) or of the double tartrate of bismuth and potassium, give adherent deposits on an electrode consisting of a platinized mirror; the resistance of bismuth obtained from the first compound increases considerably in magnetic fields and the thin layers obtained show the Hall phenomenon very decidedly both for continuous and for alternating currents; layers made from the double tartrate do not show the Hall phenomenon; the thin plates of bismuth can be produced by the process which he gives, without difficulty and can be made much thinner than by other methods; the Hall phenomenon as observed with these thin layers of bismuth, forms a very sensitive method for measuring magnetic fields and for this purpose the E. M. F. can be measured by a capillary electrometer or by the method of Fuchs; the Hall phenomenon can also be used for measuring the component of the earth's magnetism in any direction, by using very sensitive galvanometers; bismuth does not appear to follow the law of Kundt, that the velocity of propagation of light in metals is proportional to their electric conductivities.

Vacuum Tube After-glow.—Mr. Palmer, in the Lond. "Elec.," June 7, in reply to a recent communication of Mr. Lomas (see Digest, June 1), gives references to descriptions of the phenomena in THE ELECTRICAL WORLD, Jan. 20 and Sept. 1, 1894, and states that in addition he has collected some data which he gives; the influence machine is better adapted than Ruhmkorff coil; if a 16-cp lamp be held in the hand by the bulb and the base brought near an influence machine the interior will glow and the filament will bend, gradually approaching the side of the bulb and producing the crackling discharge; if the bulb contains some loose pieces of carbon it will have great capacity and if isolated on a table it will glow for eight minutes. He concludes that if a charged body be surrounded by rarefied gas the molecules of gas will be attracted, will receive charges and be thrown off; a relatively small voltage will produce a visible glow.

Cathode and Light Rays.—A French Physical paper by Mr. Curie is abstracted briefly in the Lond. "Elec.," June 7; he describes experiments to find whether light rays were deviated by a magnetic field like cathode rays; he finds there is no deviation in 20 cm in a strong field; although he does not think these experiments are conclusive proof that cathode rays are different from those which constitute light, yet he believes they tend to show that there is some difference.

Electric Discharge Through Gases.—A Royal Institution lecture by Prof. J. J. Thomson is reprinted in the Lond. "Elec.," June 7; he describes and discusses some phenomena connected with the passage of electricity from the gas to the electrode and *vice versa* and some properties of a discharge when its course lies entirely in the gas; several of the experiments have already been described in these columns.

Sound Produced by Thermic Radiation.—The Lond. "Elec. Eng.," June 7, mentions briefly a paper by Mr. Semmola, from the "Comptus Rendus," (no date given) in which he shows that intermittent solar light focussed on the gilded metallic plate, 2 mm thick, of a Hunnings microphone, produces a distinct sound in a telephone connected with it, the intensity of which increases with the frequency, and it is greater when the plate is covered with smoke black; there is no sound when the light passes through non-thermo substances; the point of light should be hot enough to carbonize paper.

An abstract of a paper by the same author and which appears to be similar to the one from which this is taken, is published in the "Elec. Rev." (N. Y.), June 19.

Telephones and Earthquakes.—According to the Lond. "Elec. Eng.," June 7, Prof. Estrada, of Mexico, suggests the use of the telephone with a grounded return circuit for foretelling earthquakes in volcanic regions; he suggests making a microphone in the form of a pendulum suspended on a thin spiral wire so arranged as to close a magnetic circuit with the slightest motion; he proposes to connect the central observatory with the base of the volcano Popocatepetl, grounding it in one of the deepest cracks and connecting the other end with a deep artesian well. He believes that eruptions and earthquakes may thereby be foretold many days in advance.

Electric Conductivity and Convexion in Poorly Conducting Dilute Solutions.—A paper by Mr. Warburg from the "Wied. Ann.," 54, p. 396, is abstracted in the "Elek. Zeit.," June 6.

Electric Oscillation of Short Wave Length.—Prof. Righi's long serial is concluded in "L'Eclairage Elec.," May 25.

General Solution of Maxwell's Equations for an Absorbent, Homogeneous and Isotropic Method.—A paper by Mr. Berkeland from the "Comptes Rendus," 120, p. 1041, is reprinted in "L'Eclairage Elec.," May 25.

Influence of Electric Waves on the Resistance of Conductors.—"L'Eclairage Elec," May 25, contains a short note by Mr. Branly claiming priority of discovery.

Atmospheric Electricity on the Ocean.—"L'Elec.," June 28, gives a summary of a recent article by Prof. Magie, in the "American Meteorological Journal."

Magnetic Surveys of the United Kingdom.—A short paper by Prof. Rücker is reprinted in the Lond. "Elec. Eng.," June 7; he gives briefly a description of some of the results of the survey made by himself in 882 places in Great Britain and Ireland. In regard to local disturbances he found that the north pole of the needle is attracted to certain regions and lines which can be traced for even hundreds of miles, the underlying strata of which are known to be non-magnetic for great depths. Regarding the relation of the lines of disturbances to the location of the principal coal fields he states that the results do not give any countenance to the view that the magnet can be used for the discovery of coal. He shows that dykes and thin uniform basaltic sheets produce no measureable effects except at distances from their edges which are small multiples of their thickness; isolated masses of trap rock a few square miles in area produce no important effects at distances comparable with their dimensions; the view commonly held that faults affect the needle may in some cases have some foundation in fact.

Magnetization of Iron in Very Weak Fields.—A paper by Mr. Schmidt, in the "Wied. Ann.," No. 4, 1895, is briefly abstracted in the Lond. "Elec.," June 7, and "Phil. Mag." for June. In fields up to 0.06 C G. S. units the susceptibility for iron and steel is constant; steel follows weak forces more easily than iron; the susceptibility of soft steel in weak fields is greater than that of iron; for fields of about one unit their susceptibilities are about the same while for greater field strengths that of iron is the greater; 0.06 C. G. S. unit is the upper limit for which the susceptibility remains constant.

Magnetization of Iron Cylinders.—A second article by Mr. Grotriam, from the "Wied. Ann.," 54, p. 452, is abstracted in the "Elek. Zeit.," June 6. It has been claimed that the circular magnetization of hollow iron cylinders, as used in practice in iron-clad transformers, is not dependent upon the thickness of the iron; in the present paper he gives the results of experimental determinations made to investigate this; two hollow cylinders of the same size but different thicknesses were used, the primary and secondary coils being threaded through them; he finds that the thickness made a very great difference. He also experimented with longitudinal magnetism of hollow and solid cylinders of the same outside diameters placed in a magnetic circuit, and finds that for low degrees of saturation the flux in the magnetic circuit remains unchanged.

Influence of Magnetization on the Constant of Elasticity in Iron.—The results of researches by Mr. Bock, published in the "Wied. Ann.," No. 3, 1895, are briefly summarized in the "Phil. Mag." for June, as follows: by magnetization the constants of elasticity of soft iron, the modulus of torsion, and the modulus of elasticity are certainly not altered by more than ½ per cent.; the series of observations indicate that the flexure diminishes; at the same time the torsion seems also to diminish, while the ratio of the lateral contraction to the longitudinal expansion increases; iron is more incompressible in the magnetic field; nothing can be alleged with certainty as to magnetized steel bars.

Electromagnetic Attractive Force.—The results of some experiments given in an article by Mr. Weber, in the "Wied. Ann.," No. 1, 1895, are briefly given in the "Phil. Mag." for June. An iron wire of great length compared with its diameter, one end of which is in a magnetic field parallel to the lines of force, experiences a pull in the direction of its length, which per sq. cm of cross-section is equal to the product of I and $\mathcal{H}$. If the lines are at right angles to the axis the attractive force at right angles to the lines of force is smaller than that just given; the ratio of the former to the latter, which, with mean strengths of $\mathcal{H}$ equal 100, is greater than 100, rapidly decreases as the field increases and appears to approach unity.

Magnetic Strains.—The Lond. "Elec. Eng.," June 7, refers briefly to a Royal Society of Edinburgh paper by Mr. Knott and Mr. Shand on the volume changes which accompany magnetization in iron and nickel tubes.

Analogies of Magnetic and Optical Phenomena.—An article by Mr. Collischann is begun in the "Zeit. fuer Elek.," June 1; he points out analogies between polarized light and three-phase currents; it is mathematical in character.

Permeability of Russian Irons.—The "Zeit. fuer Elek.," June 1, translates from the Russian a paper by Mr. Chatelin in which he gives the results of measurements made of a number of Russian irons and steels which were determined by the Hopkinson and the Thompson methods; the permeability seems somewhat high.

Iron.—"Elec. Eng'ing" for June contains an article by Mr. Summers on the chemistry of pig iron and its application for electrical purposes; it deals chiefly with the effects of the usual impurities on the mechanical qualities, and refers briefly to their effects on the magnetic qualities.

ELECTRO-CHEMISTRY AND BATTERIES.

Bleaching Process.—A process invented by Dr. Kellner is briefly described in the Lond. "Elec. Eng.," June 7. The apparatus consists of a pair of rollers, one iron and the other carbon, between which a current is passed; the cotton cloth to be bleached is saturated with brine and runs, in company with an endless felt blanket also saturated with brine, between these rollers; the felt being in contact with the iron roller receives the caustic soda which is formed, delivering it into a tank filled with salt water; the chlorine liberated at the carbon roller accumulates in the cotton fabric which remains rolled up for some time before it is washed; whether the process has already found practical application does not appear.

Electromotive Force from Thermo-Chemical Data.—A paper read at the German Electro-Chemical Society by Mr. LeBlanc is abstracted briefly in the Lond. "Elec.," June 7. He discusses the common method of calculating the E. M. F. from known electro-chemical data as described by Thomson, and shows the objections to it; cases were discovered in which the agreement between theory and experiment was not satisfactory; he believes that it holds good only when the E. M. F. is quite independent of the temperature as in the Daniell cell and a few others; he shows how the equation can be modified so as to take into account the change of temperature.

Equivalence of Mercury and Copper in Electrolytes of Different Concentration.—An article of some length by Dr. Bolton is begun in the "Zeit. fuer Electrochem.," June 5; he describes experiments which are intended to determine whether certain salts, especially those of mercury and copper, have the tendency, in solutions of different concentrations, to form ions of different equivalence; for measuring the current he uses a mercury voltameter in preference, a description of which is given.

Helmholtz Electrochemical Theory.—The "Phil. Mag.," for June contains a short communication by Prof. Richarz in which he points out some conclusions deduced from this theory and makes some deductions regarding the electrical atom.

Researches on Polarization.—The Lond. "Elec. Rev.," June 7, abstracts briefly an article by Mr. Roszkowski, in the "Zeit f. Phys. Chem.," 15, p. 267 and 305 describing some interesting experiments with solid and liquid cathodes.

Ozone and Nitrous Compounds—.The Lond. "Elec. Rev.," June 7, contains a short article by Mr. Andreoli in which he quotes numerous authorities regarding the production of nitrous compounds during the generation of ozone from air by means of the electric discharge. He believes that the production of nitrous compounds has been greatly exaggerated and without any ground; he has made careful researches in publications and is unable to find any experiments showing either the percentage of nitrous compounds or their noxious influence on persons breathing ozonized air; his own experiments have shown him that there is no danger in ozonized atmospheric air and he believes it may be taken for granted that if after so many years no deleterious effects have been cited, ozone is not only safe but healthful and beneficial.

Theory of Electrolysis.—The "Electrochem. Zeit." for June contains an article by Prof. Bucherer; it appears to be similar to, though not a translation of the article by the same author in THE ELECTRICAL WORLD, Feb. 2., p. 138.

Commercial Zincate of Potash by Electrolysis.—An article by Dr. Schoop, from the "Zeit. f. Elec. u. Electrochem.," 6. p. 205 and 347, is abstracted in the Lond. "Elec. Rev.," June 7; he describes a process for making this material for the Lalande primary and secondary batteries. The apparatus consists of a copper vessel with a cylinder of spongy copper within which there is a zinc cylinder resting on a layer of magnesia, which keeps the two out of contact; the liquid consists of a solution of caustic potash, is kept stirred and is heated to about 60 degrees; the copper is first made the anode after which the current is reversed; the liquid thus obtained is freed from its impurities by electrolysis in a separate vessel with zinc electrodes and a porous diaphragm of magnesia.

Baths for Nickel Plating.—The Lond. "Elec. Rev.," June 7, gives a number of baths used in German factories, all of which are said to give excellent results when they are carefully handled.

Metallurgy of Gold.—Several processes including those of Siemens & Halske, Keith, McArthur-Forest and others are briefly described in an article by Mr. Rogers in "Elec. Eng'ing" for June.

Electro-Metallurgy.—A summary of the recent paper by Mr. Moissan, mentioned in the Digest, May 25 and June 1, is published in the "West. Elec.," June 15.

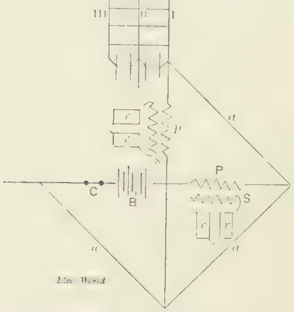
Reduction of Refractory Metals.—The "West. Elec.," June 15, reprints an abstract of Prof. Roberts-Austen's lecture mentioned in the Digest, June 8.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring the Mean Spherical Intensity of Sources of Light.—The article by Prof. Blondel, mentioned in the Digest, April 13 and May 18, is continued in "L'Eclairage Elec.," June 1; he discusses three new methods for replacing the tracing of the photometric curve by a single operation; they all depend on the same principle; the light is placed at the centre of an opaque sphere having one or more openings through which a definite fraction of the total flux of light passes and which is then concentrated at a single point by apparatus which he calls lumen-meters, the difference between these constituting the difference in the methods. After discussing the properties of diffusion by transmission and reflection he describes and gives the theory of the various methods; in one of these a reflector is placed behind the light embracing a certain fractional part of all the rays emitted by the light, and directs them on to a translucent screen, the direct rays being prevented from reaching the screen; the light on the opposite side of this screen is then measured by a photometer and is a measure of that part of the total flux of light which is intercepted by the mirror; the reflector may for simplicity embrace all the light which passes on one side of a plane through the source, that is, just one half of the flux, and instead of passing it through a translucent screen it may be thrown on a white diffusing surface the illumination of which is then measured by a photometer; in practice these methods are exact only if the loss in each of the reflected rays [illegible] but this is not the case; in practice the only reflector which [illegible] made of silvered glass; to climate the error due to the different losses in the reflection of the different rays, he devised the lumen-meter which was described in the Digest, April 13 (see also May 4 and June 8), and in which only a zone of rays is reflected, the angles of incidents of which are nearly constant for all the rays.

Measuring Luminous Flux.—An interesting paper by Mr. Ray is reprinted in the "Bul. Soc. Int. des Elec." for May, being devoted to the measurement of mean spherical illumination in general and in particular to the ingenious instrument of Prof Blondel mentioned in the abstract above. He calls attention to the importance of being able to measure the total luminous flux, or quantity of light, as it is sometimes incorrectly called; the value of the total flux is an important quantity to know in dealing with the illumination of a light in a closed space or room; the usual method is to measure the light in different directions and plot the curve, from which the total flux is then calculated; in the method of Prof. Blondel the mean illumination in a number of different directions represent a definite fraction of the whole surrounding spherical surface, and is measured in one operation; the mirror used in the above-mentioned apparatus is a zone of an ellipse and its surface represents one tenth of that of the whole surrounding sphere; the total flux is therefore 10 times that measured; with this instrument he finds that one lumen will be equivalent to about 0.003 cp on the screen; the total flux in lumens, of an arc light for different currents and carbons, is given, that for 10 amperes, 43 volts with carbons 21 and 13 mm in diameter is 6,660 lumens, and for the same lamp with six amperes it is 1,000, while with 30 amperes it is 16,260. Several photographic reproductions are given of the luminous spots on the screen. In conclusion he describes a much cheaper apparatus in which the expensive mirror is replaced by a frustrum of a cone whose apex has an angle of 100 degrees, the inside surface being covered with a white paper having a dull surface; this takes the place of both the reflector and the diffuser, the light from it being measured directly by the photometer; the opaque sphere, surrounding all but a definite portion of the space around the source, is used as before; the illumination measured by the photometer under these conditions is approximately proportional to the flux measured; the apparatus is naturally much less exact than the preceding one, but it can be used to great advantage in practice. He also suggests the use of a zone of a parabolic mirror.

Measuring the Insulation Resistance of an Installation While Running.—The "Elek. Zeit.," June 6, reprints a long paper by Dr. Froelich in which he gives a mathematical discussion of the Wheatstone bridge when not balanced, and of ohm-meters, concluding with a description accompanied by illustrations, of the apparatus and of a method of measuring the insulation resistance by means of an instrument which gives the value directly. The ohm-meter used is the usual type in which there are two coils perpendicular to each other, acting on an iron needle, one of them generating the directing field and the other the deflecting field; when the installation is not in use this instrument may be used directly; when the installation is in use the arrangement shown in the adjoining figure is used; it is a Wheastone bridge arrangement in which the fault forms one of the branches, the two other branches a and a are equal while the fourth n is made 1, 10, 100, etc., ohms; one of the diagonals contains the battery, B the contact C, and an induction apparatus P the coils rr of which form the directing coils of the ohm-meter; the other diagonal contains a similar induction apparatus the coils of which form the deflecting coils of the instrument; a different scale must be used for each resistance inserted in the branch n; the contact C must be periodically opened and closed in such a way that the circuits of the battery branch and that of the other branch are opened and closed alternately and not simultaneously (from this it appears that there ought to have been another contact in the other diagonal; the description is not as clear as might be desired); this contact is operated by an electric motor running at constant speed; the induction apparatus in the battery circuit may be omitted. It appears that variations in the voltage of the lighting circuit affects the results quite materially, but in the large station in Berlin these variations were not important. He enumerates the following as the novelties in this method: The insertions of the directing coils of an ohm-meter in one of the diagonals of a Wheatstone bridge and the deflecting coil in the other when there are no E. M. F's. in that circuit whose resistance is to be measured; and the measurement of this resistance by means of the "ratio of the variations of the current in the two diagonal branches in combination with an induction apparatus and a galvanometer with two coils perpendicular to each other," when there are E. M. F's. in the circuit to be measured.



Electrical Inspector's Laboratory.—The English journals, June 7, contain illustrated descriptions of the laboratory of the Electrical Inspector to the City Commissioners of Sewers; the most complete description and the one containing the best illustrations is that in the Lond. "Elec. Rev."; the duties of this inspector are published in the Lond. "Elec. Eng."; those for which the laboratory is required are chiefly the calibration of volt, ampere and supplying meters. For alternating-current work there is a special transformer connected with the street mains, having three secondary windings two of which can be made to increase the voltage by two-volt steps; Kelvin balances are used, also Ferranti non-inductive resistances, illustrations of which are given, which enable the current to be regulated by tenths of an ampere up to 500 amperes; they are made of five vertical copper rods surrounded concentrically by German silver wires of different lengths, dipping into mercury cups at the bottom, which can be raised or lowered by hand, connecting these resistances in multiple.

Electrical Measurement of Starlight.—An abstract of a preliminary report to the Royal Society by Prof. Minchin is published in the Lond. "Elec.," June 7. He describes the method used for measuring the intensity of light from stars and planets which consists in the determination of the E. M. F. generated by this light in certain photo-electric cells, the square of this E. M. F. being proportional to the energy of the light; the surface of these cells is formed by depositing a thin layer of selenium on a surface of clean aluminum and immersing this in oenanthol; the seat of the E. M. F. is the contact surface of the liquid and the selenium, the latter receiving a positive and the former a negative charge; the experiments are said to prove conclusively that there is little difficulty in obtaining fairly accurate measurements of the light of stars of the first and second magnitudes even without a large telescope; there appears to be a surprising agreement between the photo-electric and the photo-metric determinations of the magnitude of a star.

Standard Resistances for Strong Currents.—The "Elek. Zeit.," June 6, reprints in full with illustrations a short paper by Dr. Feussner describing the new standard resistances of the Reichanstaldt for measuring large currents at the terminals of a known resistance, an abstract of which appears in another column.

Measurement of Temperatures by Thermo-electric Couples.—An article of some length by Messrs. Van Aubel and Paillot is reprinted in "L'Eclairage Elec.," May 25. It describes experiments made with constantan couples by the Fuchs method; their conclusions are that the E. M. F. of a constantan-iron couple is 53.86 microvolts per degree centigrade between 0 degrees and 98.9; this couple is preferable to others as it can be used to measure the temperature at a small point when great sensitiveness is necessary; the curve of the E. M. F's. approaches very closely to a straight line and between certain points it can be considered as such.

Lecture Apparatus.—A simple and ingenious apparatus is described and illustrated in the "Zeit. fuer Elek.," June 1; it consists of a diagrammatic drawing of a dynamo with spaces occupied by the wires and commutator cut-out, behind which rotate discs so arranged as to give an optical imitation of the flow of the current; the description is somewhat incomplete.

Measuring Magnetic Fields.—See above under "Hall Phenomenon."

TELEGRAPHY, TELEPHONY AND SIGNALS.

Fac-simile Multiplex Telegraphy.—A recent paper by Dr. Cerebotanti is briefly abstracted in the "Elek. Zeit.," June 6. He describes a fac-simile telegraph based on right-angular co-ordinates with the introduction of two polarized relays in the receiver, with a common elbow-joint lever operated by a variation in the intensity of the current by means of which the third wire, which in the Gray telautograph is required for raising and lowering the pen, is therefore rendered unnecessary. He also described an ingenious combination of local circuits with relays at the transmitter, which avoids sending the currents for the two co-ordinates simultaneously and which enables them to be sent successively thereby obtaining a means of operating a fac-simile telegraph with only one wire. He also described a Morse quadruplex telegraph without synchronism, the main factor of which is an interrupter at the sending station, whose object is to interrupt the sending currents which vary in direction and strength so that one impulse follows the other in the form of four alternating impulses, thus necessitating the use of only a single wire. This is practically all the information given in the abstract. In the discussion Mr. Bieringer expressed the belief that there was nothing gained in using variations in the current strength in place of a synchronous apparatus, as experience has shown that apparatus depending on current variations are greatly affected by the insulation resistance of long lines.

Telephone Installation in Stuttgart.—The "Elek. Zeit.," June 6, contains the first part of a long and well-illustrated description by Mr West, of the station in Stuttgart, including a number of illustrations of the details; the installation was completed in April, 1894

Telephone Switchboard for Central Station.—A well illustrated description of one made by Naglo in Germany, is published in the "Elek Zeit.," June 6

Telephone Switches Used in Antwerp.—An illustrated description is published in "L'Eclairage Elec.," May 25.

Accumulators in Telegraphy.—A paper on "Electrical Accumulators," by Mr. Stewart, read at the convention of the Association of Railway Telegraph Superintendents is reprinted in the "Elec. Age," June 22. He describes briefly the plant at the New York terminal of a railroad in which 72 accumulators were substituted for 238 gravity cells, 70 of the cells, having a capacity of 12.5 ampere-hours, are for working the lines, and two of 150 ampere-hours for the local circuits consisting of 21 sounders; the cost of maintaining the gravity cells for one year was more than enough to purchase the storage battery plant; it seems to be working very satisfactorily. In conclusion he refers briefly to the use of accumulators in lighting and for trolley lines.

Relative Cost of Telephone Service to the User..—"Elec. Eng'ing" for June contains an article by Mr. Deland in which he discusses in detail the relative cost of the service in large and small exchanges. In large exchanges about 100 times as many subscribers are reached and about 10 times as much service is actually rendered; in a town having 100 to 200 subscribers about one mile of line is used when two subscribers are talking while in Chicago the average length of line actually used for each conversation is nearly four miles.

Sound-Amplifying Telephone.—The Nikolajczuk system is described and illustrated in the "Elec. Rev.," June 19; it appears to consist of a sort of telephone relay; the transmitter currents "vary the internal resistance of a separate source of electricity, which in turn transforms the current variations into telephonic vibrations"; it appears to be an adaptation of Mr. A. G. Bell's original liquid transmitter to operate as a relay.

MISCELLANEOUS.

Influence of Telephone Wires on Atmospheric Electricity.—From a brief note in "L'Elec.," June 8, and "L'Eclairage Elec.," May 25, the German government telegraph department have collected some statistics in order to determine the influence of networks of telephone wires in cities on the atmospheric electricity, in order to find out whether the dangers from lightning are increased or diminished; the results showed that the presence of telephone wires tends to diminish the "violence of the thunder" (*sic*) and to diminish the dangers from lightning; in 340 cities there were telephone wires and in 560 there were none; in these two cases the damage done by lightning varied in the proportion of 1 to 4.6; the mean number of lightning discharges per hour of storm, was five for the villages without telephone wires and three for the others.

Mechanical Principles of Electrical Engineering.—A long address by Mr. Ransom is reprinted in the Lond. "Elec. Eng.," beginning with June 1; he recommends electrical engineers to give adequate attention to the principles of mechanical engineering; most of the present portion is devoted to a discussion of iron from the mechanical engineer's standpoint, an elementary discussion of the transformation of energy, the testing of some engines and boilers, and to refuse destructors; regarding the latter he says it may be fair to assume that the average refuse in English towns can never evaporate as much as 3.5 pounds of water per pound of refuse; for poorer refuse he gives 1.1 pound of water as the average.

Electric Organs.—A brief description of the one used in St. George's church in London is given in the Lond. "Elec. Eng.," June 7.

Vulcanized India Rubber.—The specifications for the Russian navy are published in the "Zeit. fuer Elek.," June 1.

Tubular Poles.—A form of composite pole made in Germany, consisting of iron tubes and resembling those used in this country, is illustrated and described in "L'Elec.," June 8.

Royal Society Transactions.—The catalogue mentioned in the Digest last week appears with the issue of the "Phil. Mag." for June.

Electric Organ.—An illustrated description of the one used in Steinway Hall, Chicago, is published in "West. Elec.," June 22.

Electric Railways in Japan.

Russia is just now placing large shipbuilding and machinery orders in France; but Japan does not seem to recognize help from Great Britain in a similarly substantial manner, for German papers announce that the Allgemeine Elektricitäts-Gesellschaft has received a commission from Tokio for electric railway material to the value of several thousands of pounds, and the placing of a second large contract with the same firm is reported as pending.

Zickler's Universal Electrodynamometer.

In a letter to the London *Electrician* Mr Karl Zickler discusses the subject of electrodynamometers in reply to a criticism on an instrument devised by himself. Referring to the conditions which an instrument for measuring potential has to fulfil and which have to be considered in the construction of the same, he says they are comparatively easy to comply with when the instrument is only intended for measuring potential. In the case of the electrodynamometer here considered, however, the conditions take the following form: If, first of all, mirror-reading is supposed, then the watt loss and the influence of the self-inductance can be made very small. In direct-reading electrodynamometers, torsion electrodynamometers and electrodynamic current weighers, it is easily possible to bring the maximum watt loss down to about 0.1 watt for every volt of the potential to be measured. As an instance of this is mentioned the centi-ampere balance of Lord Kelvin, when used as a voltmeter. Again, the influence of self-inductance in potential measurements of alternating currents can, with medium periodicity, be easily confined to a small percentage of the potential to be measured. An instance of this is the astatic potential dynamometer of Siemens and Halske, which, with alternating currents of 50 to 80 periods per second, show only 2 to 3 per cent. difference in the readings for continuous and alternating currents.

Considerably greater difficulties are caused in this direction when it is required to construct an instrument which, besides potential measurements, also permits of measuring current and electric power (watts) between very wide limits. One is generally obliged to make larger concessions with regard to watt loss and the influence of self-induction. In the composite balance of Lord Kelvin, which serves for current, potential and watt measurements of continuous current, there is a maximum watt loss of 0.5 watt for every volt of the potential, though this instrument has no conductor for large currents in the movable coil, but requires an auxiliary current to be taken through the movable coil when measuring big currents.

The result attained by the Zickler instrument of a maximum loss of 0.4 watt per volt of the potential is therefore better than the result of the above-mentioned universal instrument, the more so when one considers that even the biggest currents are conducted through the movable coil, and no auxiliary current is required.

The most unfavorable feature in the universal instrument, as compared with a simple potential electrodynamometer, is the greater weight of the movable coil, which consists of a copper frame of 35 square millimetres, and 60 turns of a wire 1.2 millimetres thick. This requires, in order to attain a certain sensibility, a powerful spring, and therewith likewise the turning moment is settled, which the current-carrying coil has to exercise upon the movable coil. Having settled upon a suitable maximum for the voltmeter current, then the product $m_1 \times m_2$ of the number of turns of the fixed and movable coils will have a certain value. Theoretically speaking, then, other conditions being the same, the self-inductance of the coils is smallest when the sum of the turns $m_1 + m_2$ is a minimum. This is the case when $m_1 = m_2$. To get near this favorable point in practice without increasing the weight of the movable coil, the same can be made of *aluminium* instead of copper. An instrument of this kind is in course of construction, and, owing to the increase of windings of the movable coil and the decrease of the windings of the fixed coil, more favorable results in potential measurements of alternating current in respect to self-inductance will be arrived at, so that, for instance, at the same torsion angle the variation between the readings for a continuous current (600 volts) and alternating current at 100 periods should no longer be 50 per cent. (900 volts), but only 2 to 3 per cent. At the same time the watt loss in the instrument will become smaller. In future, therefore, all instruments will be so constructed that the influence of self-inductance and the watt loss of the instrument will be confined within the desirable limits. This universal instrument should therefore be of great service to electricians in all those cases, which often occur, where no suitable instrument for the special measurement in hand is at their disposal.

French Submarine Cables.

A despatch from Paris on the 7th inst. says that strenuous efforts are being made by the French colonial party to force the government to introduce an extensive system of submarine cables, in order to avoid having to depend upon the English lines in case of war, a necessity which is declared to be a great national danger. It is now stated that considerable opposition will be offered before the budget committee to the renewal of the subventions paid to the English cable companies, of which the principal are the Spanish Submarine Telegraph Company, 1,700,000 francs a year for the cable to Senegal; the Eastern Extension Company for Saigon and Tonquin 300,000 francs, the African Direct Telegraph Company for the west coast of Africa 300,000 francs, and the Eastern Telegraph Company, the short line from Obock to Berlin, 37,500 francs. It is contended that this money should be devoted to founding French cable companies.

Enamel Rheostats.

[illegible] motor-starting rheostats have recently been put on the market by the Carpenter Enamel Rheostat Company, of Hoboken, N. J., which contain some very meritorious features. One type, known as spring starting rheostats, are so made that the contact lever cannot be left by the operator upon any intermediate contact. In addition to this feature of protection against burning out the rheostat, a recent invention of Mr. H. Ward Leonard is introduced, by which, while all the current needed for the motor can be secured, it is impossible for an excessive current to flow through the rheostat, which so frequently occurs with such devices in the hands of unskilled or careless operators. The Carpenter Company claims that it is practically impossible to burn out the new spring starters except by deliberately trying to do so.

A second type of rheostat just marketed by the company is the Leonard automatic rheostat. This rheostat is so constructed that if, from any cause, the current through the motor exceeds a certain predetermined amount, the circuit is instantly opened by a light, quick-moving snap switch. This affords a perfect protection against overload under any and all conditions. The most familiar causes of burn out which this prevents are the cutting out of resistance too rapidly, and a resulting rush of current through the motor; the application of too great a load when the motor is running, and the interruption of the central-station current followed quickly by a resumption of service after motor has come to rest. It is claimed to be impossible to do any harm to either the motor or rheostat under any of these conditions. The arrangement is such that after the safety device has operated and opened the circuit it is necessary to insert *all* the resistance of the rheostat before the circuit can be again closed through the motor or rheostat.

A third style of rheostat the Carpenter Company is offering is the Ball automatic rheostat. In this device, if the current fails, the circuit is instantly opened without inserting the resistance. Then the resistance must be inserted by hand before the motor can receive any current. The controlling magnet for this rheostat is not in series with any part of the motor, and hence has no effect upon its speed or efficiency as former similar types have had.

Electric Lighting in the Orient.

The new electric light station being erected at Shanghai, China, by the municipal council has been designed to combine a striking exterior with internal adaptability to the purposes for which the edifice is intended, being similar to the new electric light station at Cleveland, O. The building throughout is constructed of blue and red brick, and the engine house measures 116 feet in length by 35 feet in breadth, and 25 feet in height. The chimney is 130 feet high, with an internal diameter of 7 feet.

It is intended to install no fewer than 14 compound-horizontal surface-condensing engines. The dynamos for arc lighting are by the Brush Company, of Cleveland, O., and the alternators, switches, transformers and such instruments are the work of the Brush Company, of England. The boiler house will contain three Lancashire boilers, each measuring 7 feet by 28 feet, and capable of sustaining a working pressure of 140 pounds. There will also be two locomotive boilers working at the same pressure.

In the City of Manila, Phillippine Islands, a large new electric light station has just been completed, all the work here being done by the Brush Company, of Cleveland.

Automatic Telephone Exchange.

An interesting demonstration of the perfected automatic telephone exchange system invented by Mr. Romaine Callender is being given daily at the Decker Building, Union Square, New York. The system has been considerably simplified since its description in THE ELECTRICAL WORLD last January, the numeralizers and numerical separators having been abolished, and their functions combined and performed by the numerical receivers. Broadly, the system comprises signaling apparatus at each subscriber's station by which the number desired is set in to the central station, where it is registered by an instrument designated as the numerical receiver. A circuit selector then makes connection between the calling circuit and the circuit whose number has been sent in, and signals both sub-stations. When conversation is finished a clearing-out signal is sent in by either subscriber, and the circuit selector restores both lines to their original condition.

The system is a percentage one, cross-connections and numerical receivers being furnished for 10 per cent. of the total number of subscribers, which statistics show to be about the maximum proportion of telephone exchange circuits that are in use simultaneously. The arrangement is exceedingly ingenious, and was operated repeatedly on last Thursday with unvarying accuracy.

Electric Lights in Dutch Guiana.

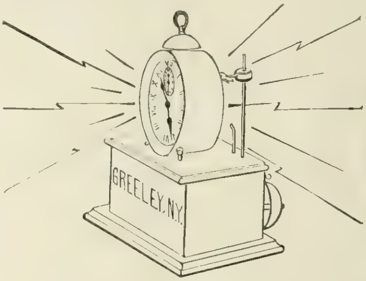
The local authorities of Paramaribo have been approached by a company with a scheme for the electric lighting of the town, and a committee appointed to inquire into the matter has decided in favor of electricity.

Some New Specialties.

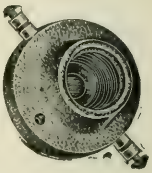
Electric alarm clocks have now become quite as common as the ordinary mechanical alarm clock was formerly. Owing to the fact, however, that the cheap popular clock of the so-called "nutmeg" pattern is liable to serious derangement by any attempt to provide for electrical contacts in its works, attempts have been made to produce a device that could be used in connection with any of the various styles of circular alarm clocks now on the market without any attempt to make electrical connections thereon, and this seems to have been accomplished by an inventor who has put his work into the hands of The E. S. Greeley & Company, 5 and 7 Dey Street, New York, who are now manufacturing it.

The device consists simply of an ornamental battery box provided with an electric bell and a time ball. The time ball is hung upon the alarm key of the clock, the turning of which upon release of the alarm drops the ball and completes the circuit, the bell continuing to ring until the ball is raised. The accompanying cut fairly illustrates the attachment.

The waterproof lamp socket shown in the accompanying illustration has been recently put on the market by the Fiberite Company, of Mechanicsville, N. J., for whom The E. S. Greeley & Company is New York agent. The insulating material is the well-known Medbery composition, and is pressed in shape around the metal parts under enormous pressure, so that moisture cannot penetrate between the binding posts and the insulating body. For outdoor work such as illuminated signs, store-front decoration, etc., these sockets are especially suitable, and they are also useful for work in breweries and other damp interiors. The sockets are furnished to fit any of the standard lamp bases.



ELECTRIC CLOCK ATTACHMENT.

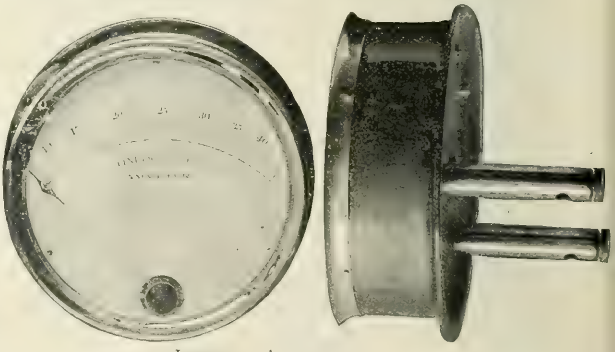


INSULATED WALL SOCKET.

New Iron-clad Volt and Ampere Meters.

We illustrate herewith the most recent production of the Whitney Electrical Instrument Company, Penacook, N. H., in the way of switch board ammeters for direct currents. As will be seen from the engraving, the instrument is of the familiar circular-case form which has become so generally liked throughout the trade, and it is provided with rear lugs for connecting behind the board.

These instruments are guaranteed accurate within 1 per cent., and are encased in iron so as to obviate interference from extraneous sources and to allow the instruments to be placed as near each other as may be desired without exerting mutual influence. They are handsomely finished in black enamel with nickel trimmings, and fully come up, in design, workmanship and material, to the high standard characteristic of the product of this company. The voltmeter is identical, in principle and appearance, with the ammeter, both being designed to meet the great demand for an inexpensive yet reasonably accurate and wholly reliable instrument for switchboard service.

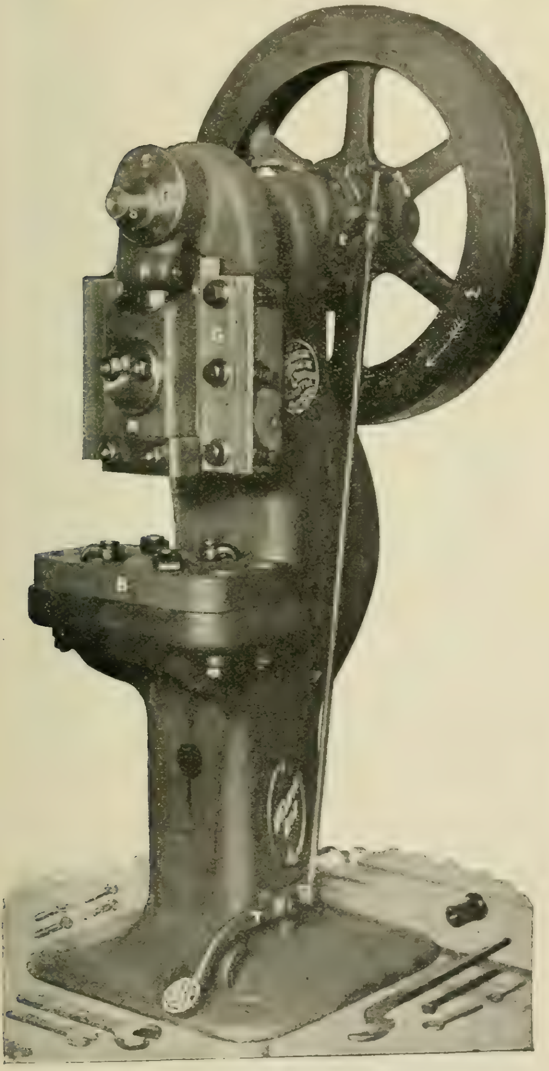


IRON-CLAD AMMETER.

Power Presses at the Westinghouse Works.

Among the special machine tools which the Westinghouse Electric & Manufacturing Company have had furnished for its new plant at Brinton may be mentioned a heavy power embossing press built by the Ferracute Machine Company, of Bridgeton, New Jersey. This machine is made unusually wide and high to suit the purposes for which it is used. Two vertical columns rising from either side of the bed take the tensile strains, each column being six by nine inches in section, and the two being capable of withstanding a stress of some two or three million pounds.

This company has also furnished a number of its regular presses, there being eight new cutting presses in use. These presses have large beds, and are adapted for cutting and forming sheet metal work in great variety but are especially useful in cutting and punching such work as armature discs and other sheet metal parts of electrical goods which are comparatively thin but have large area. These machines can be used either upright or inclined, the centre of oscillation being so placed as to keep the centre of the dies at approximately the same height, whatever the inclination of the press. The distance from bed to ram is unusually high, and the adjustment of the ram is about double what it is on other styles of presses, thus allowing considerable variety in the height of dies. The heads of the bolts which hold the bolster to bed of press are sunk into the bolster, thus giving a wide flush surface on which to rest the lower dies. These presses will cut and form rectangular sheets 10 by 14 inches in size, or round ones 14 inches in diameter.



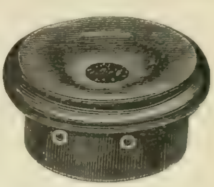
Heavy Punching Press.

Several punching presses are also in use in the Westinghouse Works, one of which is shown by the accompanying engraving. As the metal to be handled by these presses is thicker than sheet iron, and as the work is usually of small diameter the depth of throat and width of bed is less than is the case with cutting presses while the general construction is heavier. The design in regard to correct proportion and symmetrical appearance speaks for itself, the metal being put where it will give the most strength for the least weight, and the harmony of proportion being secured by unbroken surfaces, flowing curves and heavily rounded corners. The motion is conveyed to the ram *R*, by a pitman, *P*, with a graduated threaded rod passing through the fulcrum pin, while the connection with the shaft *S* is by means of an eccentric, *E*. Other eccentrics giving a greater or less stroke can be substituted when desired. One of these punching presses has been equipped with an indexing attachment adapted for automatically punching the notches on the periphery of motor discs, the machine being designed to take in any diameter and punch any number of notches up to a certain limit.

All of the Ferracute presses have automatic clutches with tripping devices adjustable around the axis of the shaft and arranged so that the shaft cannot make more than one revolution by one action of the treadle. The fly wheel contains several steel jaws so that the operator only has to wait a portion of a revolution for the clutch to act when the treadle has been depressed, the time thus saved being quite considerable in the course of a day.

Improved Watch-Form Telephone Case.

The accompanying engraving shows a new telephone receiver case, of the watch case type, which is being placed on the market by the Electrose Manufacturing Company, 214-218 William Street, New York. While the general shape and design of the receiver case are not novel, there are several meritorious features embodied in its construction which are worthy of consideration. The cap of the case is so shaped as to fit over the ear perfectly, so as to exclude all foreign sounds. Another improvement consists of an almost imperceptible beveling of the rim of the case upon which the diaphragm rests, the outer edge being the slightest bit higher than the inner edge of the rim, so that the diaphragm is clamped firmly at its outer edge and without any buckling tendency. The inner face of the cap where it clamps the diaphragm is ground perfectly smooth and true so as to contribute to the result just mentioned.

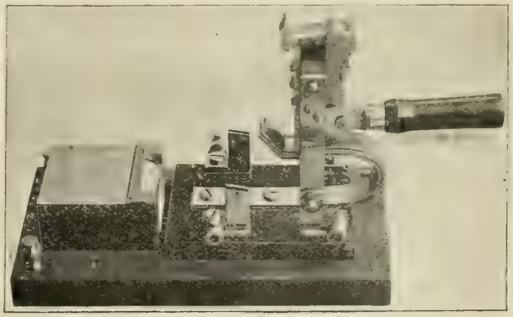


Telephone Shell.

The material of which the case is constructed—Electrose—is peculiarly suitable for this purpose in that it is impervious to moisture, and, therefore, cannot warp or swell and thus alter the inter-relation of the various parts.

An Emergency Switch.

An ingenious application of the familiar electric door-opener principle is embodied in the emergency switch herewith illustrated, which is manufactured by Edwards & Co., at 144th Street and Fourth Avenue, New York. The cut is practically self-explanatory. A strong spring constantly tends to open the switch, which, when closed, is held by a spring latch. This latch is adapted to be withdrawn by a magnet whose circuit may be controlled by a push button or switch located at any desired point—near the generator or engine, for instance—so that in case of trouble the circuit which the switch controls may be instantly opened without taking time to get to the switchboard. Numerous applications will suggest themselves to all engineers who are familiar with the exigencies frequently arising in the operation of electrical installations.



Emergency Switch.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

ELECTRICAL STOCKS appear to have anticipated the regulation summer apathy [illegible] days, the entire list being practically devoid of life or interest.

EDISON ELECTRIC ILLUMINATING, of Brooklyn, on Wednesday held a special stockholders' meeting and increased its capital stock to $3,750,000. The directors were authorized to issue $500,000 additional bonds for the purchase of the Citizens' Company's capital stock and making extension.

AMERICAN BELL has remained almost stationary notwithstanding a faint effort to make capital of the retirement of certain Western Union people from the Philadelphia directorate by suggesting that this move was preliminary to the wholesale entry of the Bell Company into telegraph work. The true inwardness of the matter, as given by high authority, is that the American Bell Company bought {a controlling interest in the Philadelphia local company, among the holdings transferred being some which the Western Union parties had previously controlled.

BALTIMORE TRACTION continues strong above 20. While the reported deal between this company and the City & Suburban Company, of Baltimore, is not an accomplished fact, there was some ground for the rumor, though President Brown said not—in a perfunctory kind of way. The consolidation was suggested by certain City & Suburban interests, though no specific proposition has been made, and the prevailing opinion in traction circles is that the consummation of the deal depends only upon the terms which may be proposed.

ELECTRICAL STOCKS.

	Par.	Bid	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	101	101¾
“ “ “ Brooklyn	100	..	108
“ “ “ Boston	100	129	130
“ “ “ Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	29	30
General Electric	100	35⅞	36
General Electric, pref	100	..	65
Westinghouse Consolidated, com.	50	36	36½
“ “ pref	50	52⅝	..

BONDS.

	Par.	Bid	Asked.
Edison Electric Ill., New York	100	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co. deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

	Par.	Bid	Asked.
American Bell Telephone	100	..	205
American District Telegraph	100	30	40
American Telegraph & Cable	100	96	..
Central & South American Telegraph	100	117	120
Commercial Cables	100	159	..
†Erie Telephone	100	58	58½
Gold & Stock Telegraph	100	105	
New England Telephone	100	74	74¼
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63½	
Western Union Telegraph	100	92	92⅛

ELECTRIC TRACTION STOCKS.

	Par.	Bid	Asked.
Baltimore Traction	25	20⅝	20⅞
Binghamton RR. com	100	100	..
Brooklyn Traction	100	15	16
“ “ pref.	100	..	53
Buffalo St. Ry	100	84	91
Cleveland City Ry.	100	68	70
Cleveland Electric Ry.	100	59	60
Chicago City Ry	100	305	315
Columbus St. Ry	100	48½	..
Consolidated Traction of N. J.	..	26	30
Electric Traction, Philadelphia	50	..	75
Hestonville	100	58	58⅞
Long Island Traction	100	12¾	13¼
Louisville St. Ry. com.	100	37	39
“ “ “ pref.	100	87	88
New Orleans Traction	100	20	22½
“ pref.	100	69	71½
North Shore Traction	100	28	32
“ “ pref.	100	81½	86
People's Traction $30 pd.	25	61⅝	61⅞
Philadelphia Traction	50	83⅛	83½
Rochester St. Ry	..	38	.
Union Ry. (Huckleberry)	100	112	115
West End, Boston	100	71¼	72
“ “ pref	100	..	92
Worcester Traction	100	17	19
“ “ pref	100	83	87

BONDS.

	Par.	Bid	Asked.
Buffalo St. Ry. 1st con. 5s	100	106	108
*Binghamton Railroad Co. 5s	100	99	100
*Columbus St. Ry. 1st 5s.	100	104	..
Rochester St. Ry. 1st. 5s.	100	95	97
*Union Ry. 1st. mtge 6s.	100	105	108
*Westchester Electric 1st. mtge. 5s.	100	98	101

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* With accrued interest.

† Ex-Div.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD
253 BROADWAY, NEW YORK, June 24, 1895.

STOCKHOLDERS' MEETING.—A meeting of the stockholders of the Electric Illuminating & Power Company, of Long Island City, has been appointed for July 1, for the purpose of increasing the capital stock from $50,000 to $150,000.

LIGHTS FOR OCEAN BOULEVARD.—The Brooklyn aldermen have decided to put electric lights on Ocean Boulevard from Prospect Park to Coney Island, and voted last week to make a contract for the lights for a term of three years. The lights will greatly reduce the danger attendant upon traveling the boulevard after dark.

TROLLEY CAR TOOK A HEADER.—Mount Vernon trolley car 102, while traveling at the rate of 12 miles an hour Friday night, jumped the track, and, striking a trolley pole, took a header into a ditch where it stood on end. The passengers were shaken up, and the conductor lost a pocketful of change. No one was badly hurt. It is said that the switch was tampered with by residents who oppose a trolley line.

NANTASKET'S ELECTRIC LINE.—The test of an electric locomotive last Friday night on the Nantasket Beach branch of the New York, New Haven & Hartford Railway has caused quite a ripple of excitement in railway circles, and premature suggestions are rife concerning the abolition of steam on the main lines, and kindred absurdities. The test was thoroughly satisfactory, the speed attained being estimated at 60 miles an hour, and the control of the motor car being complete and reliable. The car was equipped with the Westinghouse air brake, and all the standard appliances now in vogue.

OVERHEAD WIRES IN WALL STREET.—The District Attorney was requested last week by Amos J. Cummings and Col. Henry S. Kearney, of the Board of Electrical Control, to lay before the Grand Jury the proceedings of several persons who are violating the subway law by stringing private wires overhead in and around Wall Street connecting brokers' offices. The wire use is very small copper wire, covered with dark green silk, which makes it almost invisible from the street. The wires are put in for $15 a month, and are used for transmitting stock quotations and other messages from one broker's office to another. Assistant District-Attorney Battle, who has charge of the matter, said the wires were not connected with the Stock Exchange. The Board of Electrical Control has been after the violators for some time, and has cut down a number of the wires

THE EDISON COMPANY WINS.—A suit was on trial last Wednesday in the Court of Common Pleas before Judge Bookstaver, brought by W. Preston Hix against the Edison Electric Light Company to recover $45,000 as commissions for the organization of the Edison Electric Light Company of Philadelphia. The basis of his action is founded upon an agreement which was entered into on Feb. 23 1886, with the Edison Company, by which Mr. Hix was to organize a company with a capital stock of $1,000,000, for which he was to receive 15 per cent. of the capital stock and 5 per cent. additional should any further increase be made in the capital stock. A company was organized in February, 1887, and, pursuant to agreement, Hix received $150,000 of the stock. Subsequently the stock was increased on several occasions until the increase amounted to $750,000. He now demands his commissions on this increase. The defence of the company was that in April, 1892, Hix signed a general release of all claims. The court decided in favor of the defendant.

RAILWAY TROUBLE IN JERSEY.—The directors of the Jersey City, Hoboken & Rutherford Railway have been trying for several months to obtain permission from the Hoboken Common Council to run their cars through Hoboken to the ferry. At present the road runs through Jersey City to the Hoboken line, where it stops. On Thursday there were happenings which seem to indicate that a scheme to outwit the authorities has been entered into by the Rutherford Company and the North Hudson County Railway Company. The latter company has a section of road from Paterson Avenue to Ferry Street, which was used by them before the elevated tracks were erected. The idea was for the Rutherford Company to run their cars over this line and thus get a clear road to the river. This piece of road has not been used in more than a year. On May 22 the Common Council passed a resolution ordering the North Hudson Company to tear up these tracks, but no notice was taken of it. At Thursday's meeting the matter was again brought up and a committee was appointed to wait on Manager W. H. Starr and inform him that the tracks must be taken up. They were told by him that the company would not do so, but, on the contrary, would at once commence running cars over the line. At 7 o'clock Friday morning Street Commission Baye, with a gang of men began tearing up the tracks. In a few minutes a car made its appearance, and shortly afterward several others came along. The drivers drove along over the stones where the tracks had been removed, but desisted after one or two trips. No effort was made to prevent the tearing up of the rails.

LONG ISLAND TRACTION AFFAIRS.—The Board of Directors of the Long Island Traction Company at a meeting last week elected Henry Seibert and Colonel T. S. Williams to fill the vacancies caused by the resignation of E. W. Bliss and the death of William Marshall. Colonel Williams was elected secretary and treasurer in the place of W. A. H. Begardus. President Daniel F. Lewis tendered his resignation, but action was deferred until next meeting. Clinton L. Rossiter, asst. supt. of the western division of the New York Central, has accepted the presidency of the Brooklyn Heights Railway, and will take Mr. Lewis's place on July 1. The plans for reorganizing the Long Island Traction Company which is the lessee of the Brooklyn Heights road contemplate the formation of a new company which will assume the lease, assets, and liabilities of the old company; the formation of a new company with $20,000,000 common stock, to be exchanged for Long Island Traction stock on certain conditions; the issue of $6,000,000 of bonds to run ten years, and pay 6 per cent. interest; the levying of a 10 per cent. assessment on the stock of the Long Island Traction Company; the collateral notes to the amount of $1,800,000 which are mainly held by the Flower syndicate, to be taken up on Aug. 6, when the one year's option will expire; the guaranteeing by an underwriting syndicate to the new company the full payment of the assessment and full subscriptions to the stock. These plans will be approved in a few days by the directors and then submitted to the stockholders. It is reported that Chauncey M. Depew may be a director in their organized company.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
ROOM 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., June 22, 1895.

THE MASON REGULATOR COMPANY, of Boston, has removed its offices to 6 and 8 Oliver Street that city.

FORBES & GLIDDEN, electrical and chemical engineers, of Boston, have removed their offices to the new Worthington Building, 31 State Street. Their testing department will be continued at 620 Atlantic Avenue. We congratulate this young firm on the business recognition it is receiving and which it justly deserves.

MR. ARTHUR D. NEWTON, the popular and efficient secretary of the Eddy Electric Manufacturing Company, of Windsor, Conn., was united in marriage, June 12, to Miss Gertrude Hyde, of Hartford. We join with the many friends of Mr. Newton in wishing for him and his charming bride a life of uninterrupted happiness and prosperity.

THE FIFIELD TOOL COMPANY, of Lowell, Mass., which about a year ago succeeded to the old-established lathe manufacturing business of Mr. Geo. W. Fifield, of that city, carries in stock constantly all parts of lathes from 17 to 64 inch swing and is prepared to furnish at short notice, in fact immediate delivery, anything that may be desired. The lathe manufactures of this company are too well known to require any special comment, and the fact that they can be had quick and at prices comparing favorably with other manufacture should be an inducement worthy consideration.

THE IRESON RUBBER COMPANY, 97 High Street, Boston, is at present making a big reputation for its excellent manufacture of "Blue Blood Packing," and testimonials are constantly being received endorsing it in the strongest terms. This packing is used in all kinds of steam joints, ammonia joints, hydraulic pumps, and in fact any place where any kind of packing has ever been used or is necessary. The manufacturers are placing it on the market in very large quantities all over the United States, and are more than pleased to subject it to the most severe tests, which they solicit. In the hundreds of cases where this packing is being used the first complaint is yet to be received.

THE GRAHAM EQUIPMENT COMPANY, of Boston, reports business as very good. Mr. Graham's new equalized brake gear in connection with the excellent trucks manufactured by this company seems to be attracting universal and favorable attention. As is now pretty well known, this new brake gear enables the motorman to stop the car easier and quicker loaded than when empty. Formerly, as the truck was loaded the shoes went lower down on the wheels, decreasing their efficiency. Now they travel upward and occupy better position, and the motorman has a quick-acting positive brake. Only a little while ago the Graham Company made good shipments of trucks to Butte, Mont., Tampa, Fla., and Bangor, Me., and have made recent shipments to Atlanta, Ga., Jackson, Tenn., and Huntington, W. Va. The mail is bringing constant inquiries, and the energies of Mr. Graham and Mr. Gardner, of this company, are being very agreeably taxed at present.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, June 17, 1895.

TELEPHONE TRUNK WIRES.—The Lord Mayor of London held a conversation to-day with the corresponding functionaries of the two other capitals of the United Kingdom, namely, Edinburgh and Dublin, over the new telephone trunk wires which have been run up by the Postoffice in anticipation of the increased telephonic trunk business likely to accrue in consequence of the taking over of the telephone trunk system of this country by the Department. I may say that the total mileage of wire in the new Postoffice network amounts to over 10,000 and the weight of copper to nearly 3,000 tons. A quarter of this mileage is of 800-pound wire and about half of 600-pound wire, the balance running to 400 pounds per mile. The circuits are all on the twisted system and, in addition, where a large number of circuits are of the same pole, the twisted circuits are crossed at intervals.

BOARD OF TRADE REGULATIONS.—The revised Board of Trade regulations for insuring the safety of the public have, I am glad to say, been thoroughly discussed by a committee of the Institution of Electrical Engineers, by the Electrical Trade Section of the London Chamber of Commerce, and by a meeting of Borough Electrical Engineers. Central station managers, of course, propose extremely drastic modifications, their recommendations being in most cases of the nature of excisions. Although, no doubt, this course is largely justified by the generally academic and stringent nature of the regulations, such a way of dealing with a powerful government department is, of course, scarcely diplomatically correct, and not to be recommended if any modification whatever is wished for. I may say that there is every probability that the three bodies I have mentioned above will join in a common representation to the Board of Trade.

THE USES OF ACCUMULATORS.—An [illegible] "The Uses of Accumulators" was recently read before the [illegible] of Electrical Engineers by Mr. J. C. Howell. The paper [illegible] the saving effected at a certain American [illegible] accumulators. Most of the speakers in the discussion were ready to admit the advantages of the judicious use of accumulators, but many of them doubted whether such a saving would be effected in this country [illegible], are in the habit of more carefully keeping our machines fully loaded. Several speakers went so far as to suggest a [illegible] in connection with an alternating-current supply; the accumulators being used for exciting the alternators and for driving motor alternators during the hours of light load or heavy demand, the accumulators being charged by a rectified current from an alternator.

General News.

NEW INCORPORATIONS.

THE MILWAUKEE ELECTRIC MANUFACTURING COMPANY, Milwaukee, Wis., capital stock $8,000, has been formed by John E. McKivitt, Mathias Weisser and others.

THE NEODESHA TELEPHONE COMPANY, Topeka, Kan., has been incorporated by G. N. Bandy and W. I. Pierce to establish a telephone system. The capital stock is $5,000.

THE CHATHAM ELECTRIC LIGHT, HEAT & POWER COMPANY, Chatham, N. Y., capital stock $10,000, has been organized by J. F. Farrell, of Albany, H. M. Francis and J. O. Carr, of Schenectady.

THE JACOBSON-BLOSSER ELECTRIC COMPANY, Portland, Me., capital stock $200,000, has been incorporated with C. B. Jackson, of Boston, as president, and Alfred Prince, of Quincy, Mass., as treasurer.

THE ERIE REED PARK & LAKESIDE STREET RAILWAY COMPANY, of Erie, Pa., has been incorporated. Those interested are Chas. M. Reed, F. G. Curtze and Harry L. Moore. The capital stock is $50,000.

THE ERIE & EASTERN STREET RAILWAY COMPANY, Erie, Pa., capital stock $25,000, has been incorporated by Harry L. Moore, F. F. Curtze and C. M. Conrad, of Erie, Pa., to build an electric railway in that city.

THE NORTH TRUMBULL RAPID TRANSIT COMPANY, Warren, O., has been incorporated for the purpose of constructing a passenger and freight electric railway from Farmdale to Mesopotamia, a distance of 20 miles.

THE BUFFALO, GARDENVILLE & EBENEZER RAILWAY, Gardenville, N. Y., has been incorporated by Charles Schoepflin, Gardenville, Jacob Kissinger, C. H. Lamy and E. C. Shafer, of Buffalo, N. Y. The capital stock is reported as $40,000.

THE HALL ELECTRIC POWER & REDUCTION COMPANY, Des Moines, Ia., capital stock $500,000, has been formed by Thurston Gordon Hall, Robert H. Laird and Thurman Miles Hall, of Buffalo, N. Y., to manufacture and deal in electrical appliances.

THE UTICA & HERKIMER STREET RAILWAY COMPANY, Utica, N. Y., capital stock $30,000, has been formed to build and operate an electric railway three miles long. Those interested are D. S. Foster, G. E. Dennison, and B. A. Rogers, of Utica, N. Y.

THE WASHINGTON & TYLERDALE ELECTRIC LIGHT & POWER COMPANY, capital stock $1,000, has been incorporated at Washington, Pa., to supply light, heat and power to the public. J. P. Black, John W. Vester and John H. Murdoch are the promoters.

TELEGRAPH AND TELEPHONE.

CLARIDON, OHIO.—The Electric Telephone Company has been incorporated with a capital stock of $2,000.

DETROIT, MICH.—The Detroit Telephone Company has been incorporated with a capital stock of $10,000.

NORFOLK, VA.—The Southern Electric Service Company is petitioning for a franchise to construct underground conduits for a telephone system, etc.

OCEAN GROVE, N. J.—The Asbury Park Mutual Telephone Company, of which Washingon White is president, has been granted the right to construct a line in Ocean Grove. Work will be begun at once.

CRANFORD, N. J.—The Township Committee of Cranford has promised a franchise to the New York & New Jersey Telephone Company as soon as the property owners' consents for the erection of poles have been obtained.

ELECTRIC LIGHT AND POWER.

WINDOM, MINN.—An electric light plant is to be established.

REYNOLDS, GA.—F. C. Goodwin is in the market for incandescent dynamos.

WILLMER, MINN.—Steps are being taken to establish an electric light plant.

SUMMERVILLE, S. C.—F. W. Wagner can supply information as to the proposed electric lighting plant.

COLUMBUS, ALA.—George L. Campbell can give information regarding the projected electric light plant.

DURAND, ILL.—M. Wilson, of Chicago, has been granted a 30-year franchise for a $10,000 electric light plant.

DILTON, MONT.—Matthew Orr has petitioned the Council for a franchise to construct an electric light plant.

WESTMINSTER, MD.—The Westminster Electric Light Company is putting in a 50-light dynamo and other machinery.

[illegible]SON, GA.—The Mayor will give information concerning the contemplated establishment of an electric light plant.

PORT TAMPA, FLA.—Work will begin at once on the erection of a large phosphate elevator to be operated by electricity.

WATERFORD, ONT.—Fitzgerald & Sauerman, P. O. Box 12, are in the market for an alternator of 500 or 750 lights capacity.

WORTHINGTON, MINN.—The city authorities have voted to issue $15,000 bonds for the construction of an electric light plant.

HALLETTSVILLE, TEX.—A new electric light plant is to be established. It will include a 900 light dynamo and an 85-hp engine.

FERGUSON, MO.—Downs & Ashbrook have about completed their electric light plant, for which they were recently granted a franchise.

OCEAN CITY, MD.—The Warfield Manufacturing Company, of Baltimore, has been awarded the contract for lighting the city by electricity.

MATTOON, ILL.—The city authorities are contemplating an increase in the electric lighting equipment in the immediate future. W. E. Tower is electrician.

LANSINGBURGH (P. O. TROY), N. Y.—A special election will be held July 1 to determine whether or not $13,000 shall be raised for lighting the streets by electricity.

GUTHRIE, O. T.—J. S. Brown, owner of the Guthrie Electric Light & Power Company, is in the market for additional equipment for 50 arc and 1,200 incandescent lights.

BROOK HAVEN, MISS.—F. F Becker and others have organized a joint improvement company to establish an electric light plant, etc. The capital stock is given at $200,000.

TOLEDO, OHIO.—The ordinance has been passed granting permission to the Toledo Consolidated and the Toledo Electric companies the right to operate a system of underground wires in said city.

WAPAKONETA, O.—The village wishes sealed proposals for the furnishing and erection of one 1,000-volt alternator having a capacity of 1,500 16-cp lamps, with exciter, one switchboard, with all station instruments, 80 transformers of assorted sizes, 500 52-volt 16-cp lamps with 500 key sockets. Also the construction of two separate circuits, on electric poles now standing in the village, from the power house to centre of distribution, a distance of about 2,900 feet.

THE ELECTRIC RAILWAY.

LOUISVILLE, KY.—A movement is on foot to build an electric line from Louisville to Fairfield.

WATERLOO, IOWA.—An electric street car line to connect Waterloo with Cedar Falls will probably be built.

BUFFALO, N.Y.—A project is on foot for an electric railway to connect Buffalo and Olcott on Lake Erie, via Williamsville, Swampsville and Lockport.

WEST SUPERIOR, WIS.—The Superior Rapid Transit Company is about to make extensive improvements in its system. S. T. Norvell is general manager.

BUFFALO, N. Y.—Buffalo capitalists have a project on foot to build an electrical road to Gardenville, to be called the Buffalo & Gardenville Electric Railway.

DALLAS, TEXAS.—The Dallas Rapid Transit & Terminal Company has been organized by B. S. Watham, A. F. Hardie and others, to build an electric road in said city.

ERIE, PA.—It is reported that a company has been formed to build an electric street railway from Erie to North East. Frank L. McLaughlin, of North East, is interested.

MILFORD, VA.—It is reported that a company will be organized to build an electric road from Milford to Bowling Green, in Carolina County, a distance of about six miles.

HOBOKEN, N. J.—A petition for a franchise to the Jersey City, Rutherford & Hoboken Railway Company has been made to Council Chairman Timken of the City Council.

BELAIR, MD.—The narrow gauge tracks of the Baltimore & Lehigh Railway and the York Southern will shortly be converted into a standard gauge road and probably electrically equipped.

ST. LOUIS, MO.—E. J. Thurman, W. D. Waters, and J. B. Clayton, of Fenton, Mo., have been granted a charter to construct and operate a double track electric railway from St. Louis to Morse Mill, a distance of 35 miles.

BLOOMFIELD, N. J.—The Bloomfield Township Committee has passed the ordinance granting a franchise to the Consolidated Traction Company for a trolley road on Bloomfield Avenue, between Newark and Bloomfield.

PITTSBURG, PA.—Mayor McKenna has signed the ordinance granting permission to the Central Traction Company to extend its line to the East End, by the way of Aliquippa and Melwood Streets and Centre and Begley Avenues.

LONG BRANCH, N. J.—Application has been made to the Township Committee of the township of Ocean, Monmouth County, by the Atlantic Coast Electric Railway Company for the construction and operation of a street railway.

MILFORD, MASS.—Money to build the proposed new street railway from South Framingham, through Holliston to Milford, has been pledged and the agreement to operate the road has been signed. Charles W. Shippee is interested.

WASHINGTON, D. C.—The Washington & Great Falls Electric Company has been granted permission to issue $500,000 in bonds to build its road. The line is about six and one half miles long and the trolley system will be used. The president is Stilson Hutchins.

CICERO, N. Y.—The Syracuse & Oneida Lake Electric Railway Company has made application for consent to construct, maintain and operate by animal power or electricity, a street surface railway, with necessary sidings, etc., along certain streets in this town.

STEVENS POINT, WIS.—The Stevens Point Electric Lighting Company has been given another year in which to begin the construction of an electric street railway under its franchise. By Sept. 10, 1896, it must have at least three miles of road completed, or forfeit $2,000.

BEVERLY, MASS.—W. B. Ferguson, Charles A. Richardson, N. E. Martin, A.B. Bruce, N. Sumner Myrick and Frank J. Perkins have petitioned to the Board of Aldermen for location of tracks with the necessary turnouts for the Gloucester, Essex & Beverly Street Railway Company.

BEAVER FALLS, PA.—A company is being organized to build an incline railway to Paterson Heights, a suburb of Beaver Falls. H. M. Meyers, John Reeves and other local capitalists are the principal movers in the enterprise. It will be 1,500 feet in length and operated by electricity.

ST. JOSEPH, MO.—The first step in the building of an electric line to St. George has been taken by the St Joseph Traction & Lighting Company. The company agrees to commence work within 90 days after the passage of the ordinance and have the road completed within six months thereafter.

WARREN, O.—The citizens of Mesopotamia, Green, Bloomfield, Gustavus and Kinsman have, under the name of the North Trumbull Rapid Transit Company, applied to the County Committee for a franchise to construct and operate an electric passenger and freight railway between Farmdale and Mesopotamia.

PERSONAL NOTE.

MR A. E. KENNELLY has received from the Western University of Pennsylvania the degree of D. Sc., in recognition of his work in the theory of cable faults, for his researches in magnetism and alternating currents, and for his application of complex qualities in alternating-current work.

MISCELLANEOUS NOTES.

AN EDISON PATENT SUSTAINED.—Edison's patent granted Feb. 17, 1880, for "Method of Preparing Autographic Stencils for Printing," was sustained last week by Judge Acheson, sitting for the District of New Jersey, a final decree being entered in favor of the Edison patent awarding an injunction and accounting. The device of this patent has been put upon the market by Edison's exclusive licensee, and has become known as the Edison mimeograph.

THE NEW YORK ELECTRICAL SOCIETY, at its annual meeting, held on June 18, elected the following officers: President, John W. Lieb, Jr.; vice-presidents, Herbet Laws Webb, Edward Caldwell, Francis Forbes, Nelson W. Perry, Prof. L. H. Laudy and Prof. Morris Loeb; secretary, George F. Guy; treasurer, H. A. Sinclair. The secretary's report for the year shows a net increase in membership of 20. The number of members now on the books of the society is 370. Although last year the average attendance showed a marked improvement on the preceding year, during the season just concluded the society has had most gratifying evidence that the lectures have been even more thoroughly appreciated than ever. The range of subjects has been wide and in almost every instance the society has been fortunate in an able and exhaustive treatment of the theme selected. Some of the best lectures promised are still on the programme for next season, and will in all probability be delivered at an early date.

Trade and Industrial Notes.

A HEALTHY GROWTH of business during the past 12 months is reported by J. Jones & Son, 67 Cortlandt Street, New York, who have just finished their inventory and taken a balance from their books for the year.

SATISFACTORY SETTLEMENT has been made by Chas. E. Chapin with his creditors, and Mr. Chapin will resume business at once at 136 Liberty Street, New York, as manufacturers' agent, with an attractive line of specialties.

G. C. WOOLVERTON has sold out his interest in the Woolverton Electric Company, of Rahway, N. J., and has established a new business at 327 Washington Street, Buffalo, N. Y., where he is prepared to repair electrical apparatus of every description.

THE KNAPP ELECTRIC & NOVELTY COMPANY, 47 Warren Street, New York, reports an extremely good business in battery motors. Practical apparatus, judicious advertising and the reputation of the goods aid the dealers in selling large quantities of these outfits.

M. E. SANGER & CO. is the style of a new firm of model makers, instrument makers and general electrical manufacturers, with headquarters at 106 Liberty Street, New York. The new firm has ample facilities for doing experimental and special work in the best manner.

FULL TO OVERFLOWING is what the Dayton Fan & Motor Company, of Dayton, Ohio, reports as being the condition of its order book. The factory has hard work to keep up with orders, and the company is much gratified to have appreciation of its apparatus expressed in this manner.

DIEHL & CO., 385 Broadway, New York, report the receipt of many orders for their new ceiling fan, for which is claimed increased efficiency, giving a saving of about 25 per cent. of current usually required; improved mechanical construction, and a new oiling device insuring perfect cleanliness.

B. J. LAUNIERE, formerly secretary of the Grand Rapids Machinery & Electric Company, was recently engaged as traveling salesman by the Metropolitan Electric Company, 186-188 Fifth Avenue, Chicago. Mr. Launiere is well liked by the trade and is meeting with great success in the sale of electrical supplies.

EXTENSIVE NEW WORKS are now being constructed by the Sessions Foundry Company, Bristol, Conn., on a large tract of land near the railway. When the new works are completed the company will have unsurpassed facilities for producing the best grade of castings in almost any quantity. It is expected that the works will be completed in the fall

ANOTHER DESIRABLE SPECIALTY has been secured by the Electric Appliance Company, Chicago, due notice of which will be given in the near future. The specialty is a staple article for which there is a big demand, and its control and sale in the West by the Electric Appliance Company, who will carry a large Chicago stock, will give that concern quite an advantage.

TO HANG A MAN would not require nearly so much rope as was recently sold by the C. W. Hunt Company, 45 Broadway, New York, to the Niagara Falls Hydraulic Power & Manufacturing Company for a rope drive which necessitated 2,550 feet of rope. The Hunt Company furnished its special "Stevedore" brand, which is made particularly for transmission purposes.

A WINDMILL LIGHTING PLANT has recently been installed at the residence of Mr. W. E. C. Eustis, Milton, Mass., containing a storage battery of 1,000 ampere hours capacity furnished by The Bradbury-Stone Electric Storage Company, of Lowell, Mass. The battery is of the very latest type in lead lined wooden tanks. The plant is the second largest installation of this character in America.

A RIVAL OF THE GRAVITY BATTERY.—The Gordon primary battery, now being placed on the market as a substitute for the gravity battery, is strongly endorsed in a recent letter from Mr. W. M. Kinch, the assistant superintendent of signals of the N. Y. C. &. H. R. railway, as the result of a severe test extending over five months of railway signal work. He states that the battery has three strong features in particular—simplicity of form, low internal resistance and standing up under the severest short circuits. The battery is manufactured by the Gordon-Burnham Battery Company, 82 West Broadway, New York.

THREE HUNDRED CONTRACTS and more have been closed by The Electrical Maintenance Company, 50 Broadway, New York, for the maintenance of electric lighting and power plants, electric elevators, etc., in office buildings, factories and central stations; and its business is rapidly assuming large proportions, notwithstanding the company has only been organized about five months. W. J. MacConnell, long and favorably known to the electrical trade, is general manager of the company.

THE NEW CONGRESSIONAL LIBRARY at Washington, D. C., will have a very complete plant when finished. Crook, Horner & Co., of Baltimore, representatives of the Ball Engine Company, Erie, Pa., are installing in the building three 175-hp Ball engines, direct-connected to Mather dynamos. The Ball Engine Company has also sold the city of Galveston, Texas, a "Ball" automatic engine for direct-connection to a Western Electric dynamo, and has secured the contract for the engines to be installed in the new Security Building, St. Louis.

AN ORNATE CATALOGUE is being distributed by the Electric Launch Company, Morris Heights, New York, in which are described launches of every type; yacht tenders, fishing and hunting launches, cruising launches, etc. The equipment is described in detail. An interesting feature is the controlling device, the hand wheel of which is located just in front of the steering wheel, the spindles of the two being concentrically disposed. The catalogue possesses only one disadvantage: the reader is seized with a strong desire to immediately forsake work and take an outing in one of these beautiful little craft.

MOST OF THE LEADING MANUFACTURERS in this country use Carpenter rheostats exclusively, and quite a number of the prominent foreign manufacturers, such as Crompton & Co., of London; Ludwig Loewe & Co., of Berlin; Brown, Boveri & Co., of Switzerland; Union Electricitats Gesellschaft, of Berlin, and many others less well known over here, are ordering these rheostats regularly and in increasing quantities. The Carpenter Enamel Rheostat Company, of Hoboken, N. J., reports a demand for these goods which has kept the factory running overtime for several months past.

THAT TIRED FEELING is an unknown quantity with H. B. Coho & Co., 203 Broadway, New York, who are always on the move for business. Among numerous other contracts this firm has closed the following during the past six weeks: 80-kw multipolar generator for Broadway Central Hotel, New York City; 15-kw multipolar generator for Hotel Vandyke New York City; 30-kw generator for Schnoering Apartments, West Ninety-fourth Street, New York; 45 hp generator for Henry R. Worthington, Elizabethport, N. J.; [illegible] hp and [illegible] hp motors for Alexander Chamberlain Electric Company; [illegible] multipolar generator for Paterson, N. J.

MUNICIPAL LIGHTING PLANTS.—It has frequently been stated that city lighting plants are few in number, of [illegible] installation and fast disappearing from sight, but the number of sales made to municipalities by the Standard Electric Company, of Chicago, would indicate the reverse. During the past few months this company has installed nearly a dozen municipal lighting plants, among them one for the city of Springfield, Ill., having a capacity of [illegible] arc lamps; and one each for Logansport, Ind.; Paducah, Ky.; Fulton, Mo.; Jamestown, N. Y., Harrisonville, Mo., Independence, Ia., Willoughby, Ohio, Kearney, N. J., and Chesaning, Mich.

GEORGE A. McKINLOCK, president of the Central Electric Company, Chicago, is a visitor in New York this week. Mr. McKinlock reports an exceptionally brisk business for the summer months and is particularly well satisfied with the large number of Lundell Fan Motors sold. Mr. McKinlock can properly claim to be one of the pioneers in the electrical industry, having been connected with telephone interests for a considerable time previous to the organization of the Central Electrical Company, which started business in Chicago early in 1887. He has successfully guided his business from a small beginning through all the different stages to be met with in business growth, and has to-day the distinction of being at the head of one of the largest electrical supply houses in the world.

FRANK DE RONDE, well and favorably known as general sales agent for the Standard Paint Company, has, in connection with his brother, A. De Ronde, taken the selling agency for the United States and Canada of the "Ship" cored carbons, manufactured by Schiff, Jordan & Co., Vienna, Austria, who are reported to be the largest manufacturers in their line on the Continent. These carbons are said to be of exceptionally high grade, insuring, where they are used, a steady, brilliant light, with minimum consumption of current. The manufacturers expect to ship all large orders direct from the factory, but will carry a large stock in this country, thus enabling their agents to fill orders immediately when so desired. The New York office will be at 254 Front Street. Messrs. Schiff, Jordan & Co. are to be congratulated upon securing the services of the De Ronde brothers, who can be relied upon to push the sale of their carbons by all honorable means. Messrs. De Ronde intend establishing agencies at once in all sections of the country, so that central-station managers and others can be supplied promptly.

A CHICAGO ACQUISITION.—The Brown Hoisting & Conveying Machine Company and the Elwell-Parker Electric Company of America, main offices and works at Cleveland, Ohio, have jointly opened a general western office at 1528 Marquette Building, Chicago. Mr. F. G. Tallman, manager of the Pittsburg offices of these companies, and late manager at Pittsburg for the crane department of the Yale & Towne Manufacturing Company, will also have charge of the Chicago office and will be assisted by Mr. Frank B. Ward, late resident engineer of the Pittsburg Testing Laboratory, Limited, and for several years head of the firm of Frank Ward & Co., inspecting and consulting engineers. The Brown Hoisting & Conveying Machine Company, in connection with its hoisting and conveying machinery and crane business, has recently purchased the entire crane business heretofore owned and controlled by the Yale & Towne Manufacturing Company. The Elwell-Parker Electric Company of America, which is the American branch of the celebrated English firm of the same name, is making a specialty of heavy electric machinery and large installations.

Business Notices.

ELECTRIC LEAGUE.—Meets every Thursday evening, 100 West 24th Street, New York. Electrical engineers and electricians cordially invited.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 18, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

541,073. **ELECTRIC CAR BRAKE**; G. B. Damon, Lowell, Mass. App. filed April 30, 1894. The combination of an independent motor adapted to operate an air pump, a tank for storing the same, and means whereby when the pressure in the said tank shall fall to the minimum for an electric circuit to actuate the motor and so compress sufficient air to apply the brakes.

541,077. **TELEPHONE SYSTEM**; W. W. Dean, St. Louis, Mo. App. filed Feb. 21, 1895. The combination of a local transmitter circuit comprising two parallel branches, two induction coils each having a primary in one of the branches of the transmitter circuit, and the secondary in the telephone line in series, a microphone and a battery adapted to direct current through the said branches in parallel.

541,081. **STORAGE BATTERY AND METHOD OF MAKING SAME**; N. H. Edgerton, West Whiteland, Pa. App. filed Feb. 27, 1894. In a storage battery, a series of cells with intervening conducting partitions and surrounding non-conducting frames molded thereon, the said cells filled with an electrolytic fluid, and the terminal partitions having conductors leading therefrom, and an envelope of plastic non-conducting material in an enclosing case adapted to retain the gaseous elements evolved in the charging and discharging of electric currents.

541,098. **CROSSING FOR TROLLEY WIRES**; J. Kroger, Pleasantville, N. J. App. filed Nov. 3, 1894. A cross-over for trolley having a central depression and a portion of the grooves cut away, locks having the cross-heads so set as to form part of the wall of the grooves at crosses.

541,186. **RHEOSTAT OR OTHER CIRCUIT CONTROLLER**; C. Willms, Baltimore, Md. App. filed Nov. 26, 1894. The combination with a rheostat having a body of resistance material forming a path for the current and divided into sections by a series of collecting sectors consisting of wires extending across the resistance material and secured at their ends, and tension pins for the wires intermediate of their ends.

541,148. **CURRENT STRENGTH INDICATOR**; F. G. Burgess, Boston, Mass. App. filed March 25, 1895. The combination of an electromagnet and armature mechanically actuated for applying to said armature a steadily increasing force in opposition to the attraction of the magnet, an indicating device, a stopping or locking device operating to arrest and prevent the further movement of the indicating device, whereby an approximate indication is obtained of the resistance offered by the said magnet to the movement of the armature.

541,149. **TRANSMITTER**; J. Burly, New York, N. Y. App. filed Oct. 23, 1893. The combination of a rotary shaft with a switch thereon, brushes bearing on the switch, opposing magnets, with the armature between them a source of electrical energy, and electric conductors.

541,152. **DISTRIBUTING FRAME FOR TELEPHONE CIRCUIT CONDUCTORS**; F. B. Cook, Chicago, Ill. App. filed Jan. 9, 1895. An appliance for [illegible] consisting of a plate upon the front side of which parallel insulating blocks are secured at a suitable distance there[illegible] having upon their upper and lower edges metal con[illegible] [illegible] extend through the plate to the rear side and there divide, all the conductors coming from the lower terminals extending in one direction, and all from the upper extending in another [illegible]

No. 541,152.—Telephone Circuit Distributing Frame.

541,165. ELECTRIC RAILWAY; R. M. Hunter, Philadelphia, Pa. App. filed Jan. 12, 1887. The combination of a car body with its supporting wheels and axles, with an electric motor connected to one axle through a frame work independent of the motor proper, having bearings arranged at a distance apart, and supported at the other end by a single support.

541,179. ELECTRIC ARC LAMP; C. A. Pfluger, Chicago, Ill. App. filed July 2, 1894. The combination of two carbons at an angle with each other, tubes containing the said carbons, a solenoid connected to the said tubes so as to be supported thereby, and a pivotal connection between the core of the said solenoid and each of the tubes, so that the tubes are moved by the movement of the core.

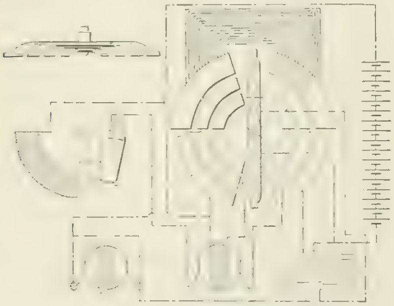
541,200. ELECTRIC ELEVATOR; R. Eickmeyer, Yonkers, N. Y. App. filed Oct. 1, 1890. In an electrically operated elevator mechanism, the combination of a shunt-wound electric motor, an armature circuit supplied from generators and accumulators, and a resistance which is automatically adjustable to counter electromotive force as it is developed in the motor.

541,225. REPEATER; M. G. Crane, Newton, Mass. App. filed Aug. 4, 1894. The combination with two or more circuits of a controller for each circuit adapted to respond to changes therein, a main motor adapted to operate in response to a movement of any of said controllers, and a secondary motor adapted to restore the said controllers to their normal positions.

541,227. ELECTRIC SWITCH; C. P. Elieson, London, England. App. filed July 16, 1894. The combination of a receptacle composed of non-conducting material, supporting pivots therefor, engaging said receptacle adjacent to one end thereof extending within the same, and forming circuit terminals and a movable conducting body within the said receptacle.

541,233. SYSTEM OF ELECTRICAL DISTRIBUTION; C. K. Huguet, New Orleans, La. App. filed Jan. 30, 1895. The method of maintaining a constant current on a constant potential circuit, consisting in establishing an inductive balance between the constant potential circuit and a separate constant current circuit and altering or distributing this balance in proportion to the change of impedance which takes place on the constant potential circuit.

541,243. PUSH BUTTON; F. W. Manger, Brooklyn, N. Y. App. filed Oct. 1, 1894. The combination of a base adapted to receive contact devices, a shell inclosing the said contact devices and having a screw-threaded flange at its outer end, a button passing through the shell and adapted to engage the contact devices, a cap or ring adapted to screw on said screw-threaded flange and having an internal flange, and a disc of soft material over the said button, the disc being held at its edges between the end of the flange of the shell and the internal flange on the cap or ring.



No. 541,200—Electric Elevator.

[illegible] RAIL BOND; W. [illegible] and H. M. Brinckerhoff, Chicago, Ill. App. filed [illegible] The combination of a rail bond secured to a rail and a flange of a girder, the girder end of the bond being presented at right angles to the plane of the flange.

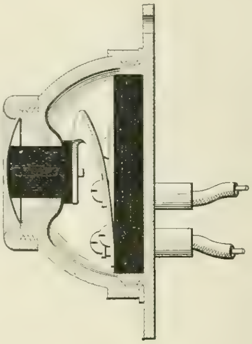
41,286. APPARATUS FOR STEERING VESSELS; W. R. Moore and W. Megarvey, Cleveland, Ohio. App. filed Feb 23, 1895. The combination of a [illegible] lever connected thereto and adapted to be swung on a [illegible] rotatable post [illegible] the lever and to be turned thereby, two horizontally swinging arms and connections between the arms and the rotatable post whereby when the lever is swung the arms will be moved in opposite directions on a horizontal plane.

541,287. ELECTRIC STOP MOTION FOR ENGINES; Eugene C. Myrick and George C. Doeg, of Providence, R. I. App. filed May 23, 1898. The combination, with a governor and valve-detaching mechanism, of mechanism connecting the governor and the valve-detaching mechanism, the said connecting mechanism being constructed in two detachable parts, one of the parts being provided with an independently movable engaging device for engaging the other part and carrying an electromagnet and its armature for operating the engaging device to disconnect the two parts of the connecting mechanism.

541,290. ARC LIGHTING; S. W. Rushmore, Brooklyn, N. Y. App. filed March 20, 1895. The combination of two arc lamps connected in series, each lamp having suitable carbons and feeding mechanism, a coil of each of the lamps in shunt to its own arc only, and a second coil at each lamp in shunt to the arc of the other lamp only.

541,332. INSULATOR; J. M. Patterson, Springtown, Texas. App. filed April 10, 1895. An insulator formed of two sections of insulating material adapted to fit together and each provided on its inner sides with a longitudinal recess, and blocks notched on their inner faces and adapted to be inserted in the said recesses, with their notches coinciding to form a passage for the wire.

541,338. UNDERGROUND CLOSED CONDUIT SYSTEM FOR ELECTRIC RAILWAYS; A. J. Smith, Milwaukee, Wis. App. filed June 6, 1894. The combination of a conduit having one or more trolley chambers, an independent conducting chamber having a conductor therein, insulated metallic shafts communicating at intervals from the conducting chamber to the trolley chamber, adapted to be rocked into contact with the conducting wire, and an actuating arm having a reciprocating trolley track connected thereto, but supported independently from the top of the trolley chamber.



No. 541,243.—Push Button.

541,341. ELECTRIC ALARM SIGNAL AND INDICATOR FOR TROLLEY RAILWAYS; J. A. Buisson, New Orleans, La. App. filed April 2, 1895. The combination with a main trolley wire or feeder of a short auxiliary wire extending parallel therewith, means for rigidly and mechanically connecting the two wires, the ends of the auxiliary wire being turned up to form inclined shoes capable of readily receiving a trolley wheel, and a wire connected to one upturned end thereof, the said connection being out of the plane in which the main portion of the auxiliary wire is located.

541,350. PORTABLE GALVANIC BATTERY CELL; F. A. Glasgow, St. Louis, Mo. App. filed Sept. 18, 1894. The combination of a battery cell provided with a removable zinc-holding screw plug, the zinc element being inserted in the said screw plug, and a removable tube adapted to inclose the zinc.

541,357. COMPOUND-WOUND ALTERNATING GENERATOR; J. D. Hilliard, Jr., Bluefield, W. Va. App. filed June 21, 1894. A method of regulating the current of an alternating generator which consists in shunting a part of the main current of the generator through a rectifying or commutating device and through the series winding of the field of the generator, arranging a variable inductive resistance in the shunt circuit, and providing an automatic cut-out actuated by the increase of current in the resistance to short circuit the said resistance.

541,367. ELECTRIC TRUSS; B. R. Lathrop, Weedsport, N.Y. App. filed Aug. 27, 1894. A truss having a pad containing a battery, and a screw passing through the bearing face of the pad, and making contact with the battery pole, and provided with a pole plate combined with a support connected at one end of the pad, the back pad mounted on a support and also provided with poles which are connected with the support.

541,380. ARMATURE FOR ELECTRIC MOTORS AND GENERATORS; J. F. McLaughlin, Philadelphia, Pa. App. filed Dec. 5, 1891. An armature consisting of a cylindrical iron body provided with troughs opening into the periphery, armature coils removably seated in the said troughs, and an iron wire wrapping constituting a magnetic shield continuous both longitudinally and peripherally over the cylinder.

541,389. ELECTRIC TRAIN SIGNAL; E. J. Devine, Port Arthur, Canada. App. filed Dec. 11, 1894. The combination of a series of wires and a circuit closer provided with a frame and a movable shield, said wires extending into or mounted on the said frame and shield, one of them having an uninsulated portion, another of said wires also having an uninsulated portion extending across the plane of said former uninsulated portion.

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